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Advanced Education
and Employment

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Adult Basic Education Level Three:

(Adult 10)

Science Curriculum Guide

Learning for Life!

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Introduction

Background

In 1999, Saskatchewan Post-Secondary Education and Skills Training (now Advanced Education and Employment) conducted an evaluation of Adult Basic Education (ABE) in Saskatchewan. The evaluation identified strengths and possible areas for improvement. Specifically, the Evaluation Working Group suggested seventeen key recommendations, including:

- *Review and redesign Adult Basic Education 10 programs* including the academic courses – include employability skills and the development of minimum exit standards that facilitate credit transfer and Prior Learning Assessment and Recognition (PLAR).

- Ensure Adult Basic Education program policies and implementation strategies *reflect the needs of Aboriginal learners and communities.*

- Develop and implement strategies to *strengthen labour force attachment or progress to further training by Aboriginal learners* (e.g., work placement, partnerships, support, and follow-up).

- Support the *continued involvement of Aboriginal training institutions* in the delivery of ABE programs targeted to Aboriginal people.

An Adult Basic Education Redesign Task Team was created in March 2001, to oversee the implementation of the recommendations. Their work was organized in four phases:

Phase 1: Planning and Foundations[1]
- the vision, scope, guiding principles, goals and objectives for Adult Basic Education;
- a framework for credit programs;
- a curriculum development philosophy; and,
- recommendations for the remaining phases.

Phase 2: Curriculum Development
- process for developing benchmarks for Levels 1 and 2 (literacy); and,
- a process for developing and piloting curriculum guides for Adult 10, Level Three credit courses (Communications, Social Sciences, Life/Work Studies, Science, and Mathematics).

Phase 3: Implementation

[1] The *Basic Education Redesign Phase 1: Planning and Foundations (March 2002)* report can be found at the Advanced Education and Employment website (http://www.aee.gov.sk.ca/abe/redesign.shtml)

- a process for provincial implementation of new curricula including professional development activities and development of a Best Practices document.

Phase 4: Sustainability

- processes to ensure ongoing curriculum renewal, to support delivery of programs and to evaluate the effectiveness of programs and services.

During Phase 1, the team conducted research to discover trends and issues in adult education, both nationally and internationally. Consultations[2] were also held with provincial stakeholders. The results of these activities informed the work of the Task Team and guided the development and content of Level Three curricula.

Influences

Some things have stayed fairly constant since the initial provincial Adult Basic Education curriculum guides were developed in the 1980s. For example, the reasons adults provide for returning to school are similar: to obtain academic certification in order to access further training, to increase employability, and for personal satisfaction (Saskatchewan Learning, 2002, p. 27). Adult Basic Education credit and non-credit programs continue to be designed to address these needs. However, the content of these programs has changed, and will continue to change, as more research is conducted and our understandings of adult education increase.

Several factors influenced the redesign of Adult Basic Education: current research in adult education, national and international trends, provincial priorities and so on. Although several influences were considered, only the major factors are discussed here.

Nationally and internationally, adult basic education programs are placing more emphasis on inclusive, holistic, and participatory approaches, and on reducing the alienation that some learners feel between what happens in the classroom and "real life." These approaches reflect understandings from Aboriginal, transactional, and transformative perspectives. Areas such as cultural awareness, cognitive strategies, and anti-racist education are frequently integrated in academic credit programs.

Delivery organizations have, or are, engaged in reviewing their courses and resource materials through an "anti-racist" lens and are making changes as needed. Lee (1991) describes four stages that schools often go through when implementing multi-cultural or anti-racist education practices:

1. Surface Stage – Expressions of culture are evident in the school. Welcome signs in several languages are visible and a variety of foods and holidays are discussed.

[2] Contact Advanced Education and Employment for a copy of the *Summary of Basic Education Redesign Consultations (September 2001)*.

2. Transitional Stage – Two or three week units of study about "others" are created with the main curriculum remaining unchanged. Heroes or exceptional people from minority groups are highlighted and contributions to mainstream society are discussed.

3. Integration Stage - Elements of units in the transitional stage are integrated into existing units. What is at the centre of the curriculum is changed. Events, concepts, and issues are viewed from several points of view. In mathematics, statistics are studied not only with sports and weather numbers, but also with employment and ethnicity numbers. Historical events are studied from a variety of perspectives.

4. Social Change Stage – The curriculum helps lead to changes outside the school. Critical thinking and decision-making skills are developed. For example, the media is examined for the way that different peoples are portrayed and letters are written to editors.

It is no longer viable to teach "just the basic skills." Today, training programs and participation in the community and a knowledge-based economy require adults to have complex skills in working with others, in problem solving, and in accessing, processing, and managing information. Demands have increased for higher-level skills. Knowing how to learn is necessary for participation in a variety of settings and a prerequisite skill for learning throughout one's life. These realities were considered when developing Adult Basic Education curricula.

Alternative academic certification programs also acknowledged the increased demands on adults in our society. For example, the Tests of General Educational Development (GED), revised in 2002, place a greater emphasis on problem-solving and higher order thinking skills – comprehension, analysis, synthesis, application, and evaluation. Workplace, practical and "how to" documents were included in the test items (GED Canadian Administrators Meeting, April, 2001).

Findings from the 1994 International Adult Literacy Survey (IALS) [3] contributed to changes in Adult Basic Education programs. The IALS examined three literacy domains in order to measure adults' proficiency levels in processing information:

- prose literacy – the knowledge and skills needed to understand and use information from texts including editorials, news stories, poems and fiction;

[3] In 2003, Canada participated in a second International Adult Literacy and Skills Survey (IALLSS), in which four literacy domains were surveyed: Prose Literacy, Document Literacy, Numeracy, and Problem-solving. A significant sampling occurred in Saskatchewan, with a specific sub-sample of Aboriginal residents. The IALLSS will provide a profile of prose and document literacy, numeracy, and the analytic reasoning component of problem-solving for the adult population of Saskatchewan. Additional information will be made available on aspects of the teamwork domain and familiarity with information and communication technology. First reports from the survey were released in 2005.

- document literacy – the knowledge and skills required to locate and use information contained in various formats including job applications, transportation schedules, maps and charts; and,
- quantitative literacy – the knowledge and skills required to apply arithmetic operations, either alone or sequentially, to numbers embedded in printed materials such as balancing a chequebook, figuring out a tip, completing an order form or determining the amount of interest on a loan from an advertisement.

For each domain, five skill levels were identified. Survey participants were placed along this scale, ranging from Level 1 (adults who have difficulty with simple tasks such as reading labels on medicines to determine the correct amount to take) to Levels 4/5 (adults with command of higher-order information processing skills and the ability to solve more complex problems). Level Three is considered the minimum level needed to function in today's society. It is the most common level for those who have completed high school. It requires the ability to integrate several sources of information, make inferences, and solve complex problems. However, adults can, and do, score at different levels in different domains. For example, an individual may be at a higher level on the prose scale than on the quantitative scale.

Results from the IALS reinforce the need for appropriate assessment[4] of skills when placing adult learners in Adult Basic Education programs. They also support the long held understanding that adults' skill levels are not "homogeneous"; an individual may have strengths in one area and need extensive development in another area.

Programs that are designed to determine individuals' strengths and gaps and are flexible enough to address specific skill development needs are best suited for adult learners. In addition, the goals and content of Adult Basic Education programs need to include the development of skills specifically related to learning and keeping literacy skills. As Fagan (2001) notes, "enrolment in adult education programs does not necessarily lead to improved literacy skills of the type that give the learners greater expertise in extracting information from prose and quantitative documents" (p. 11).

IALS, along with related development projects such as Essential Skills (Human Resources Development Canada) and Employability Skills (Conference Board of Canada), influenced the inclusion of Generic Skills and learning objectives in credit programs in Adult Basic Education.

Finally, curriculum development work in the K-12 system also influenced content in Adult Basic Education courses. Options for grade 12 completion include 30-level courses from the K-12 system. Therefore, Adult 10 courses need to provide a foundation for those learners who choose to continue on to Bridging and 30-level Adult 12 courses.

[4] In 2003, three public training centres – Northlands College, Cypress Hills Regional College, and SIAST Kelsey Campus – participated in the pilot of an IALSS-based Internet locator test developed by ETS on behalf of HRDC. The locator test is designed to determine if a learner is at Level 1, 2, or 3+ on each of the IALS scales. The test requires further development before it becomes available.

This overview introduced some of the factors influencing Adult Basic Education Redesign. You will see these influences reflected in the framework for Adult Basic Education credit programs and in the curriculum guides for Adult 10 courses.

Structure of Document

The Adult 10 program consists of three levels:

- Level 1, Literacy
- Level 2, Literacy
- Level Three, Adult 10 certificate

Levels 1 and 2[5] focus on developing foundational literacy skills - the knowledge, technical skills and strategies necessary to engage in activities related to areas such as reading, writing, numeracy, computers and problem-solving. Level Three builds on this foundation and further develops the application of these skills in different contexts. Learners will develop those foundational skills, knowledge, and abilities that will assist in their transitions to further studies, to the community, or to employment.

Level Three curriculum guides are organized into five parts:

- *Part One* presents the philosophical spirit and related educational theories that form the curriculum foundations;
- *Part Two* outlines the components of the curriculum design and provides an image of the parts that make up the planning and delivery of instruction;
- *Part Three* builds a relationship between the curriculum elements and outlines the curriculum content;
- *Part Four* suggests ways to implement the curriculum guide; and,
- *Part Five* discusses assessment techniques consistent with the curriculum foundations.

Each Part begins with a curriculum roadmap. The roadmap is intended to provide an easy reference to each part in relation to the whole curriculum. At the end of each chapter, reflective questions give the instructor an opportunity to consider potential concerns.

A list of references is included. Appendices contain templates, checklists and other resources for instructor reference. An Annotated Bibliography of resources is also included in the document.

[5] Benchmarks for Levels 1 and 2 have been developed through a partnership project between Advanced Education and Employment and the Saskatchewan Literacy Network.

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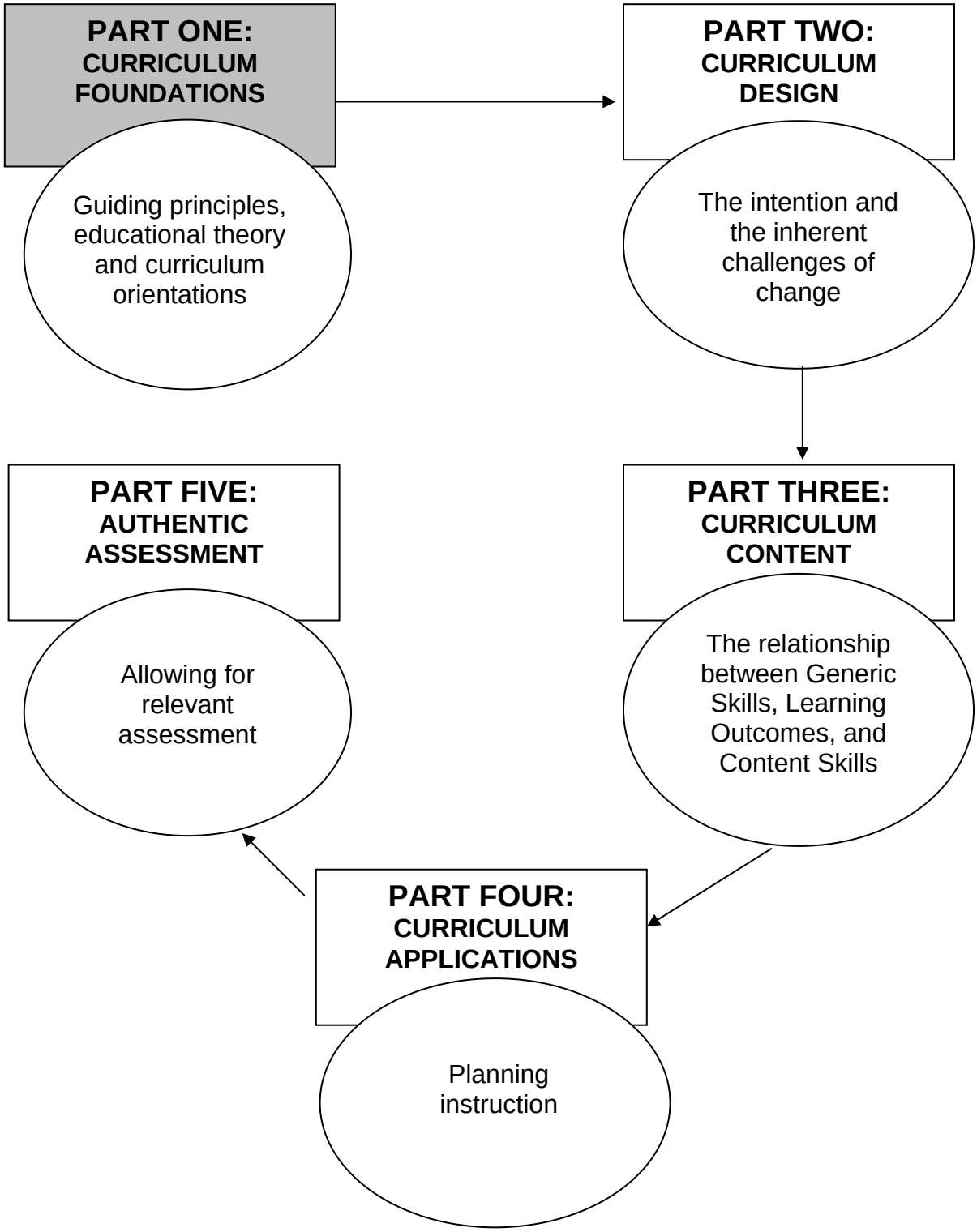
PART ONE:
CURRICULUM FOUNDATIONS

The Curriculum Roadmap:



For clarity and ease of reading, the use of the pronouns she, he, her, him, hers, and his are varied and used equally throughout this curriculum guide. Wherever the context of the writing so requires, references to pronouns of a specific gender are used.

Chapter One: Introduction

Why We Do What We Do…

Early in the process of developing this curriculum, the developers met with the Curriculum Advisory Committee members and asked them to share their understanding about our roles as Adult Basic Education instructors. We asked them to reflect on what they understood about their learners. The participants' stories were rich with intimate insights into the lives of individuals with whom they work. The following is a composite sketch of a learner constructed from their lived experience.

> *Megan is a young mother of two from a nearby First Nation. She is apprehensive about meeting with you today, but states, "I want to be more than a welfare mother to my children. I want them to see me and not be ashamed." She explains that she had her first child while still in high school and that she never really returned to school since then. Megan has tried Adult Basic Education before but issues associated with childcare, money, and pressure from her partner led to her decision to quit. She has registered this year because she says, "I'm ready to learn this time. I want to find out what I can do now that I'm on my own."*

The Diversity in Our Classrooms

Instructors recognize the visible diversities within our classrooms. Learners are immigrants, they are urban Aboriginals, they are mature men seeking new work skills or retraining, and they are Caucasian women looking to enter the workforce for the first time. They attend programs in a variety of locations – in northern and southern regions, on reserves and in rural and urban communities. Each community has its own characteristics, interests, and needs. However, the diversity in our classrooms extends beyond the visible. Learners play a variety of roles in their communities. They are parents, family members, and community members. They also have a wide range of personal experiences that are unique.

While we refer here to the diversity of learners, we must also recognize the diversity among instructors. Some instructors are new to Adult Basic Education while others have worked in this area for many years. Some deliver individualized programs, as opposed to larger, group-taught programs; some have continuous intake while others work in programs with block intakes. We represent multiple ethnic, classed, and gendered identities. These multiple identities affect our perceptions about teaching and instructional practices. Instructors and learners alike bring these diversities to our classrooms.

Learners come to Adult Basic Education for a variety of reasons. Some want skills to enhance their chances for employment or to gain academic certification. They want to make changes in their lives. Most hope to contribute to change for their children and

communities. Others seek the tools to gain empowerment and achieve personal transformation.

The diversity in our classrooms is also reflected in the way in which learners view our roles as instructors. Some may expect us to play the role of "expert in control" of the classroom. For them, the concept of a good teacher is rooted in traditional teaching practices (lecture, test, rote-memory work, worksheets, and so on).

Diversity can pose challenges for all of us. Choosing more inclusive teaching approaches can also be challenging. Instructors and learners alike will be faced with many opportunities to negotiate across cultures. To negotiate effectively, individuals need to grow in their multicultural competencies. Cross-cultural competence is a skill that requires substantial effort to learn. We need to approach new relationships in a humble manner, recognizing and admitting to ourselves when we lack experience and comfort in working with others. Then we, like all adult learners, must choose to move towards social action by committing ourselves to learning more about others. Working with someone from a different ethnic tradition does not necessarily lead to uncovering differences in expectations, communication styles, and values. However, it can open the door for those negotiations to begin. As trusting, reciprocal relationships develop, perhaps we can then each gain the competence to be true bicultural negotiators.

While all learners are unique, special mention is made of the growing population of adult Aboriginal learners in our province. Nearly 60% of Adult Basic Education learners are Aboriginal (Saskatchewan Learning, 2002). Therefore, curriculum content and instructional practices and approaches need to be inclusive of Aboriginal peoples' experiences and knowledge. For these reasons, Aboriginal perspectives and Aboriginal education are discussed throughout this curriculum.

Aboriginal Perspectives

There are many reasons why a disproportionate number of Aboriginal adults are attending Adult Basic Education. A lengthy, chronicled, colonial history in Canada has clearly documented the tragedies of Canada's Aboriginal peoples (Wotherspoon & Satzewich, 1993). Many Aboriginal peoples and entire communities have experienced some type of trauma, and, in some cases, generations of people have experienced profound consequences that have affected every part of their lives. This is a trauma that flows from colonialism[6] and the resulting layers of cultural oppression. This is the history that continues to hand Aboriginal learners their inheritance: school failure, social instability, domestic violence, language loss, financial insecurity, systemic discrimination, and racism.

Many Aboriginal learners will be actively struggling with the lingering effects of colonization. Joseph Naytowhow, Elder Representative, clearly understands the baggage learners bring with them to school. He reminds us, "Our students are

[6] Colonialism – the unequal distribution of power and resources because of ideological and structured oppression

damaged." He knows intimately the struggle Aboriginal learners experience as they are asked to become workers with little or no work experience and to study and learn from materials that are not reflective of their knowledge or experiences.

To move past the negative to a positive process of education for learners and instructors, Aboriginal perspectives are integrated across curricula. This integration will help all participants to develop an understanding of and respect for the history, cultures, contemporary issues, contributions, and accomplishments of Aboriginal peoples. By developing informed opinions on matters related to Aboriginal peoples, non-Aboriginal learners are better prepared to participate fully in an inclusive and accepting society.

The goal in integrating Aboriginal perspectives into curricula is to ensure *all* learners have opportunities to understand and respect themselves, their cultural heritage, and the cultural heritage of others. These inclusive practices and perspectives will better equip learners with the knowledge and skills needed to fully participate in the civic and cultural realities of their communities and the workforce.

Aboriginal perspectives apply to learning experiences for all learners. Many recommended instructional approaches for Aboriginal learners are recognized as "best practices" for all learners[7]. However, there may be unique and particular learning experiences that apply only to Aboriginal learners.

Being inclusive of Aboriginal perspectives is not necessarily easy, for some will resist and even challenge its importance or relevance. Instructors need to be aware of attitudes and beliefs that have resulted from our shared history.

- We cannot assume that all Aboriginal peoples have an understanding of their cultural heritage. The "Sixties-Scoop,"[8] the child welfare system, incarceration, residential schooling, and other forms of systemic separation resulted in many individuals who visibly appear Aboriginal, but who have few connections with Aboriginal communities.

- Some Aboriginal people have learned to ignore or dismiss their own identity. They will not respect or participate in discussions that focus attention on their identity. For them identity is an emotional issue; it has brought about racist attitudes. History has shown them that their identity works against them, and, ultimately, they work very hard to "pass." Some will even lash out laterally at their peers and deny their classmates the expression of their own experiences.

[7] For further information on integrating Aboriginal perspectives refer to "Appendix D: Teaching Strategies and Practices" in *Basic Education Redesign Phase 1: Planning and Foundations (March 2002*).

[8] The term "Sixties Scoop" is commonly used to refer to the practice of Aboriginal children being taken into care and/or adopted by non-Aboriginal families. Often, these children were placed in homes far from their original communities or in other countries such as the United States.

- When some learners experience an openness of Aboriginal content for the first time, it motivates and propels them on their healing path. For them, this work is extremely emotional.

- Sometimes when instructors first share their own stories, they may unwittingly create a standard or norm that learners feel they have to measure up to. As a result, learners may feel embarrassed and threatened about sharing their own stories. For these learners, conversation can simply shut down.

We recognize that the diversity in our classrooms creates diverse expectations and assumptions about the educational experience. However, we also believe that delivery organizations and instructors who are responsive to the unique needs and interests of the learner can create a transformative environment for all. The next section discusses some ways to acknowledge Aboriginal perspectives in your learning environments.

Core Activities That Acknowledge Aboriginal Perspectives

Allow different voices to be heard in learning activities and units of study. A diversity of voices, including feminist, Aboriginal and multicultural voices, allows us to come to identify and to understand the structures that maintain difference in our society. Exposure to a diversity of voices, rather than a consistent focus on the dominant culture's voice, brings about an awareness of the impacts and limitations imposed by racism, sexism, and other forms of oppression. This is essential to understanding our collaborative work.

Demonstrate an attitude of acceptance. A wide range of theories support the idea that true progress can occur when we move past simple tolerance to acceptance. In this case, true acceptance is unconditional while tolerance maintains limitations for some people (e.g. "I wish s/he would quit acting so queer" – this statement implies limitation and judgment toward another person). Acceptance does not limit. Since childhood, we have all developed well-established biases and assumptions that unconsciously infiltrate our thinking about others who are different. Confronting our biases and assumptions is the first step in developing an attitude of acceptance, which is then revealed through our language and actions. To demonstrate a true spirit of acceptance is to cultivate an open mind about different cultures and peoples through a willingness to explore and cooperate in learning about others.

Apply the four Rs. *Respect* the cultural knowledge, traditions, values, and activities that individuals bring with them. *Relevance* occurs when respect is embedded in the curricula, instruction, and policies. *Reciprocity* refers to the revising of relationships between student and instructor from a hierarchy to that of a relationship focused on mentorship. In this way, both individuals are viewed as learners. *Responsibility* demands that the instructor shares responsibility for change even if not personally disadvantaged by the barriers of the learner. The reward for instructors who apply the four R's is the ability to continue to grow and develop professionally (Kirkness & Barnhardt, 1991).

Recognize the diversity of nations. Understand that there is no "universal Indian." Know that while Métis people and First Nations peoples may have some common issues and goals, they are diverse. Avoid making stereotypical statements. To recognize diversity means getting to know your learners. Find out where their home community is. Honour them by learning something about their community or their language and provide opportunities for learners to share their experiences and knowledge.

Commit to understand and practice inclusion. Inclusive practices will benefit all: Aboriginal learners, their families and communities, and learners who do not identify as Aboriginal. Being inclusive will demand careful critical reflection about current practices and a willing desire to make change. Instructors may also transform as a result of this decision-making.

Understand that Aboriginal pedagogy exists. Seek to understand and use instructional approaches that have been proven to best suit Aboriginal learners' unique cultural needs. Know that different ways of knowing exist and nations transmit knowledge in diverse ways. Aboriginal pedagogy is more than an instructional approach. There exists a philosophy of living in these approaches. For example, within Plains cultures the Medicine Wheel is commonly used to transmit knowledge and to organize learning. As a philosophical framework, the Medicine Wheel helps us understand the interrelatedness of all life. It also guides us to strive for balance in the mind, body, spirit, and emotional realms. However, we also need to remember the diversity of nations. We may have to seek out local interpretations and understandings so that our courses are more responsive to the needs of the people in each community.

Understand and accept that the process of healing is ongoing and an essential component to learning. Know that for most Aboriginal learners in Adult Basic Education, learning cannot be separated from healing. Some learners will, for the first time, learn the language to express their experiences. They may use words like racism, cultural genocide, and sexism. We can often feel attacked by these words. Learners' development and use of this language is part of the healing process. In time, as broken people transform, they may learn to use new language to describe their experiences. By providing people with access to cultural teachings, physical activity, healing circles, and other supportive programming, we can facilitate healing.

Apply decolonising strategies to bring about personal, social, and systemic change. These strategies may include, but are not limited to the following:

1. Seek local sources of knowledge. Learn about proper protocols when approaching Elders: offer tobacco. Seek out and invite a wide range of community-based resource people to share their knowledge.

2. Critique your course materials (texts, videos, newspapers and the like). Re-examine the teaching resources that are Eurocentric and/or from male

perspectives only. Integrate authentic materials and resources responsive to diverse voices.

3. Use a variety of instructional methods including:
    - storytelling,
    - personal narrative and testimony,
    - spirit writing,
    - talking/sharing circles,
    - cooperative group work, and,
    - experiential learning.

4. Consider different ways to view or organize learning. For example, The Medicine Wheel is an acceptable way of addressing the interrelatedness of all life (Graveline, 1998).

5. Consider self-directed, critically reflective assessment.

Creating a positive environment where Aboriginal perspectives are acknowledged will benefit everyone. Adult Basic Education can be a place where all learners can appreciate how their cultural heritage helps to shape our provincial and national identity. Adult learners bring with them a wealth of knowledge and experiences that serve to form a foundation for learning. To better understand this, we now look to adult education principles.

Adult Education Principles

Critical to the planning and delivery of the Adult Basic Education Level Three curricula is the understanding and implementation of adult education principles. Six adult education principles (Imel, 1998) that demonstrate the treatment of our learners as adults include:

- **Involving learners in planning and implementing learning activities**. Adults' past experiences, their current learning goals, and their sense of self will influence what they want to learn and how they learn it. Instructors must actively engage adult participants in the learning process. They must also serve as facilitators, guiding learners to their own knowledge and helping them expand it rather than supplying them with facts to memorize.

- **Drawing upon learners' experiences as a resource**. Instruction that is personally and culturally relevant is vital for adult learners who bring with them a wealth of life experience and knowledge. By focussing on the strengths learners bring to the classroom, rather than their gaps in knowledge, learners are able to connect new learning with prior knowledge.

- **Cultivating self-direction in learners**. In a supportive, caring, and safe learning environment, instructors become mentors to adult learners. They help learners to develop skills that lead to self-direction, independent learning, and empowerment

(rather than assuming that all learners are self-directed when they enter programs). Empowered adults are those who see themselves as decision-making citizens, as proactive community members who are responsible and accountable to themselves, their families, employers, and society.

- **Creating a climate that encourages and supports learning**. An atmosphere where learners can safely admit confusion, mistakes, ignorance, fears, biases, and different opinions is one that enhances learner self-esteem and reduces fear. Instruction must demonstrate respect and promote acceptance for diverse cultures, beliefs, values, religions, and lifestyles.

- **Fostering a spirit of collaboration in the learning setting**. Collaborative learning stresses the interdependence of each member. Learners collaborate with instructors and with each other. Collaboration is founded on the notion that the roles of instructor and learner can be interchangeable.

- **Using small groups.** This can help "achieve a learning environment that is more learner centred and collaborative than either large group or one-on-one, individualized approaches to instruction" (Imel, p. 4). Learning from peers and being accountable to a team also helps to develop social responsibility.

Adult education principles also have implications for the instructor/learner relationship.

Central Assumptions about the Instructor/Learner Relationship

Instructor as facilitator…

- helps and guides learners;
- focuses on group dynamics and the learning process rather than being the
- "expert" who provides content knowledge;
- frees learners to make choices;
- remains non-judgemental;
- encourages learners to be responsible for their own learning;
- supports collaborative and cooperative methods of learning;
- is sensitive to the social, psychological and cultural issues that learners bring to the group; and,
- takes a gentle leadership role.

Instructor as mentor…

- supports, challenges and provides vision within a context of support;
- establishes a climate of trust in the learning environment;
- accepts learners where they are now and confirms their self-worth;
- listens to learners' stories;
- advocates for learners;
- expresses positive and realistic expectations;

- encourages learners to see new possibilities, directions, purposes and meanings;
- helps learners to see and to name the changes they can make; and,
- celebrates learner success.

Instructor who creates meaningful context…

- centres instruction around learners' social, cultural and psychosocial contexts;
- seeks to teach knowledge and skills that are transferable to real-life contexts;
- structures lessons around learners' experiences;
- uses teaching materials, situations and examples relevant to the learners' cultural worlds;
- designs lessons that are personally meaningful, significant and relevant;
- structures lessons based on the concrete (e.g. unemployment) and moves to the abstract (writing clearly and effectively); and,
- supports experimentation with personal application of new knowledge to make positive change: transformation.

Instructor who models and promotes critical reflection…

- sees reflection as an ongoing cognitive process;
- knows that critical reflection requires examination of one's underlying beliefs, assumptions and values;
- is open to defining problems, exploring different ways of problem solving, and is able to see self within the context of the issues;
- acknowledges the inner discomfort, the self-doubt, uncertainty, ambiguity and the feelings of isolation critical reflection can bring;
- supports learners as they too see the "dark side" of critical reflection; and,
- provides activities that challenge "norms," encourages the development of alternative perspectives and supports learners in integrating these new ways of thinking into living.

Reflective Questions

Why do I have to abandon traditional teaching approaches? I know they worked for me and for many of my students.

- *You won't have to abandon all traditional teaching approaches. We still have to be responsive to those learners who plan to go onto further studies. Therefore, there is certainly room for memorization, test-taking and lecture, but what we advocate for here is to recognize that those approaches are limited and that there are other approaches to try.*
- *It may be helpful to be reminded that traditional teaching approaches serve to privilege dominant culture learners. Research clearly indicates marginalized learners have not received the same benefit from these approaches. Inclusive approaches strive to include everyone and are designed to best serve the unique needs of multiple groups.*

How will I know if I am being inclusive of Aboriginal perspectives?

- *You will probably have more questions than answers as you begin to be exposed to different ways of knowing.*
- *You may see your learners struggle with sensitive or highly charged terminology.*
- *You will be exposing more about the history of Aboriginal peoples. This will involve an investment by all of us. Discussions about our shared history may bring discomfort, uncertainty, emotion, and perhaps pain, blame, and even guilt. This is normal.*
- *Cajete (2000): "Students must begin with understanding where they have come from, and they need to understand it thoroughly." We need "to be willing to turn history inside out and upside down" (p. 188). We have this responsibility. We cannot change what we don't acknowledge.*

Isn't this like "reverse discrimination"? By focusing on Aboriginal perspectives won't we now oppress non-Aboriginal peoples?

Often dominant cultures do not realize the manner in which they are oppressed. They fail to see that their access to a one-sided curriculum has kept them from feeling comfortable with others. This discomfort often means further social distancing, cultural misunderstanding, and fear. However, because dominant cultures don't need *to interact with others in order to survive they can choose not to ever address or even see the manner in which they are oppressed. Our increasingly diverse communities mean that mainstream individuals often lack cultural competencies that would make them more effective in the workplace, classroom, and community. Access to diverse perspectives and authentic information about Aboriginal people will address the fear and enable growth in cross-cultural competency issues.*

Chapter Two: Curriculum Orientations

Moving Toward Transactional & Transformational Orientations

Current views of learning emphasize understanding by constructing meaning rather than the traditional view of passively receiving transmitted factual knowledge. Meaning construction goes beyond the memorization of facts and procedures. Learners become active in making meaning as they interact with knowledge. Key concepts in active, constructivist[9] views of learning include:

a) the importance of prior knowledge;

b) the importance of metacognitive awareness (understanding and controlling one's own thinking processes); and,

c) the critical reflection on new knowledge.

Two curriculum orientations reflect these views: transactional and transformative orientations.

The ***transactional curriculum orientation*** is a constructivist approach where:

- Instructors are facilitators, mentors, and tour guides. They encourage learners to use their knowledge to make meaning. They integrate literacy with critical thinking.
- Learners construct meaning by linking new information to prior knowledge and by making inferences and interpretations. Learning has to be contextual.
- Qualitative methods are used to help learners to understand, gain meaning, use prior knowledge, interact with others, be active learners, be active meaning makers, be social, self-directed, independent learners, and be aware of metacognition.
- Knowledge acquisition is viewed as a process that involves life-long learning.
- Instructors and learners collaboratively learn together to establish a community of learners where each person takes responsibility for his/her own learning.

The ***transformational curriculum orientation*** focuses on personal and social change where:

- Learning takes on a more critical, multidimensional view of society.
- Children are "forming" while adults can "transform." Each adult has an established value system, a set of beliefs, basic assumptions, and certain biases. Instructors

[9] Constructivism: A theory of learning where learners construct new knowledge from their own previous knowledge.

and learners engage in a collective process to become aware of basic assumptions. They critically reflect by looking at things from unfamiliar perspectives, and, then, challenge those initial assumptions.

- Expectations exist about how the world operates. Together, instructors and learners use critical reflection to look at unfamiliar perspectives by challenging and questioning assumptions, values, beliefs, and expectations. Mezirow (1990) calls this a "disorienting dilemma."

- People, events, or crises can stimulate transformative learning. Dramatic events in our life often trigger transformation: change of job, loss of a loved one, birth of a child, divorce, bankruptcy, or education. When people learn to look at firmly held ideas from a different view, they can raise their consciousness. The learner can transform when given the opportunity (the power) to see with new eyes.

- A holistic perspective emphasizes the interrelations of our world.

- The desired outcome is to change, to transfer learning into action outside of the classroom setting.

- Change can occur at varying degrees. Freire (1970) identifies four levels of consciousness that can provide the catalyst for change: from the lowest level where people are merely concerned with personal survival to the highest level where learners engage in action for social change. Instructors will guide adult learners to see "how we are caught in our own history and are reliving it" (Cranton, 1994, p. 23). We will begin to change when we begin to express our feelings, perceptions, and personal reactions and discover that we are socially constructed.

- Those who hold dominant positions come to understand the complexity of inequality and are able to examine their own position in relation to social justice issues. Dominant people (instructors), who support transformation, must provide opportunities for dominated group members (their learners) to take power, to speak out. The first phase of change for any dominated person/group will be (re)discovering their history, developing a sense of self-pride, and breaking the silences that have been imposed upon them. Achieving this and moving past the shame of being inferior helps people to gain the skills to control their own destiny, and to make change based on the principles of equality.

- From an Aboriginal perspective, transformation can come in the form of decolonisation.

Considering Aboriginal Education Initiatives

To better meet the needs of the increasing Aboriginal population in Saskatchewan, Adult Basic Education can benefit from understanding that Aboriginal Education has been progressive and is established in our province. For 30 years, Aboriginal and non-Aboriginal peoples have worked together to create a unique intellectual discourse founded on expertise from a variety of disciplines, organizations, and partnerships. Their work has been difficult and frustrating, yet clear evidence of its positive rewards is shown by the province's response.

The provincial articulation of Aboriginal Education is connected to work done at a national level. The progression of Aboriginal Education has involved certain focus points that have brought about Canadian awareness. It has raised a Canadian consciousness about the layers of oppression that can be traced back to the devastating mistakes that residential schooling inflicted on generations of Aboriginal peoples. In addition, the researched proof of the sad realities and multiple problems that continue to face Aboriginal peoples has further grounded this work. Documented in an overwhelming five volumes, with 3,500 pages of personal testimony, 440 recommendations were made by *The Royal Commission of Aboriginal Peoples (RCAP).* Land claims issues, economic, social, educational and political disparity portrays the devastating conditions that are all too common for many Aboriginal communities in our country.

Saskatchewan's provincial response to Aboriginal Education issues resulted in an orientation for change. Saskatchewan Learning (now Advanced Education and Employment) has taken action to be inclusive and to incorporate the different groups that can contribute to the development of Aboriginal Education in the province. Work that has been conducted in the area of Aboriginal Education "is aimed at ensuring that all students are educated in a manner consistent with their needs." (Saskatchewan Education, n.d., p. 4). The Aboriginal Education Unit for the K-12 system was formed. Their website provides insightful information that offers a vision for change and principles that will guide their work. Several documents referred to at this site are available on the Internet and can provide direction and answer questions (see Annotated Bibliography). The Aboriginal Education Unit was designed specifically to support K-12 education; however, Adult Basic Education administrators and instructors can benefit from knowing that this work exists and can adapt and/or use information that is relevant for adult learners.

Aboriginal Education can also be viewed from the unique perspectives that the Saskatchewan Indian Institute of Technologies (SIIT) and the Dumont Technical Institute (DTI) have implemented. With a bicultural focus, SIIT provides programs for First Nations peoples and from a First Nations perspective. DTI develops and delivers programs for Métis peoples and from a Métis perspective. Programs designed to focus on First Nations and Métis histories, peoples, cultures, languages, and worldviews, contribute to the movement toward self-determination.

Aboriginal Education in our province can be seen through different lenses, yet commonalities exist. Well documented are the interwoven themes of responsibility, community, authenticity, equity, and competency. As presented throughout this document, Adult Basic Education is responding to these themes. As we meet a growing number of Aboriginal learners, we must take responsible and informed steps to consider the initiatives that are in place in the different sectors of our province. Some instructors and administrators may be unsure of and/or nervous about the implications for them. This uncertainty is not uncommon, for change can be challenging at times and demanding at best. Our ability to work together as community members in equitable partnerships will improve relationships for the benefit of all.

Reflective Questions

What will a constructivist approach look like in the classroom? What does this mean for me?

- *Constructivism is the idea that we all create knowledge. It recognizes individual differences in interpretation. A constructivist instructor may ask, "How did you come to understand this?"*
- *Constructivist instructors pose open-ended questions and present problems. They then guide learners to find their own answers.*
- *Constructivist instructors prompt learners to form their own questions (inquiry); allow for many interpretations and expressions of learning (multiple intelligences); encourage group work and the use of peer tutors (collaborative learning); and provide opportunities for active learning (experiential learning).*
- *Constructivist instructors provide opportunities for learners to reflect and self-analyse.*

What will a transformative approach look like in the classroom? What change will that mean for me?

- *You will plan activities that involve learners in reflecting and narrating their stories. You want them to be able to see themselves within the larger structures of our society. They may use words like racism, discrimination, and prejudice.*
- *You will encourage learners to deepen their understandings about their own positions and circumstances by providing opportunities for them to know and articulate the structures of their identities.*
- *Transformative instructors provide opportunities for diverse voices to be heard and for events and issues to be examined from a variety of perspectives.*
- *You will engage in an examination of your own biases, assumptions, and prejudices.*

If I acknowledge Aboriginal perspectives as suggested here, what guarantee will there be for a higher success rate for Aboriginal learners?

"It would be a mistake, to assume that as some individual faculty members change attitudes and behavior, the success rate of [Aboriginal] students will automatically increase. Changes need to be systemically and societally implemented to make big differences. In addition, change must be organizational in nature rather than in isolated subsystems of an educational institution" (Roy & Hampton, 2000, p. 68).

Aboriginal perspectives in this document are guidelines and examples only. It is important to remember that we are all on a learning journey.

Glossary

(Note: These terms may have different meanings in other contexts.)

Aboriginal Section 35 of the Canadian Constitution (1982) defines the term "Aboriginal" as referring to the original occupants of Canada. In Saskatchewan Aboriginal refers to Indian/First Nation or Métis peoples.

Colonialism An unequal distribution of power and resources. Colonialism is caused by cultural and structural oppression that is enforced through the imposition of power, influence, and authority. We are all affected by the relationships established under colonization in Canada. These relationships are characterized by economic and political ideas and practices based on each Nation's (First Nations, Métis, Inuit, and non-Aboriginal) beliefs about the process and its outcomes. In our province, processes of *decolonisation* are presently underway. (See decolonisation)

Constructivism A theory of learning, that we all create knowledge. Learners construct new knowledge from their own previous knowledge. Rather than simply absorbing ideas transmitted to them by instructors through endless rote practice, learners instead create knowledge by connecting new information to their own pre-existing notions and later modifying understandings in light of new data.

In a constructivist approach, learners' ideas gain in complexity, and, with support, learners begin to understand how they think and what they know about the world. Constructivism emphasizes the careful study of the processes by which learners create and develop their ideas. Educational applications, therefore, match (not challenge) learners' understandings by encouraging further growth and development of what is already known.

Contextualized learning An approach to learning where learners develop skills for real-world uses in real-world situations. Lessons and units of study give learners opportunities to learn in a variety of meaningful contexts. This approach facilitates the transfer of knowledge to new contexts.

Criterion-Referenced Assessment A test taker's performance is compared to the domain of performances being assessed. Assumes that ability can be represented along a continuum from little ability in a specific domain to higher levels of competency. A criterion-referenced test is used to determine where along the continuum a learner should be placed. *Performance standards* specify the tasks that a learner should know at a given level or point along the continuum. *Minimum competencies* indicate the lowest level of performance that is acceptable. The focus is on determining what an individual already knows and, therefore, what needs to be taught instead of an individual's standing relative to a norm-reference group (Adapted from Kruidenier, 2002, p. 91).

Critical reflection A cognitive process where we think about our experiences: to muse, to review and so on…, but to reflect critically is also to examine the underlying beliefs and assumptions that affect how we make sense of our experience.

Critical thinking To analyse and look at our assumptions from as many unfamiliar perspectives as possible[10].

Decolonisation Decolonising involves an active process of exposing the realities of Eurocentric dominant culture practices and policies that have systemically dominated and denied Aboriginal participation in mainstream activities[11]. By deconstructing the disastrous impact in maintaining unjust power relations, decolonisation involves *all* people unlearning the strategies that have deliberately silenced Aboriginal peoples' full participation in social, political, economic, and emotional growth.

Discourses A discourse is spoken or written language that creates meaning embedded in a certain political view. Discourses come to us through books, videos, societal institutions (e.g. government, church, school), and even through informal discussions.

Dominant culture White, patriarchal, heterosexist, Eurocentric and Judeo Christian in origin.

Demystification A process to examine and clarify the alienating and oppressive features that have been disguised and hidden from the oppressed.

Empathy The emotional response of shared understanding in which each person assumes the other's perspective and cultural values as much as possible.

Empathetic communication skills Verbal and/or nonverbal expressions of understanding and respect for a person's beliefs and values. These expressions may include accepting, validating, acknowledging, confirming, and extending.

First Nation A term that came into common usage in the 1970s to replace the word "Indian", which many people found offensive. Although the term First Nation is widely used, no legal definition of it exists. Among its uses, the term "First Nations peoples" is meant to be inclusive and refers to status Indian people in Canada. It implies a shared heritage of culture, knowledge, history, and colonialism. Symbolically, the term elevates Indian peoples to a status of "first among equals" in their quest for self-determination and self-government within the Canadian nation-state. Many Indian people have also

[10] "Critical thinking entails adults understanding that the flow of power is a permanent presence in our lives. In our personal relationships, work activities, political involvements, even our recreational pursuits, power relations shape how we experience the world. Questioning these power relations so that we might redirect the flow of power **over** into power **with** learners is an important part of critical thinking" (Brookfield, 1995, p. 112).

[11] The curriculum is one example of a Eurocentric tool used for maintaining oppression and inequality to silence the history, cultures, knowledge and experience of Aboriginal peoples in Canada (Battiste, 2000; Battiste & Henderson, 2000).

adopted the term “First Nation” to replace the word “band” in the name of their community; for example, “I am from Sweetgrass First Nation.”

Indian A legal term that includes Aboriginal people who have special legal status in Canada as regulated by the Indian Act. These people are descendants of the First Nations of Canada.

Integration Integration is about wholeness. Learners combine new information with what they have already learned in other ways and in other contexts. For example, communications skills are integrated with other skills as learners participate in language activities in all subject areas. Integration also refers to the mixing of the different kinds of learners who participate in groups. Integrating learners with a variety of abilities promotes peer tutoring.

Meritocracy A social system in which people’s success in life depends primarily on their merit: their talents, abilities, and effort. Within this belief is the idea that all individuals can be successful if they apply themselves. We attribute the “bootstraps” idea to this concept – whereby individuals can rise up to greatness through the application of their common sense and a strong work ethic. However, under critical examination, we have come to understand that not all individuals can achieve solely on their merit. Critical perspectives also illuminate the inherent bias that a privileged construction of ability and talent create. The myth of meritocracy continues to flourish in spite of systemic oppressions, prejudice, and discrimination that limit opportunities for the lower classes and those who are visible minorities.

Metacognition The process of thinking about thinking. Flavell (1977) describes it as follows: "Metacognition refers to one's knowledge concerning one's own cognitive processes or anything related to them” (p. 232). Metacognition involves the active monitoring and regulation of cognitive processes. Metacognitive processes are central to planning, problem-solving, evaluation and many aspects of language learning.

Métis The term “Métis” refers to those Aboriginal residents of Canada who have gained membership in a Métis community and have received the right to be legally defined by their collective group.

Multidisciplinary approach Content from a variety of subject areas is included to enhance relevance. For example, if the theme “low-budget cooking” is used by a particular group of learners in a Communications class, the instructor who uses a multidisciplinary approach will ensure crossover from other subject areas. In this case, the Communications instructor will include lessons that involve concepts traditionally reserved for math, science, or life skills courses. This may include banking knowledge, estimating and calculating costs of meals, understanding bacteria growth and connecting nutrition with success. Taking a multidisciplinary approach represents a way for instructors to focus on and to respond to the holistic dynamics adult learners bring to school.

Mystified concepts Those ideas, notions, assumptions, and/or categories of information that have been normalized by dominant society[12]. These are concepts that have become so deeply familiar that they are rarely questioned, and their meanings reflect and perpetuate old exclusivities that masquerade as universalism. Partial knowledge exists when a tradition of thinking is continually shaped and expressed by confusing partial truths.

Performance-Based Assessment is used to evaluate a learner's ability to use knowledge or skills gained in a realistic or authentic situation to complete tasks. Generally, performance tasks involve written or spoken responses or participation in group or individual activities (Kruidenir, 2002, p. 91).

Praxis It is what we do in addition to what we think. Characteristics of praxis include self-determination (as opposed to coercion), creativity (as opposed to homogeneity), and rationality (as opposed to reaction and chance). Praxis is made of a continuous cycle of action-reflection-action that is central to emancipatory education (Freire, 1970). Action stands in direct contrast to theory (Johnson, 1995). Praxis is informed action.

Racism People's prejudicial attitudes as well as discriminatory practices towards individuals of a certain ethnic/racial background. Racism is a system of domination and subordination designed to maintain inequality.

"Racism is not something which simply affects its victims in various adverse ways: It also benefits all those against whom it is not directed, by affording certain privileges" (Shadd, 1991, p. 34). This idea of racism moves away from a definition that only focuses on deliberate hateful acts (lynching or racially motivated violence) to an acceptance of the way in which racism operates more commonly (systemic racism that replicates inequality). For example, schooling privileges particular ideas of success (monetary reward and individually gained status). These same ideas are examples of racism when they structurally deny other definitions of success (strong networks and sharing of power), thus unwittingly denying full opportunity for some based on race.

Standardized Assessment Administration and scoring procedures are standardized for all examinees. Tests are scored in the same way, using detailed examination guides and trained examiners. An individual's score is often compared to the scores of a representative group of those taking the test (a norm group). Results may be expressed as grade equivalencies, percentile ranks, or stanines.

Traditional teaching practices These refer to the technical nature of transmission curriculum delivery. These include programmed learning by structured teaching approaches. [13]

[12] Educational systems are key instruments in the dissemination of mystifications. For example, unemployment is "mystified" as personal failure rather than a failure of the economy and globalization. Mystified concepts skew truth by imposing dominant values.

[13] See "Appendix C: Curriculum Philosophy" in *Basic Education Redesign Phase 1: Planning and Foundations (March 2002)* (Saskatchewan Learning, 2002, p. 29).

Transformation One of the three orientations of curriculum – transformation focuses on personal and social change where learning takes on a more critical, multi-dimensional view of society. [14]

Transaction One of the three orientations of curriculum – transaction reflects the practical aspects of teaching.[15] A transaction orientation of curriculum is achieved when the power is shifted to the learner, and the instructor assumes the role of facilitator.

Voice A people's authentic self-expression that is shaped by cultural, gender, racial and class/status identities.

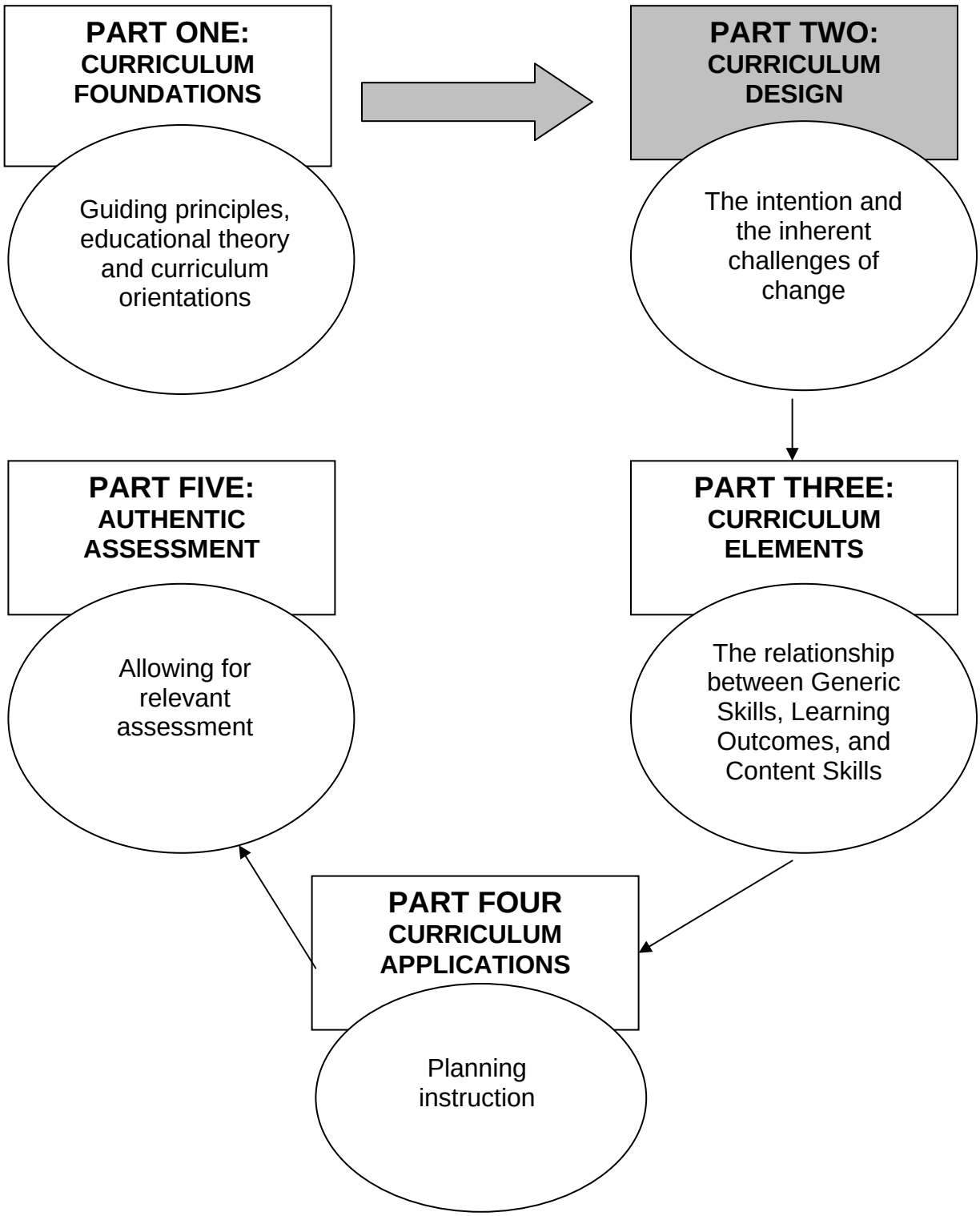
Worldviews Those general understandings about the universe and our philosophic relationship to it - some broad assumptions about the meaning of life, the way things work and what is important. A worldview is often associated with a group or society, recognizing that there are variations between individuals within the group.

[14] Miller & Seller (1990) identify assumptions of transformation that include realization of positive inner potential, self-directed learning abilities, need for a value system, importance of developing a positive self-concept, interrelated cognitive and affective developmental levels, teachers as facilitators, validity of learner concerns and the importance of self-assessment. Central to all these is the focus on social change that results as learners become critically conscious of their positioning.

[15] Miller & Seller (1990) describe a transaction philosophy as one where learners make connections between their own prior knowledge to that of new instruction being presented. Intellectual growth is encouraged through problem solving activities and group-work collaboration.

PART TWO:
CURRICULUM DESIGN

The Curriculum Roadmap:



Chapter Three:
The Interaction Between Design and Planning

The Vision and the Challenge

A curriculum design gives instructors and others a picture of the curriculum to be implemented, much like an architect gives clients a drawing of the house to be built. Just as the architectural design guides the development of a new house for the homeowner, this curriculum design guides the planning and development of Adult Basic Education courses. This chapter presents the key elements that form the design that guides instructional planning and curriculum application. The key elements of this curriculum include Generic Skills, a learning outcomes approach, contextually-based instruction for adults, and an authentic assessment rationale.

The vision for this curriculum is one that:

- is sensitive to the realities of adult learners' lives;
- is informed by current understandings of inclusive and anti-oppressive education;
- acknowledges the essential role that instructors and other staff have in creating a positive learning environment; and,
- engages others in the discourse of transformation.

The vision also greatly impacts participants in our programs for it strives to empower adult learners, prepare them for a changing and demanding future, and encourage them to realize they have much to contribute to our communities.

With these high expectations come realistic challenges. Informed by critical and social theory, education has evolved a great deal in the last two decades. In keeping up with this change, professional development is of the utmost importance. As the Aboriginal numbers continue to grow in Adult Basic Education, current cross-cultural training becomes even more imperative. With shrinking budgets and a call for authentic materials that reflect our community of learners, having adequate planning time is vital to maximize the success of the implementation of this curriculum. These challenges only represent the obvious.

We know challenge and resistance are the natural partners that travel with change. If we can acknowledge this, perhaps we can better accept and recognize them when they arrive.

The key elements of this curriculum's design follow.

Generic Skills

Generic Skills are skills that:

a. can be developed and applied across a variety of subject areas and contexts; and
b. take longer to acquire than subject-specific skills.

Generic Skills are best viewed as transferable general life skills or skills that contribute to independence. They may be transferred into contexts different from the ones in which they were first learned. The intent is that learners acquire the skill and then transfer and further develop it when attending further training and education, when in the workforce, or when participating in other life-long-learning activities. Generic Skills are essential to personal, social, and employment success.

Three primary references [16] for the development of the Generic Skills were as follows:

1. Common Essential Learnings (C.E.Ls) incorporated in Saskatchewan Learning's K-12 curriculum guides.

2. The Employability Skills 2000+ developed by the Conference Board of Canada.

3. Equipped for the Future Content Standards for Adult Literacy and Lifelong Learning, an initiative of the National Institute for Literacy in partnership with the Division of Adult Education and Literacy, U.S. Department of Education.

The broad categories that make up the Generic Skills include:

- Lifelong Learning
- Communications
- Numeracy
- Technological Literacy[17]
- Creative and Critical Thinking
- Valuing Diversity
- Interpersonal Teamwork

Generic Skills are fundamental to each curriculum area in Adult Basic Education. Interconnection between Generic Skills, learning outcomes, and content skills will be further discussed in PART THREE.

[16] For further information on these documents, refer to the References section at the end of PART TWO.
[17] For more information with respect to guidelines for Level Three computer skills, refer to APPENDIX A: Technological Literacy – Computer Skills and Knowledge Checklist.

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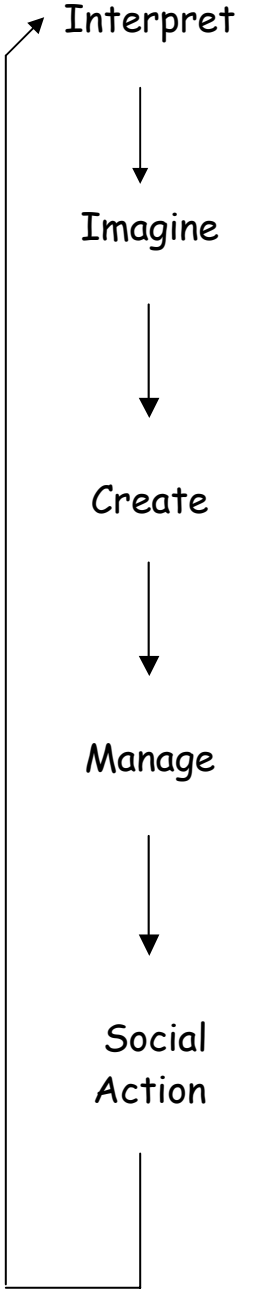
Generic Skills



Lifelong Learning (LL)	Communications (C)	Numeracy (N)
Reflect upon and interpret your own learning style; recognize areas of strength and areas for further development	Reflect on and interpret your own thoughts and feelings and express these to others	Reflect upon and interpret the ways in which numbers are used in your daily life
Work independently	Read with understanding and interpret information in various formats	Analyse and interpret numerical data
Establish learning goals, monitor progress, and adjust strategies as necessary	Present information in a variety of ways	Present information in a variety of forms
Identify a variety of learning strategies appropriate to the task and the context (work, home, and school)	Speak so others can understand	Observe and record data accurately using appropriate methods, tools, and technologies
Plan and manage time, money and other resources to achieve learning goals	Listen actively	Use numerical data to argue and present a point
Plan and carry out multiple tasks; take responsibility for assuring work quality and results	Continue to develop personal communication skills	Apply numerical skills in a variety of contexts and for a variety of purposes
Advocate for self	Apply communication skills in a variety of contexts and for a variety of purposes	

Technological Literacy (TL)	Creative & Critical Thinking (CCT)	Valuing Diversity (VaD)	Interpersonal/ Team Work (IT)
Reflect upon and interpret the ways in which technology is used in your community	Reflect upon, recognize, and express how you see yourself in relation to change	Reflect and interpret your own roles and identity	Reflect upon and interpret self in relation to family, the workplace and the community
Use computers and other tools to locate, process, and manage information	Assess situations and identify problems	Identify the connections between beliefs, culture, and change over time	Accept and provide feedback in a constructive and considerate fashion
Use technology for research, communication, and creative purposes	Access and use information from diverse sources and perspectives	Identify and respect the similarities and differences across cultures	Manage and resolve conflicts
Demonstrate what you understand about technological literacy	Analyse information for accuracy, bias, and usefulness	Identify and respect diversity	Participate in group processes and decision making; adapt to changing requirements and information
	Generate options and solutions	Demonstrate that you have learned from others' experiences and ideas	Listen to and ask questions of others to understand and appreciate their points of view
	Form opinions and make decisions based on critical reflection	Recognize and articulate points of view different than your own	Be socially responsible and contribute to your community
	Put decisions and plans into action	Recognize, discuss and problem solve around issues of racism, prejudice, and stereotyping	

Learning Outcomes Approach

This approach to planning instruction focuses on what the learner will do by the end of a lesson, a unit, or a course. This is different from the more traditional approach where instruction is determined primarily in terms of what content is taught.

Key principles of the learning outcomes approach to curriculum development include the following:

- Curriculum design that determines course content, instructional delivery and assessment techniques by identifying the knowledge, skills, attitudes, and values needed by both learner and society.

- Learning outcomes generally include Generic Skills and are broken down to clearly express the specific skills and integrated abilities of a successful learner.

- Learning outcomes should clearly explain how learners will transfer their learning outside of the classroom setting.

- Learning outcomes are achieved through specific subject-area content skills that can be assessed in a relevant context(s): school, home, work, or community.

- Authentic assessment of learning outcomes and subject-area content skills allows learners to self-assess, integrate, and transfer their learning.

This approach allows for flexibility because learning outcomes can be achieved using a variety of processes and resources making instruction culturally relevant, characteristically holistic, and personally meaningful to learners. One way to implement a learning outcomes approach is through contextually-based instruction.

Contextually-Based Instruction for Adults

Current understandings of adult education principles, transactional and transformative orientations, and Aboriginal perspectives support a contextually-based approach to instruction and learning. Writings in these areas show **the need for learning to be meaningful in order to be transferable**. Studies on the recruitment and retention of adult learners also highlight the need for relevance in programming. Imel (1998) states that in contextualized learning the “instructions – and the instructional materials – draw on the actual experiences, developmental stages, and problems of the learners” (p. 3). Wherever possible, academic skills are developed through and applied to a variety of life contexts.

Dirkx and Prenger (1997) refer to this approach as “theme-based.” A theme-based approach is of significant advantage for instructors who are responsible for delivering all subjects in a Level Three program. Generic Skills and content-specific objectives from several subjects can be developed through one theme.

Through a holistic lens, and using an integrated theme-based approach, instructors will consider the following areas:

- Instructors consider content skills, resource materials, instructional methods, and assessment tools together with the life contexts and goals of their adult learners.

- By considering learners' experiences, Generic Skills, learning outcomes and content skills can be developed through a theme that is personally and culturally relevant to learners.

- Ideally, learners collectively brainstorm (or instructor facilitates a group discussion) to capture and articulate an issue or concern that can be designed into a theme to be studied. The selected theme is then used for organizing the interdisciplinary content and the curriculum specifics. Learners are then involved in a number of tasks related to developing the theme. They are asked to identify what they want to learn about the theme, to bring information or resources related to the theme and to conduct research to find answers to their questions.

- In a multi-level or individualized setting, learners in the whole group or in smaller sub-groups can work together to identify themes. However, the instructor will vary the specific content skills (and corresponding activities and assignments) developed through the theme. S/he will also vary the resource materials and assessment criteria and standards according to learners' levels.

- In a continuous intake setting, instructors may need to identify theme topics to develop.

Different approaches will be used to implement contextually-based instruction for adults because of the variety of program delivery structures in the province. Regardless of the approach used to identify relevant themes and contexts, academic skills are taught via resource materials that reflect the personal, work and/or community contexts of learners. The skills that learners develop in school are connected to the broader contexts of their lives.

Authentic Assessment Rationale

Varieties of measures (formal and informal) are used to place adults in the appropriate Adult Basic Education level. Along with information gathered directly from the learner, some combination of standardized, criterion-referenced, or performance-based[18] assessments are often used. The results of this initial assessment provide information in areas such as:

- learners' needs,
- goals and career plans,
- learning styles, and,
- academic strengths and weaknesses.

[18] See Glossary in Part 1 of this document for definitions of assessment terms.

This information helps to guide the instructor in the development of training plans and in the selection of instructional methods and materials.

Assessment practices in Level Three programs are consistent with the foundations and vision of Adult Basic Education. Kasworm and Marienau (1997, as cited in Kruidenier, 2002, p. 97) identify five "best practices" relating to assessment and adult education principles:

- *Assessment recognizes that adults come to literacy instruction*[19] *with a wide variety of experiences and an extensive knowledge base and that what they learn will be applied to specific situations.*
- *In addition to the need to improve their literacy skills, adults also have affective needs and should be involved in the assessment process through, for example, self-assessment and the sharing of assessment results.*
- *Giving adults feedback promotes learning.*
- *Assessment should take into account, and use, adults' involvement in work, family, and community.*
- *Adults' prior experienced-based learning gives them the knowledge to participate in the design of assessment programs and to be actively involved in their own assessment (through the use of procedures such as portfolio assessment).*

Since the learning outcomes approach in Level Three provides learners the opportunity to develop skills that apply to the real world, assessment also needs to reflect the authentic nature of that learning. Assessment is an ongoing process and potentially any activity can provide an assessment opportunity. Authentic assessment is sometimes referred to as performance-based assessment – assessments "used to evaluate how well students complete tasks that require the application of knowledge or skills in a realistic, or authentic, situation" (Kruidenier, 2002, p. 93).

The intent of authentic assessment is to look at a learner's work as a whole and to conduct assessments under conditions similar to conditions found outside the classroom. For example, in the workforce, adults often work in teams. The mechanic or the statistician has access to an array of reference materials in order to perform his/her tasks. Security personnel have limited time to write a report at the end of a shift as do parents when writing a note to their child's teacher.

[19] This research is American in origin. In this context, "literacy instruction" refers to programs at one of six levels: the first four levels relate to literacy development to the beginning of secondary education and the last two levels cover adult secondary education. These six levels are similar to the four levels in Saskatchewan's Adult Basic Education framework for credit programs. In the United States performance standards are available for numeracy, functional and workplace skills, family literacy and English as a Second Language as well as literacy (e.g., reading, writing, and speaking).

Most often authentic assessments are used to measure more global skills such as metacognition or reading comprehension, rather than specific components (Kruidenier, 2002, p. 113). The focus is on the ability:

- to use analytical skills,
- to integrate what is learned,
- to think critically and creatively,
- to work collaboratively, and,
- to develop written and oral expression skills.

Authentic assessment values the learning process as much as the finished project.

In general, assessment in Level Three courses includes pre-tests to determine prior knowledge and skills. Then, instruction is provided based on assessment results. Learners are involved in assessment activities throughout the program in order to adjust instruction and to determine learners' progress in their attainment of knowledge (factual and procedural), cognitive strategies, and metacognitive processes.

Knowledge is important because it is the foundation of deep understanding and complex problem-solving (Tombari & Borich, 1999, p. 75). When assessing knowledge, the instructor focuses on the facts, concepts, rules, and generalizations needed to make sense of a specific topic or task. S/he will also assess whether the learner knows how to perform a task or a function (e.g., how to divide fractions, how to use the writing process, or how to access computer files). Knowing how to organize and use information separate "the skilled performer from the unskilled" (Tombari & Borich, 1999, p. 69). It is, for example, difficult to predict which team will win a soccer game if you have no knowledge of soccer. It is also difficult to make accurate predictions if you have misconceptions or "faulty knowledge." These misconceptions (e.g., good readers always read every word or gravity causes heavier objects to fall faster than lighter objects) may initially be firmly held and adhered to by the learner even when presented with new information.

Tombari and Borich (1999) describe cognitive strategies as "general methods of thinking that improve learning across a variety of subject areas" (p. 10). These strategies are sometimes referred to as problem-solving strategies and are related to the higher order thinking skills in Bloom's Taxonomy or to Quellmalz's non-hierarchical taxonomy of cognitive operations[20]. Strategies range from scanning a chapter for sub-headings or for bold or italicized words, to pausing to summarize key points to ensure comprehension or to ask yourself if you are clear about what the task is. Assessment of

[20] Quellmalz (as cited in Tomari & Borich, 1999, p. 126) lists four fundamental cognitive strategies – analysis (perceiving the whole task or problem, identifying the distinctive elements and the relationship between elements), comparison (identifying similarities and differences in the elements), inference and interpretation (gathering information and evidence), and evaluation (taking a position or arriving at a conclusion) – that are used in all problem-solving, regardless of the content area. These processes, however, are carried out in specific contexts such as history, biology, or writing.

cognitive strategies occurs after demonstrations, explanations, modelling, and guided practice.

Metacognitive processes involve the learner becoming aware of the strategies that work best for him/her and recognizing when to use a strategy. Learning how to learn is an essential component in developing independent or lifelong learning.

Current educational practice acknowledges that tests, as the sole means of assessment, have limitations. Rather, a variety of assessment strategies and techniques is preferred. Portfolios (including items such as writing samples and documentation of specific practices), rubrics, projects (often used to assess learning outcomes from several subjects), oral retellings, and demonstrations are frequently used techniques. Authentic assessment tasks "add to the tools that can be used rather than supplant all others" (Kruidenier, 2002, p. 137).

Assessment techniques, as they relate to specific curriculum guides, are discussed in PART FIVE of this document.

Reflective Questions

What cross-cultural competencies do I need to effectively deliver this curriculum?

- *Be aware of your own cultural values and biases. Once we are aware of our own, we can better accept others who are different. As demographics shift, valuing biculturalism is essential to understand our own limits and expertise.*
- *Be aware of how oppression, racism, discrimination, and stereotyping affect all of us. Acknowledging how some have directly or indirectly benefited from individual, institutional and cultural racism allows for understanding the social impact on others.*
- *Be aware of communication styles and understand that our styles may clash. As a result, we may devalue approaches that work with certain groups, for example, the time that is required to do a sharing/talking circle.*
- *Be aware that cross-cultural competence means a constant effort to seek out educational, consultative, and training opportunities to improve understanding and effectiveness in working with culturally different populations. This also involves recognizing the limits of our competence and knowing when to seek advice from other more qualified individuals.*
- *Be aware and sensitive of the life experiences, cultural heritage, and historical background of culturally different groups.*

What does current research about inclusive and anti-oppressive education offer us?

Terminology that includes inclusive and anti-oppressive education is closely linked with anti-racist education and critical pedagogy. Literature in these areas present inclusive ways for educators to view core disciplines and overall programming. Kumashiro (2000) describes three focus approaches. Each has strengths but also weaknesses when used alone; therefore, it is suggested that all three of the following approaches be understood, implemented and balanced:

- ***Education for the "other":** improves experiences, treatment and success for those learners who are designated as "other" than the norm. Oppression is not only understood to happen because of the actions (harassment, isolation, alienation, violence, exclusion, etc), but it also occurs because of inaction (inappropriate instruction, attention, materials; inadequate cross-cultural training; or insensitivity).*
- ***Education about the "other":** teaches about marginalized groups (staff awareness sessions or culture day awareness) to a predominant non-marginalized instructional population.*
- ***Education that is critical of privileging and "othering":** involves critical examination and encourages transformation by openly discussing "norms". Oppression and marginalization are recognized as being produced and reproduced through existing social structures and competing ideologies, e.g. meritocracy. Power relations are exposed, emotions are released as difficult questions are posed: Whose knowledge is of most worth? What are my unearned advantages? What tools of oppression have been normalized - do I use these?*

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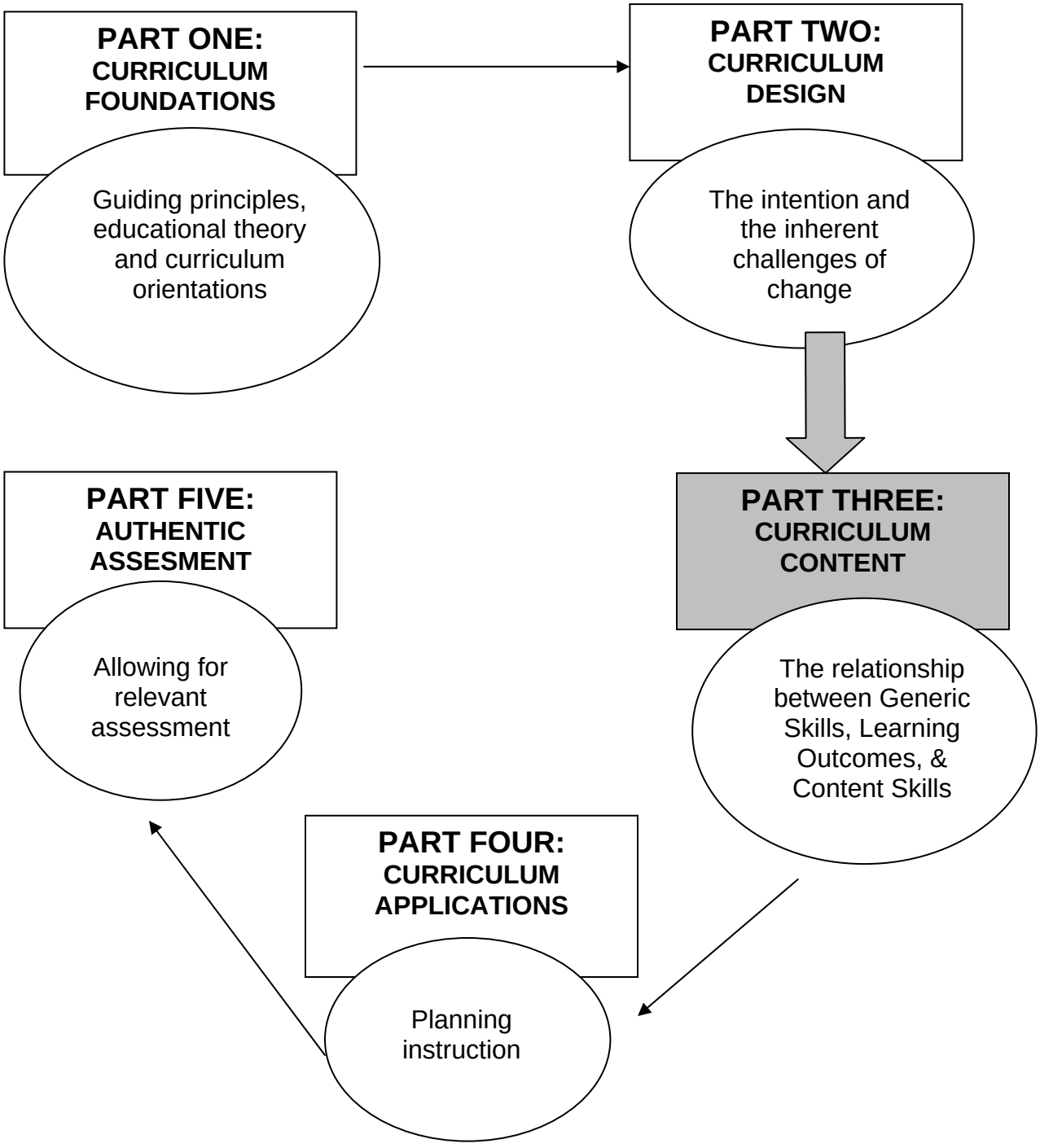
PART THREE:
CURRICULUM CONTENT

The Curriculum Roadmap:



Chapter Four: Foundations of Scientific Literacy

Goal of Adult Basic Education Level Three (Adult 10) Science

The goal of ABE Level Three (Adult 10) Science is for learners to use scientific knowledge, skills, and attitudes to:

- develop and apply the foundations of scientific literacy;
- broaden their definition of science; and
- participate and engage in relevant discussions, decision making, and inquiries.

Foundations of Scientific Literacy

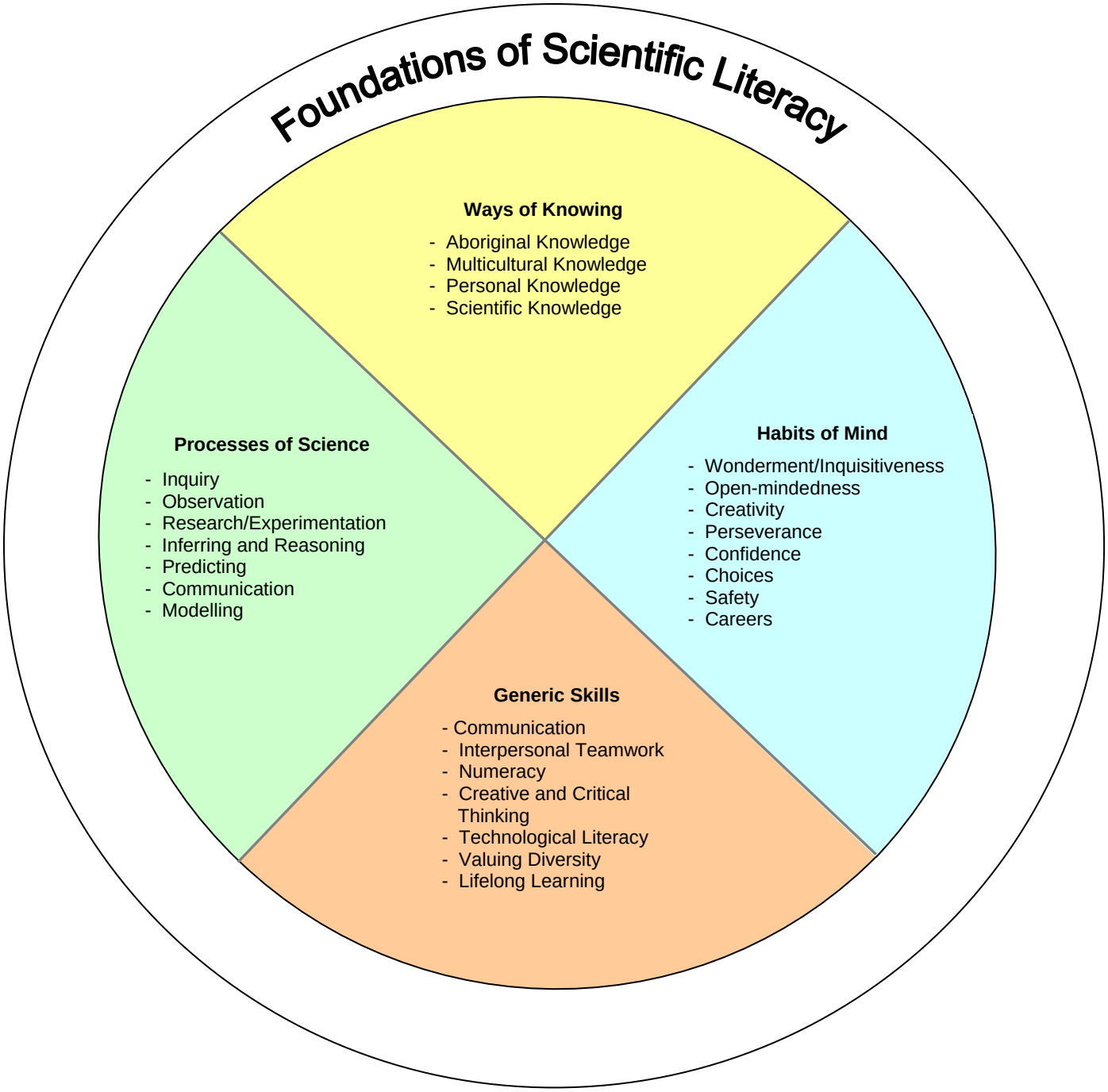
To be scientifically literate goes beyond the content of science and its many branches. Definitions of scientific literacy include skills and processes, attitudes and perspectives, and an understanding of the relationships between science, technology, society, and the environment as well as a scientific knowledge base (Council of Ministers of Education of Canada, 1997; Massachusetts Department of Education, 2001; Robitaille, 1993). To be scientifically literate means a person can identify science in an existing knowledge base, a new topic, or current social issue, and make decisions and choices around such topics. As Enger and Yager (2001) state

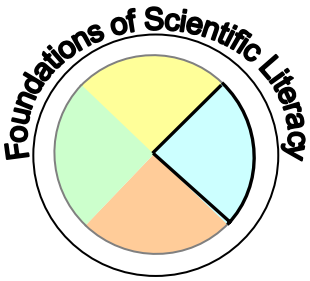
> a scientifically literate person is believed to be one who appreciates the strengths and limitations of science and who knows how to use scientific knowledge and scientific ways of thinking for living a better life and for making rational social decisions. (p. 1)

In Level Three Science there are four foundations of scientific literacy: Ways of Knowing, Habits of Mind, Scientific Processes, and Generic Skills (in the context of science). Although these foundations of scientific literacy are being acquired in the subject base of science, the foundations attained in this course are intended to be transferable to other aspects of learners' lives. At Level Three, it is necessary to address learner needs no matter what their exit level or goal – further training, the workplace, or personal/community life. The foundations of scientific literacy outlined in this section should equip learners with the processes, knowledge, skills, and habits of mind to be successful in any of the branches of science, in further training, as well as in the workplace or personal life. They should also equip learners with the confidence and knowledge base to be active members of their community so they can ask questions, form opinions, and make informed contributions around science-based issues.

These foundations are interconnected and present a holistic approach to a person becoming scientifically literate. For example, acknowledging and respecting the different ways of knowing is actually a way to exhibit the generic skill of valuing diversity. Asking questions and making inquiries fits with Habits of Mind, Scientific Processes, and the Generic Skill of Communication. It is this overlap that provides connections for learners and models the transferability of the foundations.

The Foundations of Scientific Literacy can be illustrated using a circle with four quadrants. As all of the foundations are connected, there is no beginning nor end. As shown in this model, each of these four quadrants represents one of the foundations.





Habits of Mind

In this quadrant of the circle, the foundation called “Habits of Mind” focuses on the development of the attitudes, perspectives, interest, and motivation a learner has towards science. Habits of mind are practices that strengthen learning. “Habits of Mind are performed in response to those questions and problems the answers to which are not immediately known. We are interested in observing how students produce knowledge rather than how they merely reproduce knowledge” (Costa and Kallick, 2001, p. 1).

Learners can develop these habits to attend to the attitudes and beliefs they hold about themselves in relation to science. They are ways of thinking that can

- guide how the learning of science is understood and performed;
- form an appreciation of science;
- build a tolerance of the uncertainty of science; and
- develop an interest in the field.

The habits listed below are described in the context of science, but could support learning for all of Adult Basic Education Level Three.

Wonderment/Inquisitiveness – To be intrigued by the world around them indicates learners are engaged and, like scientists, have a desire to learn. Asking questions and posing problems are basic activities of science and essential to lifelong learning. This shift towards learners initiating and guiding their own learning and developing understandings in their own framework of knowledge is a shift towards transactional and transformative instruction.

Open-mindedness – The consideration of new ideas is critical to advancements in science and technology. Scientific theories are not constants – they are dynamic and open to reconsideration. Having an open mind is characteristic of being a scientist, but it is also important throughout life for personal discovery and intellectual growth. Open-mindedness is what allows us to recognize that there may be several right answers, more than one way to view a topic, and more than one way to assign value to skills and knowledge (Massachusetts Department of Education, 2001). This connects to Ways of Knowing, one of the foundations of scientific literacy.

Creativity – It is not often conveyed that much of what is taught has been created by someone else. Learners, then, should have a grasp of the content and processes and use these effectively in both familiar and unfamiliar contexts. In situations new to them,

learners need to be imaginative and develop unique and innovative ideas, products, solutions, alternatives, and techniques, all of which require creativity. When learners can do this effectively it is evident they have an understanding of a concept.

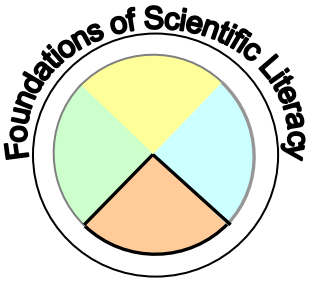
Perseverance – Scientists persevere even when results may not be satisfactory, anticipated, or even desired. Persistence and determination are driving forces in science and can be driving forces in the lives of learners. Perseverance draws on a repertoire of tools, skills, and attitudes to see something through to an endpoint even though the endpoint may be one of fruition or failure. Perseverance is having the tenacity to proceed – even with the risk of failure. Perseverance is about the ways of getting to an end – the processes of science – not the end itself.

Confidence – Science can be intimidating to learners as it can sometimes seem like a specialized body of knowledge disconnected from life. But science is a process of inquiry and understanding. Both instructor and learner should approach the exploration of science with the confidence that they can participate and engage in the process. Learners often use the applications of science and do not realize they are. Confidence can be built by starting with the learners' personal knowledge and illustrating or naming the science they already do and are familiar with at home, at work, in their community or within their own culture.

Choices – A scientific knowledge base allows learners to widen, analyze, and understand possible options they may not have considered before. Part of informed decision-making is having an awareness of all available choices and recognizing the driving values behind choices and behaviours. When learners make choices of their own, or analyse other people's choices, it is important that they examine the values underlying those choices, and understand that different sets of values may result in different choices. For example, choices made would be very different if the driving value were respect for the environment as opposed to valuing money. This habit of mind can also refer to learners choosing to employ intelligent behaviours which value their learning.

Safety – A concern for safety must be exhibited by learners in a science context, as well as in a personal or workplace situation. Encouraging learners to assess and handle potential dangers properly and apply safety procedures in every possible situation throughout instruction makes safety a habit and the first consideration.

Careers – Having a working understanding of a discipline widens career choices. Learners should look at science as a skill set, a knowledge base, and a way of thinking that provides opportunities to investigate careers and set goals within a broader range of possibilities. Some potential career choices may have a component of science in them and, in some cases, science is the career. "Students who understand the role of process skills in scientific investigations may be more likely to see science as a career that is fun and creative" (Enger and Yager, 2001, p. 5).



Generic Skills (in the context of science)

Generic Skills are highlighted in this quadrant. Generic Skills are those skills that are developed and applied across several disciplines and subject areas. They are viewed as transferable, general life skills and are common to all Level Three (Adult 10) curricula. When Generic Skills are addressed in the context of science, learners will not only enhance how they do science, but they will also be preparing to transfer the skills to different contexts – for further training, for the workforce, and for other lifelong learning experiences.

Communication (C) – asks questions, reads, writes, and talks about science with an understanding and use of scientific vocabulary. Reading a newspaper article, listening to oral traditions passed on from Elders, recording observations and data, and participating in a debate are examples of communication.

Interpersonal teamwork (IT) – collaborates by incorporating others' views and perspectives and utilizes the strengths of peers to enhance learning and the success of the group. Interpersonal teamwork is the building of a community where work is done with others in experimentation, projects, and problem solving. There are scientific communities consisting of teams of people working together.

Numeracy (N) – uses mathematics as a language to explain science and make empirical observations and measurements. Examples of numeracy are graphic representations of density or phase changes, and the probability of inherited traits such as eye colour or certain diseases (e.g. cystic fibrosis). Someone who possesses a working knowledge of measurement systems could be considered a numerate person.

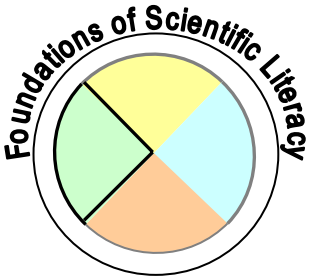
Creative and critical thinking (CCT) – is creative in developing an accepted systematic method to solve problems and evaluate scientific claims. Learners should be encouraged to look at all alternatives by posing questions and shifting focus to the unknown instead of searching for the "truth" or the right and accepted answer.

Technological literacy (TL) – appreciates the impact of technology on science and science on technology, and recognizes this relationship as a system (A Unifying Concept). The learner uses technologies proficiently in lab work, calculations, and research. There should also be acknowledgement of the impact technology has on society and everyday life.

Valuing diversity (VaD) – values scientific knowledge as well as ways of knowing and doing science. Learners should acknowledge that individuals come with unique

personal knowledge bases, cultural knowledge bases, and academic knowledge bases. It may be the case that learners have a wide scientific knowledge base they are unaware of because it has been learned holistically and without attention to the parts or labels of "Western science". Learners are all gifted in different ways and with encouragement can learn to explore their giftedness.

Lifelong learning (LL) – possesses such traits as confidence, inquisitiveness, and a passion for learning. Being a lifelong learner is what drives new findings. "They seize problems, situations, tensions, conflicts, and circumstances as valuable opportunities to learn" (Costa and Kallick, 2001, p. 12). A lifelong learner will inquire rather than give answers: he or she will prefer to explore alternatives rather than know which choice is the correct one. A lifelong learner engages in the processes of learning and is not concerned with only the attainment of knowledge. A lifelong learner depends on personal initiative to acquire relevant knowledge and is able to learn independently with limited instructor guidance.



Processes of Science

The "Processes of Science" quadrant shows us that science is a process, a way of problem solving, of uncovering and finding patterns. The process of doing science is often named as the scientific method, implying that there is one way to carry out a series of processes. This curriculum identifies that there are many accepted "scientific methodologies" – not just one. The Processes of Science highlight commonalities and do not negate processes which may be used by others. The processes can be used in a number of efficient ways to investigate, think about, and "do" science. Other places and people may use other processes that are not named below, or named at all, but the processes may still be carried out. It is the responsibility of the instructor to honour what is already known and recognize there is no one scientific method of lock step processes. Rather, there are multiple scientific methodologies.

In Aboriginal cultures, the knowledge is learned in a holistic manner and the processes of science need not be named. The importance of the process is the purpose of the knowledge for survival. An example comes from an oral teaching of how the base root of the poison oak was used to treat encephalitis[21]. People and animals were dying from the disease, yet not all animals. Some managed to fight off the fatal illness. Upon closer observation it was noted that those animals were eating the base root of the poison oak. It was then realized that this was a possible treatment for encephalitis. If Western science were to blend with this traditional knowledge, an inquiry process of

[21]Danny Musqua, Saulteaux Elder, conveyed this traditional knowledge to the Curriculum Advisory Group.

asking the questions: “Why aren’t all the animals getting sick?”, and “What were those animals doing differently?” could be identified.

Aboriginal people look at the connectedness of natural phenomena, and see the patterns of cause and effect. It is bigger than one instance: there are circles of causes and effects. Traditional knowledge, by its holistic nature, does not require labels, but by looking at this example through a different lens it can be recognized that scientific processes and Habits of Mind were employed to solve a problem.

If the processes of uncovering and acquiring this knowledge were to be named in accordance with this curriculum it could be said that observations were made and reasoning and inferring would certainly have been the Western scientific processes used. The bigger unifying concept of Patterns was also being used in the uncovering of the treatment.

This is an example where it is the role of the instructor to identify the scientific processes in the learner’s existing knowledge, and it is the role of the learner to understand the labels given. Through a Level Three Science course, learners can gain the scientific knowledge, skills, and attitudes to be able to recognize scientific processes in cultural learnings, day-to-day experiences, and in the world around them. Coming to understand how different types of processes apply to different types of knowledge is what is important.

Sometimes a scientific methodology is serendipitous, and results in accidental discoveries that occur in the quest for something else. Examples of serendipitous discoveries in science include penicillin, WD-40©, Post-it Notes©, and Velcro©. Although these instances of chance may not appear to be following any processes of science, it is the ability to see the potential in something, make observations, and be open to possibilities that are scientific processes. Scientific processes and knowledge are not fragmented in the attainment or transference of knowledge. This foundation acknowledges the commonalities of several scientific methodologies and outlines some processes by which science can be carried out or done.

Inquiry – Inquiry is a process of science that requires learners to “combine processes and scientific knowledge as they use scientific reasoning and critical thinking to develop their understanding of science” (National Research Council, 1996, p. 103). Learners should integrate skills and knowledge to carry out scientific inquiry, but also to understand the process of scientific inquiry so that process is transferable to the learners’ lives. This integrates an understanding of scientific concepts with an understanding of how we know what we know in science.

Observation – Observations, both qualitative and quantitative, are ways of collecting data or gathering evidence. The use of technology can be integrated with observation and related to the precision and accuracy of measurements and the devices and techniques used to measure to make observations and record data. Observations are often thought to be objective because they are made using the five senses. However,

the way in which observations are made may be affected by a person's prior knowledge of the object or subject being observed. In addition, the prior knowledge and existing frameworks of understanding may affect the nature and depth of observation. An example of identifying colour can illustrate this point. One person may observe a colour as red, while the second with an artistic background sees vermillion, a particular shade of red containing more of an orange hue.

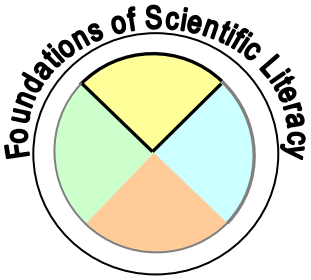
Research and Experimentation – Experimentation is the means by which scientifically literate people carry out a plan to investigate something to answer a question. "Meaningful hands-on scientific inquiry engages adult learners as they follow and develop their curiosities and intuitions" (Massachusetts Department of Education, 2001, p.14). It is through experimentation that abstract knowledge can become concrete to learners because experimentation is the opportunity to test their own ideas. Part of experimentation is the examination of all results – if they were repeatable or not, or if they could validate the purpose of the experiment. Learners need to recognize that all results should be questioned.

Inferring and Reasoning – An inference uses prior knowledge, experiences, and cultural understandings to interpret, evaluate, and theorize about the evidence and data collected. Reasoning requires learners to look at the evidence, new and old, with logic and healthy scepticism.

Predicting – Predictions are closely related to the Unifying Concept of "Patterns of Change", which is explained in more detail on page 54. It is through recognizing and identifying patterns that predictions can be made. It is a culmination of understanding of facts and knowledge, experiences, observations, pattern recognition, and intuition that lead to making predictions.

Communication – Scientists work collaboratively, so communication skills are essential in conveying observations, investigations, mathematical explanations, and conclusions to members of the science team. Communication occurs through discussion, drawings, graphs, mathematical representations, and writing. Listening, speaking, reading, representing, and mathematical skills are also essential for understanding the knowledge or information being conveyed.

Modelling – Models in science are often thought of as physical representations, either larger or smaller than reality. There are also mathematical models that represent the mathematical relationship between two properties. An example would be the linear relationship of mass to volume in density. There is a third and very important type of models – the conceptual models that use metaphors and analogies. One example would be the circle, which in some Aboriginal cultures can be used to illustrate meaning, holistic understandings, and connections among concepts. There is no separation – no beginning nor end. Modelling is any representation that helps people understand something by suggesting how it may work.



Ways of Knowing

"Ways of Knowing" is concerned with the cultural and personal knowledge learners bring with them to the classroom. A misconception that learners may have is that scientific knowledge is a constant and unchanging body of knowledge. They believe that science is a body of facts or information that is disseminated in class for them to know and memorize, and that it is the right (and only) way to explain the world around them. In reality, the nature of science is dynamic and changeable which needs to be taught as a human endeavour that tries to make sense of the natural world.

It is desirable that instructors help learners create a positive disposition towards science by acknowledging value in all ways of knowing. Knowledge is not finite: it is dynamic, unique to each individual, and influenced by experiences, gender, and culture. It may be enlightening to learners to see that many people in a vast array of contexts carry out the processes deemed unique to science – observing, experimenting, implementing, justifying, and solving problems. Therefore, all "Ways of Knowing" need to be acknowledged as valid ways of knowing and applying science. Learners can learn science by examining *how* people know what they know and not just *what* they know.

Science can be described as a way to "uncover" and explain what is in the world around us. With this approach, all learners can feel empowered to know they can be successful at science even though the ways that they make sense of, understand, and explain science will vary greatly depending on their life experiences, culture, personal beliefs, and the community in which they live. This can be acknowledged and valued as personal knowledge, multicultural knowledge, and Aboriginal knowledge.

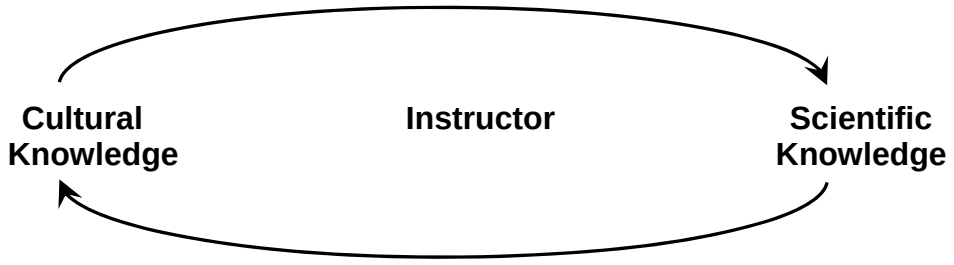
Instructors need to recognize that learners come with a set of cultural and personal beliefs, skills, and understandings that may not coincide with the explanations of "Western" science. Although looking at natural phenomena through a different conceptual lens may seem illogical, other ways of knowing needs no validation from "Western" science. To value diversity, the instructional setting should be one where learners are able to maintain and make their own personal and cultural contributions to the understanding of science. According to Aikenhead (2005)

> The act of "translating" Western science into an aboriginal context (or visa versa) can unintentionally force a Western worldview onto Aboriginal students. Thus, in spite of our best intentions, we can inadvertently engage in assimilation, rather than empowering students to walk in two worlds. Each of our units should establish an Aboriginal framework of a community, to which Western scientific knowledge can relate without distorting that Aboriginal worldview. (para 1)

Scientific knowledge needs to be relevant to all learners. Relevance can come through connections with geographical location, community, culture, personal goals, life experiences, prior knowledge, or experience in the work force. For example, the sustainability of a particular ecosystem can be studied with reference to the impact of mining, the impact on hunting and fishing, or the effects of economic growth on a community. Chemical reactions can be studied in the context of safety in the workplace when handling particular cleaners and solvents, through food preservation techniques, or the chemical reactions taking place in our own bodies.

The contexts in which science is studied are important to help learners make connections between science and their own experiences so they do not see the processes used in science as exclusive to science (Enger & Yager, 2001). The design of the science course, then, will look very different when concepts are taught based on the personal and cultural knowledge of the learners, as well as the uniqueness of the learners' communities. For example, disciplines such as medicine and astronomy are streams of knowledge within the broader knowledge systems of Aboriginal cultures.

For a non-aboriginal instructor, addressing culturally-based practices or knowledge could be a challenge. Depending on the experience and culture of the instructor, cultural knowledge may be integrated into the science content, or the science content into the cultural knowledge (Stephens, 2003).



Instructors and learners need to consult and develop relationships with community Elders and other Traditional Knowledge Keepers in the process of learning Aboriginal Ways of Knowing in specific contexts. When incorporating learners' cultural, traditional,[22] and personal knowledge, instructors need to ensure that proper protocol and procedures are followed, and that sacred information, rituals, and ceremonies are honoured and respected. It is suggested that an Elder be invited to share knowledge since the Elder will know what can be shared and incorporated into the science course.

[22] "*Traditional Knowledge (TK)*: A cumulative body of knowledge and beliefs handed down through generations by cultural transmission, about the relationship of living things (including humans) with one another and with their environment. It includes the knowledge of elders, current land users, and other community members. Further, TK is an attribute of societies with historical continuity in resource use practices. Other terms include 'indigenous knowledge', 'local knowledge', traditional ecological knowledge', 'indigenous science', and 'ecological wisdom' "(Northwest Territories Cumulative Impact Monitoring Program and Audit Working Group, 2005).

Beginning with the learners' understandings of science and scientific concepts is sound practice for addressing adult learning theory, cultural diversity, and the learners' mental, emotional, physical, and spiritual understandings. By building on what learners know and have already experienced through culture, work, and their communities, a sense of confidence and a culture of success is created. The knowledge learners bring with them is honoured and the learners are valued for what they know. Not only is this a best practice for adult learners, but it also approaches teaching and learning of science in a learner-centered, holistic way that is in accordance with Aboriginal ways of teaching.

Chapter Five: Unifying Concepts of Science

Science is laden with facts and content, especially as it branches out into more specific disciplines such as chemistry, biology, and physics. A science course with a primary focus on content and facts works at low cognitive and contextual levels. "When students learn to think beyond the facts, they are able to see patterns and connections of old knowledge and new knowledge; they transfer understandings to other situations; and they systematically build conceptual depth and sophistication" (Erickson, 1998, p. 41).

In other words, the facts and content are the vehicles by which the larger, key, conceptual ideas of science are taught. The Habits of Mind are the ways in which science is "done" and thought of or learned. The Unifying Concepts are the larger ideas that span across all branches of science and are all ways in which science has been or is being done, regardless of culture, personal experience, or which branch of science is being learned. The Council of Ministers of Education of Canada (1997) states

> A useful way to create linkages among science disciplines is to use unifying concepts, key ideas that underlie and integrate different scientific disciplines in ways that assist both teachers and students. Unifying concepts are meant to integrate big ideas as a way to provide a context for explaining, organizing, and connecting knowledge. Unifying concepts link the theoretical structures of the various scientific disciplines and show how they are logically parallel and cohesive. They are also instructional tools that cut across disciplines and may apply as well in mathematics, technology, business, and politics. (p. 8)

The amount of information in the field of science is enormous and is growing and changing everyday. At Level Three it is not reasonable to think that a Science course can attend to all that information, let alone have the learner understand the breadth of it all. Learners will come with some understandings from their own lives and experiences around the unifying concepts, giving them more confidence as they enter into other science courses with a belief that they can be successful. For Level Three Science, six unifying concepts have been chosen to span curriculum content: each is listed and explained below. Following each concept is a statement (the learning outcome) of what the learner should know, understand, and do upon completion of a Level Three Science course.

1. **Order and Organization** – In attempting to understand and make sense of the world around us, knowledge is often ordered and organized. The branches of science itself have been organized into disciplines.

   There are many methodologies for organizing. In everyday life, a variety of ways of ordering can be used for the same purpose. Ordering can happen quantitatively from least to greatest or vice versa, or it can be based on similar and varying traits or criteria. For example, a CD collection can be arranged alphabetically by artist or first by genre and then alphabetically by artist. All CD's could be arranged by release

date from earliest to latest, or they could be arranged by most liked to least preferred. No one way is better than the other – just different.

Order and organization of government structures, the periodic table, the animal kingdom, the types of renewable and non-renewable resources, the family structure, Aboriginal- based classification systems, and the organization of a First Nations or Métis council are more real world examples of Order and Organization. An example from Aboriginal cultures is the organization of plants used for medicinal purposes: poisons, neutralizers, disinfectants, and psychotropics.

Some cultures organize from the parts to the whole, while others organize from the whole to the parts. There are many ways that people look at the world and give it meaning: instructors must be sensitive to this. Aboriginal people order from whole to the parts, taking one thing and learning about the whole to see the parts. In Western science, the whole is fragmented into parts to see how they build or make up the whole. To be culturally responsive, instructors can take a holistic approach to science and present big ideas, concepts, or topics first and then attach the specific learning outcomes to them. Therefore,

Learners will analyze the different ways and reasons for categorizing knowledge to understand themselves and the world around them.

2. **Measurement** – Systems of measurement have been invented to quantify data so fair comparisons of values can be made. Some of these methods were formal and others informal, but in either case, measurement was systematic. This is useful both in science and in the everyday lives of learners. Including a quantitative measure is a way of communicating data and information. Making measurements with accuracy and using appropriate units are important when following a recipe, performing home repairs, sewing, or building a fence.

   Every strand of the curriculum should relate in some way to this unifying concept, whether that is in measuring the mass of matter, deriving density, measuring units of energy, or analyzing a food label. Therefore,

Learners will apply mathematical understandings in choosing appropriate tools and making accurate measurements to compare and contrast objects and events.

3. **Systems** – Thinking of things as systems indicates the ability to see the intricacies within a system and the interrelationships between systems. Systems can be studied as a whole consisting of parts, or as parts making up the whole. Examples include an automobile, the environment, body systems, the solar system, the health care system, and organisms. “Thinking in terms of systems implies that each part is fully understandable only in relation to the rest of the system” (American Association for the Advancement of Science, 1989, p. 166).

The strands within this curriculum are to be taught as interrelated units of study, which is addressed in the Interrelationships strand. For example, energy can be studied within the Life strand by looking at caloric values of food and the necessary energy it provides to sustain life. Matter can also be studied in Life as there are elements (e.g. calcium, magnesium, and iron) needed to sustain life and promote health. Chemical reactions such as photosynthesis and the burning of hydrocarbons for energy (propane, methane), can be studied within the Matter strand. Therefore,

Learners will recognize the interdependence within, between, and among systems and use that knowledge when solving problems.

4. **Patterns of Change** – "Scientists believe that through the use of the intellect, and with the aid of instruments that extend the senses, people can discover patterns in all of nature" (American Association for the Advancement of Science, 1989, para 5). Changes and the patterns of change are of particular interest in science as well as in everyday life to recognize constancies, trends, and erratic changes to be able to make predictions. In Aboriginal cultures, the importance of change, transformation, and flux was represented by various mythical heroes, as in the Trickster stories. Aboriginal people were reminded by these stories to embrace change and flux as a way of surviving in harsh environments. Weather patterns, changes in traffic flow at particular times of the day, changes in season, and the population of a particular species of animal are other examples.

   Science for All Americans states that patterns are distinguished by "three general categories: (1) changes that are steady trends, (2) changes that occur in cycles, and (3) changes that are irregular. A system may have all three kinds of change occurring together" (American Association for the Advancement of Science, 1989, para 30).

   Traditionally, cyclical patterns were used to know when to plant and when to harvest. Trends have been observed to predict the weather. Understanding patterns in nature enables people to honour all life and live in harmony with nature.

   Controlling change, or choosing a variable to change, and then observing the effect of that change is important in science when conducting experiments to test predictions. This can also be helpful in life when trying to solve problems, for example, when an auto mechanic performs an analysis on a vehicle that isn't working or when a person tries to choose a healthier lifestyle through diet and exercise. Therefore,

Learners will understand the processes and conditions in which change takes place to recognize trends and patterns and to make predictions.

5. **Ethics and Values** – A scientific body of knowledge does not have an impact on the ethics and values of people, rather it is the ethics and values of people that have an impact on scientific knowledge and what is done with that knowledge. Ethics and values are components that underlie a proposed solution to a problem or a decision to be made. Learners need to develop problem-solving and decision-making skills by analyzing and critiquing the driving forces behind any scientific decision.

   The ethics and values that emerge from the foundation of Aboriginal cultures and worldviews may be in direct contradiction with other ethics and values that emerge from other culture contexts. What is important is that learners are exposed to a variety of ethics and values that lead to different types of scientific decision-making.

   If science is a human endeavour by which nature is being explained, then the ethics and values of humans play a significant role in scientific decision-making. This reinforces the concept that science is dynamic, changing, and driven by humans – the ethics, and values of people and society, new issues and problems, and knowledge at a specific time. Issues develop, and ethics and values can change: science reflects that. Consider the example of waste management that now has great emphasis on recycling, reusing, and composting – practices that were not considered important until recently. Therefore,

Learners will evaluate the ethics and values within science to make appropriate decisions and to justify their choices.

6. **Technology** – Technology and science are interrelated and can be considered to have a cyclical relationship. "Often science and technology work as partners in that new technology is frequently dependent on scientific breakthroughs. On the other hand, new instruments and techniques developed through technology make it possible to advance various lines of scientific research" (Massachusetts Department of Education, 2001, p.14).

   Technological advancements have permeated, and continue to permeate, all aspects of life. How items are rung through at the grocery store, the ways people communicate, how information can be transmitted, and how we travel are all technological changes in our world. Examples of traditional technology that have made an impact on a people include snow shoes, boomerangs, or atlatls (a tool that uses leverage to achieve greater velocity in spear-throwing). Therefore,

Learners will understand the relationship between technology and science to identify the impact that technology has on their everyday lives.

Summary of Learning Outcomes for Unifying Concepts

1. **Order and Organization**

Learners will analyze the different ways and reasons for categorizing knowledge to understand themselves and the world around them.

2. **Measurement**

Learners will apply mathematical understandings in choosing appropriate tools and making accurate measurements to compare and contrast objects and events.

3. **Systems**

Learners will recognize the interdependence within, between, and among systems and use that knowledge when solving problems.

4. **Patterns of Change**

Learners will understand the processes and conditions in which change takes place to recognize trends and patterns and to make predictions.

5. **Ethics and Values**

Learners will evaluate the ethics and values within science to make appropriate decisions and to justify their choices.

6. **Technology**

Learners will understand the relationship between technology and science to identify the impact that technology has on their everyday lives.

Chapter Six: Learning Outcomes

In Level Three Science there are five strands – Interrelationships, Integrated Science, Matter, Energy, and Life – with each having general learning outcomes and specific learning outcomes. General learning outcomes identify the broad categories of knowledge, skills, and attitudes that learners are able to demonstrate after instruction. Specific learning outcomes identify the knowledge, skills, and attitudes that contribute to the general learning outcome.

Strands

Strands may be taught in any combination and in a variety of ways but the primary focus of instruction is not the specific learning outcome. The learning outcomes are to be used as tools to address the overarching general learning outcomes, the Unifying Concepts and the Foundations of Scientific Literacy. These are the principles guiding instruction and learning and take a more holistic approach to science.

Interrelationships deal with connections to the workplace and to everyday life and include decision- making and applications of science. Learners should see that matter, energy, and life are interrelated.

The **Integrated Science** strand consists of laboratory and mathematics skills that are common to all disciplines in science.

Matter includes topics such as the periodic table, chemical and physical changes, elements and compounds, chemical reactions, and acids and bases.

The **Energy** strand deals with heat and temperature, electricity, force, and motion.

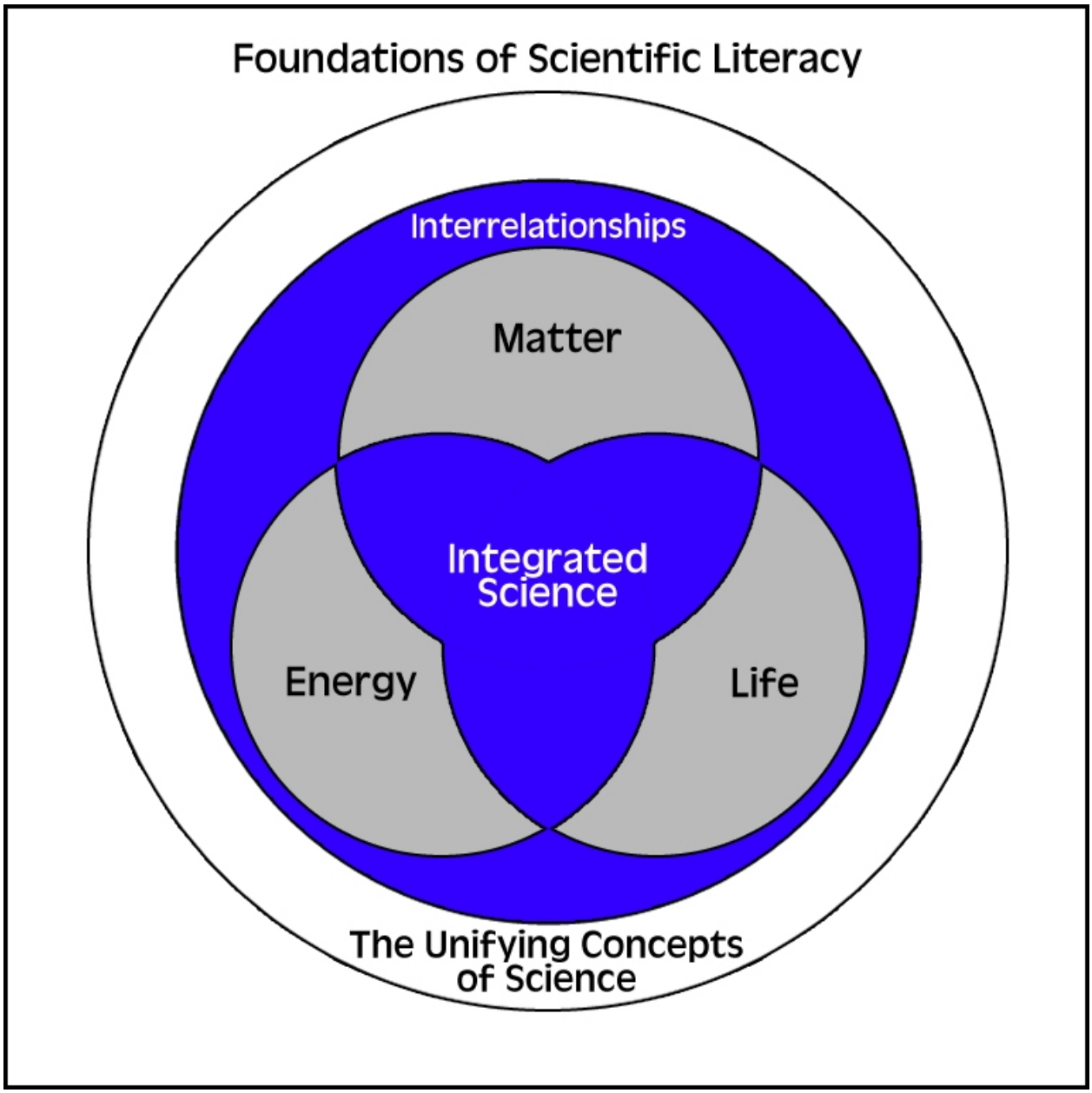
The **Life** strand is concerned with the human body, and includes learning outcomes on cells, organs and systems, nutrition, and the reproductive system.

The order of the strands is not prescriptive and the strands do not need to be taught as separate units of study: they are merely an organizational tool. The Integration of Science strand is intended to be inherent throughout all the other strands and not to be taught on its own as a separate unit. It is the instructor's responsibility to incorporate the specific learning outcomes of this strand into the other strands.

Summary of General Learning Outcomes by Strand

Attitudes	**Interrelationships**
	1. Learners will explore the interconnectedness of matter, energy, life, culture, society, technology, and environment to determine the purpose of science and its role in people's decision-making and problem-solving.
Skills	**Integrated Science**
	1. Learners will acquire and practice the skills and processes necessary to learn about and participate in science. 2. Learners will apply the skills and processes acquired in the home, at work, and in the community.
Knowledge	**Matter**
	1. Learners will use basic principles of chemistry to interpret and explain familiar phenomena. 1. Learners will identify common substances, their reactions, and interactions so they can use chemicals safely at home and at work.
	Energy
	1. Learners will demonstrate a working knowledge of common types of energy used in everyday life so that they can make decisions about their daily use of energy and their dependence on it. 2. Learners will make choices and decisions about how energy production and usage affects the environment.
	Life
	1. Learners will understand the workings of the human body to make healthy lifestyle choices.

This Venn diagram represents the holistic philosophy and approach this curriculum advocates for the teaching of science. The components of the diagram are interrelated and interconnected – represented by the circular aspects of the Foundations of Scientific Literacy. The content is important not for its own sake, but for the learners' acquisition of deeper understandings of the common themes of science (Unifying Concepts) and the Foundations of Scientific Literacy, thus enabling them to become scientifically literate. This, in turn, meets the goal of the Adult Basic Education, Level Three Science Curriculum.



Content as the Vehicle for Learning

As instructors proceed through this section, it needs to be re-emphasized that the content is the vehicle being used to teach to the bigger ideas outlined in the previous sections. What is more important for learners than knowing the content is developing the Foundations of Scientific Literacy and using the specific content as a means to address the Unifying Concepts of science. Although learners need to complete this science course with some knowledge of science, it is not the recollection of content itself that is most important but the conceptual understandings of the nature of science, how science is done, thought of, and applied to solve problems that are more valuable.

This shift in how science is taught – from pure content to conceptual understanding – is a shift toward transformational learning. Drago-Severson (2004) citing Kegan (1982, 1994) found

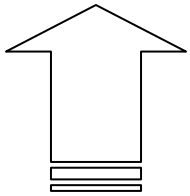
> In short, informational learning – new skills and information – adds to *what* a person knows, whereas transformational learning changes *how* a person knows. When a person's way of knowing changes, the person comprehends information in a different way and has enhanced his or her capacities (cognitive, interpersonal, and intrapersonal) to manage the complexities of work and life. For such changes to occur, the educator needs to pay attention to the ways in which a learner is interpreting, or making meaning of, his or her experience, and then provide supports and challenges that are developmentally appropriate to that way of making meaning. (p.19)

Instructors should recognize that scientific content involves scientific skills, abilities, processes, and habits of mind as well as scientific knowledge. Science is to be taught through a conceptual lens and in a holistic and culturally responsive manner. The instructor uses the content to allow learners to investigate their own understandings of science and build on them.

The flow chart on the following page provides a different overview of the structure and nature of Level Three Science. Although linear in structure, this diagram still represents the Foundations of Science and the Unifying Concepts as the overarching framework for learning the specific content. The specific learning outcomes within each strand address the general outcomes for each strand. These can be used to illustrate the Unifying Concepts that weave throughout all strands and build the foundations of a scientifically literate person.

Foundations of Scientific Literacy

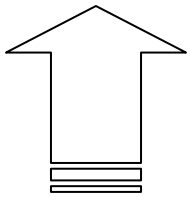
Habits of Mind
Generic Skills
Processes of Science
Ways of Knowing



Unifying Concepts in Science

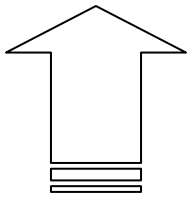
Order and Organization
Measurement
Systems
Patterns of Change
Ethics and Values
Technology

General Learning Outcomes



Content Strands

Interrelationships
Integrated Science
Matter
Energy
Life



Specific Learning Outcomes

Categorized by *Strand* within *Unifying Concepts of Science*

Organization of the Document

This section explains how to use each part of the Learning Outcomes charts.

Integrated Science

General Learning Outcomes:
Learners will acquire and practice the skills and processes necessary to learn about and participate in science.

Learners will apply the skills and processes acquired in the home, at work, and in the community.

Specific Learning Outcomes and Generic Skills	Order and Organization	Measurement	Systems	Patterns of Change	Ethics and Values	Technology	Suggestions for integration
The learner will							
Discuss different definitions of traditional knowledge. **(VaD)**	✓			✓	✓		Bring in examples of traditional ways or technology that may have been used prior to a the invention of a “high tech” object.

Interrelationships:
- Learners can research careers that use science.
- Assign and model an analysis of films such as *The Snow Walker* or *Medicine Man.*
- Design a classification system.

Reflective Questions:
- How did I ensure this strand was inherent in the other strands?
- Have I encouraged learners to understand the nature of science?

Strand: *The five content strands in any combination make up the Level Three Science Course. They are structured as individual strands only for ease of use and organization for the instructor. Instructors may address the strands in the way that best meets the needs of learners.*

General Learning Outcome: *The learning outcome expresses what the learner will be able to know or do upon completion of the course.*

Specific Learning Outcomes: ***lead instructors to planning effective learning activities, assessment, and evaluation.***	**The Unifying Concepts** *have been included in the chart to show how the general learning outcome relates to the specific learning outcomes. These are only suggestions and instructors and/or learners may see specific learning outcomes integrating with several different concepts.*	**Suggestions for Integration** *provide guidance to instructors so that the Foundations of Scientific Literacy, the Unifying Concepts of Science, the general learning outcomes, and the specific learning outcomes are being addressed in instruction.*

Generic Skills: *The generic skills have been linked to specific learning outcomes: Communication* ***(C)****, Interpersonal Teamwork* ***(IT)****, Numeracy* ***(N)****, Creative and Critical Thinking* ***(CCT)****, Technological Literacy* ***(TL)****, Valuing Diversity* ***(VaD)****, Lifelong Learning* ***(LL)***

Interrelationships *are included to provide more ideas to instructors on how the specific learning outcomes can be addressed in ways which integrate some or all strands. The instructional approaches may be inquiry-based, project-based, or otherwise.*

Reflective Questions *allow instructors to reflect on the lesson or unit and ask themselves about what has taken place during the teaching of a strand.*

Interrelationships

General Learning Outcome

Learners will explore the interconnectedness of matter, energy, life, culture, society, technology, and environment to determine the purpose of science and its role in people's decision-making and problem-solving.

Specific Learning Outcomes and Generic Skills	Order and Organization	Measurement	Systems	Patterns of Change	Ethics and Values	Technology	Suggested topics, strategies, activities, and instructor tips
The learner will							
Choose a topic and identify the matter, energy, and life components of it. **(CCT)**	✓	✓	✓	✓	✓	✓	**Energy/Life** • Photosynthesis • Respiration • The carbon sink at the Eco-centre at Craik, SK • Global warming in the north • Weather patterns and natural disasters • Myths and stories show the relationships and interdependence of all life • Invite an Elder or a group of Elders to speak about the breath of life in relation to current environment problems with air pollution • Invite an Elder to speak about Aboriginal worldview and interrelationships in nature **Life/Matter** • Organic farming • Composting **Energy/Matter** • Most efficiency in the burning of hydrocarbons. • Composting • Recycling
Explore traditional ways of knowing and Western ways of knowing in relation to the concept of interrelationships. **(VaD)**	✓	✓	✓	✓	✓	✓	
Determine what has and does drive change or "advancements" in science and the impacts of those decisions. **(TL)**	✓	✓	✓	✓	✓	✓	
Realize the impact one person has on problems and solutions. **(LL) (CCT)**	✓	✓	✓	✓	✓	✓	
Acknowledge multiple perspectives are needed in a solution. **(VaD)**	✓	✓	✓	✓	✓	✓	
Identify scientific issues in his or her community, life, and work. **(C)**	✓	✓	✓	✓	✓	✓	
Develop a methodology to come up with a possible solution. **(LL)**	✓	✓	✓	✓	✓	✓	
Initiate and/or carry out a solution plan to a problem. **(IT)**	✓	✓	✓	✓	✓	✓	

Generic Skills: *Communication **(C)**, Interpersonal Teamwork **(IT)**, Numeracy **(N)**, Creative and Critical Thinking **(CCT)**, Technological Literacy **(TL)**, Valuing Diversity **(VaD)**, Lifelong Learning **(LL)***

Reflective Questions

- Do learners have an understanding of the differences and interrelationships between science and technology?
- Has a connection been made between science and the workplace in some way?
- How have I addressed the learners' affective domain – their beliefs about their ability to succeed at science?
- Is there a way to combine an assessment tool in Science with one in another subject area, such as Communications?
- Are concepts being presented in real world situations and experiences that learners are familiar with?
- Have I used this strand to integrate and cover specific learning outcomes from other strands?
- How did I facilitate learners in developing their own methodology for investigating an issue?

Integrated Science

General Learning Outcomes

Learners will acquire and practice the skills and processes necessary to learn about and participate in science.

Learners will apply the skills and processes acquired in the home, at work, and in the community.

Specific Learning Outcomes and Generic Skills	Order and Organization	Measurement	Systems	Patterns of Change	Ethics and Values	Technology	Suggestions for integration
The learner will							
Explain what science is and name the main branches of science. **(C)**	✓						Ask learners to draw a diagram of the "tree of science" with new branches added each time a new discipline is mentioned in class. Emphasize theory over truth when presenting explanations. Bring in examples of traditional ways or technology that may have been used prior to the invention of a "high tech" object. Learn the scientific concepts that underlie the construction of traditional technologies used for survival. For example, building traditional snowshoes and canoes and the underlying physics and mathematical concept involved in their construction.
Respect that science does not explain everything. **(CCT) (VaD)**					✓		
Explain what technology is. **(TL)**			✓			✓	
Discuss different definitions of traditional knowledge. **(VaD)**	✓			✓	✓		
List examples of traditional technology. (e.g. snow shoes, tipi, travois, birch bark canoe). **(TL) (VaD)**					✓	✓	
Discuss the positive and negative aspects of technology in his or her life, the lives of others, and the environment. **(TL) (C) (CCT)**					✓	✓	
Identify the characteristics of someone who does science. **(CCT)**				✓	✓		
Investigate or inquire about a problem or question. **(CCT) (LL)**	✓		✓	✓			

Generic Skills: *Communication **(C)**, Interpersonal Teamwork **(IT)**, Numeracy **(N)**, Creative and Critical Thinking **(CCT)**, Technological Literacy **(TL)**, Valuing Diversity **(VaD)**, Lifelong Learning **(LL)***

Integrated Science - continued

Specific Learning Outcomes and Generic Skills	Order and Organization	Measurement	Systems	Patterns of Change	Ethics and Values	Technology	Suggestions for integration
The learner will							
Ask questions about objects and events and develop ideas about how those questions might be investigated and answered. **(LL) (C)**				✓	✓	✓	Ask learners to design and carry out their own experiments.
Make observations of the world using the 5 senses. **(C)**				✓		✓	
Make both quantitative and qualitative observations. **(N) (T)**		✓				✓	Ask learners to use metric measurements rather than Imperial measurements so they can use the metric system easily. Throughout the course, discuss possible sources of error in measurement. Ask learners to explore Traditional Ways of measurement and where and how counting and numbers are expressed.
Explain the advantage and need for standards in measurement. **(C) (N)**	✓	✓			✓		
Use common objects as benchmarks to measure length, liquid volume, mass, temperature, and time. **(CCT) (N)**		✓	✓				
Use the metric system and SI units to measure length, liquid volume, mass, temperature, and time. **(C) (N)**			✓				
Minimize error in measurement by choosing appropriate tools and understanding precision and accuracy. **(CCT) (LL) (N)**				✓		✓	Calculate percentage error to analyze experimental error (see Appendix B: Instructor Resources for background on calculating percentage error)
Collect, organize and display data. **(C) (N)**	✓						
Calculate % error. **(N)**		✓		✓			
Exhibit safe lab practices and skills**. (LL)**					✓		See Appendix B: Instructor resources for background on lab safety)
Correlate cultural knowledge and scientific knowledge. **(VaD) (CCT)**				✓	✓		

Interrelationships

- Explore the different types and streams of Aboriginal knowledge including protocols related to access and dissemination within a community or larger society.
- Learners can research careers that use science.
- Assign and model an analysis of films such as *The Snow Walker* or *Medicine Man.*
- Design a classification system.
- Design a measurement system.
- Investigate workplace situations where lab safety practices are required.
- Conduct a measurement lab where learners have to choose the best unit of measure for common items and explain why they chose that measure.
- Use a dart board analogy to illustrate precision and accuracy.
- Have a person enter the room for a brief time and ask learners to write down all they observed.
- Explore the perspectives of Elders in relation to global warming and its impacts on community. Correlate their answers with scientific perspectives.

Reflective Questions

- How did I ensure this strand was inherent in the other strands?
- Have I encouraged learners to understand the nature of science?
- Do I bring my instruction back to learners becoming scientifically literate people?
- Did I build on and further develop mathematical skills and reasoning in science?
- Were these learning outcomes taught through application within the other strands?

Matter

General Learning Outcomes

Learners will use basic principles of chemistry to interpret and explain familiar phenomena.

Learners will identify common substances, their reactions, and interactions so they can use chemicals safely at home and at work.

Specific Learning Outcomes and Generic Skills	Order and Organization	Measurement	Systems	Patterns of Change	Ethics and Values	Technology	Suggested topics, strategies, activities, and instructor tips
The learner will							
Describe the study of matter as the branch of science known as Chemistry. **(C)**	✓						Conduct a lab on the concepts of mass and volume. Measure out equal masses of elements and compare the volumes.
Tell what matter is and classify the types of matter. **(C)**	✓						
Make both qualitative and quantitative observations of matter using the five senses. **(N) (TL) (C)**		✓		✓			
The Periodic Table							
Recognize the periodic table as a source of information. **(C)**			✓			✓	Ask learners to investigate some of the elements and, based on the information they found, organize the elements and correlate the information to the periodic table. Discuss the technology that was available when the table was being created.
Explain the basic principles of organization of the periodic table. **(CCT) (C)**	✓			✓			
Identify trends and patterns within the periodic table. **(CCT)**				✓			

Generic Skills: *Communication **(C)**, Interpersonal Teamwork **(IT)**, Numeracy **(N)**, Creative and Critical Thinking **(CCT)**, Technological Literacy **(TL)**, Valuing Diversity **(VaD)**, Lifelong Learning **(LL)***

Matter – continued

Specific Learning Outcomes and Generic Skills	Order and Organization	Measurement	Systems	Patterns of Change	Ethics and Values	Technology	Suggested topics, strategies, activities, and instructor tips
The learner will							
The Periodic Table (con't)							
Understand the history of the use of symbols for the elements. **(C)**				✓			Discuss how symbols are used to communicate.
Use symbols for the elements correctly. **(C)**	✓						Compare a current periodic table to one from 20 years ago.
Chemical and Physical Changes							
Outline the differences between physical and chemical properties of matter. **(CCT)**				✓			Convert ice to steam in a phase-change lab. Graph temperature versus time.
Identify the differences between chemical and physical changes. **(CCT)**				✓			Make homemade ice cream.
Describe physical properties and states of matter (solid, liquid, gas). **(C)**	✓			✓			
Apply the Particle Theory of Matter by explaining or illustrating with models, how a substance goes through phase changes or changes of state. **(C) (CCT)**			✓	✓			Explore the chemistry of explosives and fireworks.
Explain the anomalous behaviour of water. **(C)**			✓	✓			
Describe the relationship between the mass, volume, and density of solids, liquids, and gases and relate this to the particle theory of matter. **(N) (CCT)**				✓			Explain how the liquification of gases allows for more efficient transport.
Describe situations in everyday life where the density of substances changes naturally or is altered intentionally. **(LL)**		✓			✓	✓	Use phase change and weather to examine the science of potholes.

Matter – continued

Specific Learning Outcomes and Generic Skills	Order and Organization	Measurement	Systems	Patterns of Change	Ethics and Values	Technology	Suggested topics, strategies, activities, and instructor tips
The learner will							
Elements and Compounds							
Differentiate between an atom and a molecule. **(CCT)**			✓				Use puzzle pieces to show ionic bonding. Study sugar substitutes. Look at all the uses of baking soda. What is smog made of?
Differentiate between elements and compounds. **(CCT)**			✓				
Identify the subatomic particles of an atom: neutrons, electrons, and protons. **(C) (VaD)**			✓				
Explain how an ion is formed. **(CCT)**				✓			
Read common ions from a table. **(C)**			✓	✓			
Distinguish between ionic bonding and covalent bonding. **(CCT)**	✓			✓			
Identify formulas of some common compounds: H_2O, NaCl, CO_2 **(N) (C)**			✓				

Matter – continued

Specific Learning Outcomes and Generic Skills	Order and Organization	Measurement	Systems	Patterns of Change	Ethics and Values	Technology	Suggested topics, strategies, activities, instructor tips:
The learner will							
Chemical Reactions							
Recognize that a chemical reaction involves reactants and products. **(CCT)**			✓				Research artificial flavours.
Recognize those characteristics which indicate that a chemical reaction has taken place (color change, formation of a gas, formation of a precipitate, emission of light, and absorption or production of heat). **(CCT)**				✓			Make Chemical Apple Pie (See Appendix B: Instructor Resources for Chemical Apple Pie recipe) Research permanents or hair colouring as chemical reactions.
Write a chemical reaction as reactants forming products. **(C)**	✓						Explore the elements and substances found in common household products such as detergent, cleaning agents, and bleach, as well as personal hygiene products such as gels, creams shampoo, nail polish, and deodorants.
Identify a chemical equation as balanced or not balanced. **(C) (N)**	✓	✓	✓				
Explain the Law of Conservation of Mass. **(CCT) (LL)**		✓	✓	✓			
Apply the Law of Conservation of Mass to explain the need for recycling programs. **(LL)**					✓	✓	Explore the chemical reactions in tanning, the process of drying fish and meat, and in making animal bait.
Recognize chemical reactions that occur in everyday life. **(LL)**				✓	✓		Research how food additives inhibit chemical reactions. Dissect an instant ice pack or make your own. Discuss how a combustion engine burns hydrocarbons.

Matter – continued

Specific Learning Outcomes and Generic Skills	Order and Organization	Measurement	Systems	Patterns of Change	Ethics and Values	Technology	Suggested topics, strategies, activities, instructor tips:
The learner will							
Acids and Bases							
Develop operational definitions of acids and bases. **(C)**			✓	✓			Use purple cabbage as an acid/base indicator. Look at advancements in the technology of measuring pH: litmus paper, universal indicator (liquid form, and pH paper), and digital meters. Find out how to prevent tooth decay. Research how stomach acid is released during times of chronic stress and how this is related to chronic stomach complaints. Find out how antacids work. Safety: Find out how to handle a chemical spill (e.g. after the derailment of a train carrying acid) Make soap.
Use chemical indicators to identify whether a solution is acidic, basic, or neutral. **(CCT)**		✓				✓	
Use the pH scale to identify acids and bases. **(N)**		✓	✓	✓			

Interrelationships

- Discuss how the anomalous behaviour of water allows for sustainability of life.
- Ask an Elder to talk about Aboriginal perspectives in relation to water.
- Invite an Elder to talk about how the four elements (earth, air, fire, and water) are used in a Sweat Lodge ceremony.
- Conduct experiments on the density of water.
- Investigate density:
    - Make whipped cream.
    - Find out how gases are liquefied for transport.
- Determine which elements and compounds are required to sustain life (e.g. iron, calcium, magnesium, water).
- Research air quality in a city such as Toronto or Calgary and in the learners' region. Investigate how air quality is measured, the impacts on health and environment, and what solutions might be utilized to improve air quality.
- Discuss diabetes or the scale used to measure blood pressure as analogies for the pH scale.

Reflective Questions

- Did I show how the Matter strand is part of the Energy and Life strands by looking at connections between them? Did I link chemical reactions which take in or give off energy or the chemical elements needed to sustain life for plants and animals (nitrogen, calcium, iron etc.)?
- Did I present the periodic table as a resource in which to find information and as an example of Patterns rather than something to be memorized?
- How did I address measurement and technology in this strand?
- In what ways did I ensure that other ways of knowing were acknowledged?
- Did I have to re-evaluate my own understandings of science so I could teach it in a holistic manner?

Energy

General Learning Outcomes

Learners will demonstrate a working knowledge of common types of energy used in everyday life so that they can make decisions about their daily use of energy and their dependence on it.

Learners will make choices and decisions about how energy production and usage affects the environment.

Specific Learning Outcomes and Generic Skills	Order and Organization	Measurement	Systems	Patterns of Change	Ethics and Values	Technology	Suggested topics, strategies, activities, instructor tips:
The learner will							
Describe the study of energy as the branch of science known as Physics. **(C)**	✓		✓				Use a concept map to illustrate how homes are heated.
Tell what energy is and identify various types of energy (heat, mechanical, electrical, food, chemical, kinetic, potential, sound, nuclear, and light). **(C)**			✓				Identify what kind of energy is used in a day.
Compare and contrast forms of energy. **(CCT)**				✓			
Examine conversions of energy between forms. **(N)**			✓	✓			
Assess the efficiencies of conversions of forms of energy. **(CCT) (LL)**					✓		
State the Law of Conservation of Energy.		✓					
Consider how light, sound, and electrical energy have an impact on our lives. **(LL) (CCT)**					✓	✓	

Generic Skills: *Communication **(C)**, Interpersonal Teamwork **(IT)**, Numeracy **(N)**, Creative and Critical Thinking **(CCT)**, Technological Literacy **(TL)**, Valuing Diversity **(VaD)**, Lifelong Learning **(LL)***

Energy – continued

Specific Learning Outcomes and Generic Skills	Order and Organization	Measurement	Systems	Patterns of Change	Ethics and Values	Technology	Suggested topics, strategies, activities, instructor tips:
The learner will							
Appreciate how technological developments affect culture and society. **(TL)**					✓	✓	Discuss, use a journal, or write a paper about how the first thirty minutes of the day would be different without technology.
Explore the consequences of decisions about individual and societal resource-use. **(LL) (CCT) (IT)**					✓	✓	Explore the impacts on hydroelectric dams on native communities.
Analyze the resources in Saskatchewan that are used in the production of energy. **(CCT) (LL)**					✓		
Investigate the personal and collective consumption of energy and the need for conservation of energy. **(IT) (LL)**					✓		Use a map of Saskatchewan to plot the use of energy resources. Research the type of jobs that are available in the energy, resource, and environment sectors.
Heat and Temperature							
Explain the difference between heat and temperature. **(N) (C)**	✓			✓			Discuss how a vehicle cooling system is used to transfer heat energy to prevent overheating.
Explain three ways heat can be transferred: convection, conduction, and radiation. **(C)**			✓				Look at building codes and current standards for insulation.
Measure temperature using a thermometer. **(N) (C) (TL)**		✓					Find out how a refrigerator works. Can you make cold? Investigate jobs in the heating and cooling trades.

Energy – continued

Specific Learning Outcomes and Generic Skills	Order and Organization	Measurement	Systems	Patterns of Change	Ethics and Values	Technology	Suggested topics, strategies, activities, instructor tips:
The learner will							
Heat and Temperature (con't)							
Know the units used to measure temperature. **(N) (C)**		✓					Analyze the design and construction of a Thermos ©.
Explain the role of heat in phase changes. **(LL)**			✓				How does an igloo, which is made of ice, stay warm inside?
Explain the Law of Conservation of Energy in relation to heat energy. **(C)**	✓	✓		✓			Research tipi construction for both summer and winter use.
Understand how heat can be provided to homes. **(LL) (TL)**						✓	Discuss how wigwam construction used moss between layers of birch bark to act as an insulator.
Understand how agencies calculate the cost of heat. **(N)**		✓					Discuss the construction of the poutowane (tipi fire pit) and the efficiency of the buffalo chips used as fuel.
Read and interpret a heating bill. **(C) (N)**		✓					
Assess the use and conservation of heat in daily life. **(IT) (LL) (CCT)**						✓	Evaluate heating bills by looking at costs.
Electricity							
Compare and contrast the characteristics of static and current electricity. **(IT)**			✓	✓			Log the amount of electricity used in one day.
Give examples of static and current electricity. **(LL)**	✓					✓	Be familiar with the unit in which power is measured (kWh).
Recognize the properties of static electricity. **(CCT)**	✓			✓			Research brown-outs and black-outs. Read an electric meter.

Energy – continued

Specific Learning Outcomes and Generic Skills	Order and Organization	Measurement	Systems	Patterns of Change	Ethics and Values	Technology	Suggested topics, strategies, activities, instructor tips:
The learner will							
Electricity (con't)							
Build simple parallel and series circuits. **(TL)**	✓					✓	Investigate Energy Star © appliances and the rebates offered for purchasing them. Imagine the first 30 minutes of the day with no electricity. Read electrical meters for usage and fill out the card. Discuss alternative energy sources: wind, solar, and cogeneration. Compare and contrast the energy efficiency of various light bulbs.
Explain the role of fuses, switches, and breakers in electrical circuits. **(TL)**			✓			✓	
Explain the Law of Conservation of Energy in relation to electrical energy. **(CCT) (C)**				✓			
Assess daily use of energy and potential conservation. **(LL)**					✓		
Understand how electricity is provided to homes. **(CCT)**						✓	
Understand how agencies charge for electricity. **(N)**		✓			✓		
Read and interpret a power bill. **(C)**		✓					
Assess use and conservation of electricity in daily life. **(CCT) (LL)**					✓		

Energy – continued

Specific Learning Outcomes and Generic Skills	Order and Organization	Measurement	Systems	Patterns of Change	Ethics and Values	Technology	Suggested topics, strategies, activities, instructor tips:
The learner will							
Force and Motion							
Define force as a push or a pull. **(C)**			✓				Invite a collision analyst to speak to the learners. Analyze braking distance and the coefficient of friction. Compare ice hockey, road hockey, and air hockey to investigate friction. Study how friction is used in the braking system of a bicycle or automobile. Compare motion and friction in traditional and contemporary modes of travel (e.g. dogsleds, canoes, and snow machines). Explore traditional trapping methods in relation to the role of motion, push, pull, speed, and force. Study crash test dummies and the statistics on seat belts and airbags.
Define motion as the result of unbalanced forces. **(CCT) (C)**			✓	✓			
Understand Newton's Three Laws of Motion. **(LL)**	✓		✓	✓			
Explain friction and its effects on an object in motion. **(CCT) (N)**				✓			
Identify the role of energy in motion. **(C)**				✓			
Apply the laws of motion to real world examples. **(LL)**	✓					✓	
Explain the law of conservation of energy in relation to motion. **(CCT)**	✓						
Define speed as a ratio comparing distance and time. **(N)**		✓					
Describe the concept of acceleration. **(CCT)**		✓					

Interrelationships

- Use an instant ice pack, or an instant heat pack, to illustrate the role of energy in an endothermic and exothermic chemical reaction.
- Explain how photosynthesis converts light energy into chemical energy to sustain life.
- Analyze the number of energy conversions in an object such as a toaster.
- Research energy production: dams, power stations, turbines (wind-powered and coal-burning), solar, geothermal.
- Look at the diets of other cultures to see how they provide food energy.
- Study pemmican as an energy source as well as the proper way to eat it to maximize the food energy provided.
- Use the combustion engine as a tool to teach the Law of Conservation of Energy.
- Study how fabric choice in various cultures affects the conservation of heat and energy.
- Ask students to explore the impact of resource extraction activities in their communities and how they might be improved using Aboriginal perspectives.

Reflective Questions

- Am I building on the learners' prior knowledge and the life experiences they bring to the classroom setting?
- Do I present science as a way of uncovering or discovering?
- Am I using the content to teach to the bigger ideas – the unifying concepts?
- Have I addressed the learners' affective domain (what learners feel and believe about how they will do in science)?
- How was I able to address Aboriginal perspectives in this strand?

Life

General Learning Outcome

Learners will understand the workings of the human body to make healthy lifestyle choices.

Specific Learning Outcomes and Generic Skills	Order and Organization	Measurement	Systems	Patterns of Change	Ethics and Values	Technology	Suggested topics, strategies, activities, instructor tips:
The learner will							
Describe the study of life as the branch of science known as Biology. **(CCT)**	✓		✓				Perform an experiment on plants changing one variable necessary for life (sunlight, water, salinity of water, fertilizer, etc). Use a lab to study an onion skin cell. Differentiate between plant and animal life using native languages and traditional classification systems. Ask an Elder to speak about the connectedness between humans, plants, and animals, and how this connectedness is represented in the art, symbols, crafts, and ceremonial regalia of Aboriginal peoples.
Distinguish between living and nonliving organisms. **(CCT)**				✓			
List those attributes of life shared by all organisms. **(CCT)**			✓	✓			
Differentiate between plant and animal life.			✓				
Look at the differences in plant and animal cells.			✓	✓			
Prepare a wet mount slide and view it using a microscope. **(TL)**		✓				✓	

Generic Skills: *Communication **(C)**, Interpersonal Teamwork **(IT)**, Numeracy **(N)**, Creative and Critical Thinking **(CCT)**, Technological Literacy **(TL)**, Valuing Diversity **(VaD)**, Lifelong Learning **(LL)***

Life – continued

Specific Learning Outcomes and Generic Skills	Order and Organization	Measurement	Systems	Patterns of Change	Ethics and Values	Technology	Suggested topics, strategies, activities, instructor tips:
The learner will							
The Human Body							
Describe the human body as independent and interdependent systems. (e.g. reproductive, cardiovascular, skeletal, digestive, nervous, muscular) **(CCT)**	✓		✓				Study the muscular system and look at how muscles need oxygen to function. Research physical activity to determine which activities are aerobic and which are anaerobic.
Understand the order of cells, tissue, organs, and systems. **(CCT)**	✓		✓				
Describe the basic functions of a system of the human body. **(LL)**	✓			✓			
List all the major organs of particular body systems and their primary function. **(LL)**	✓		✓				
Research the factors that affect specific systems: viruses and bacteria, nutrition, smoking, drugs and alcohol, chronic and acute diseases. **(IT) (LL)**			✓	✓	✓		Investigate if there is a danger in being too clean.
Describe some of the bodies' own defence mechanisms (e.g. tears, white blood cells, mucus, cilia). **(C)**			✓				Explore traditional ways of cleansing the body: sweating, talking, crying, shouting, praying, shaking, and walking.

Life – continued

Specific Learning Outcomes and Generic Skills	Order and Organization	Measurement	Systems	Patterns of Change	Ethics and Values	Technology	Suggested topics, strategies, activities, instructor tips:
The learner will							
The Human Body (con't)							
Explain the importance of sleep for the health of a human body. **(LL)**	✓	✓		✓	✓		Trace the origins of modern medicines to find their traditional beginnings. Discuss the relationship between traditional ceremonies and health. Explore the impacts of television in communities – poverty, sedentary lifestyles, and effects on health (diabetes, obesity).
Compare different ways of maintaining health: traditional medicines, holistic medicine, naturopathic medicine, Western medicine. **(TL) (CCT)**					✓		
Nutrition							
Consider the effects of good and poor nutrition on the human body. **(LL) (CCT)**		✓	✓		✓		Research and analyze fad diets. Create a healthy week-long meal plan. Bring traditional foods such as pemmican, wild berries, wild teas, wild mushrooms, and other natural foods such as dried fish. Determine the nutritional purpose of each food or ingredient. Ask learners to document the entire process of making pemmican, including photographs, explanations, and samples of the product. Use the information on a food label to calculate the number of calories from grams of fat, protein, and carbohydrates.
Become familiar with the Northern and Canadian Food Guides. **(C) (LL)**	✓	✓			✓		
Describe the role of proteins, fats, carbohydrates, water, vitamins, and minerals in a balanced diet. **(LL)**		✓	✓		✓		
Understand the unit used to measure food energy is the calorie. **(N)**	✓	✓					
Read a food label. **(N) (C) (CCT)**	✓	✓			✓		

Life – continued

Specific Learning Outcomes and Generic Skills	Order and Organization	Measurement	Systems	Patterns of Change	Ethics and Values	Technology	Suggested topics, strategies, activities, instructor tips:
The learner will							
Reproductive System							
Name the parts of the male and female reproductive systems. **(LL)**	✓						Research STDs by collecting and reading pamphlets.
Know how the reproductive system works. **(LL)**			✓				
List precautions against sexually transmitted diseases. **(C) (LL)**					✓		Conduct a simulation lab on the transmission of STDs. (See Appendix B: Instructor Resources for instructions)
Understand methods of birth control. **(TL)**					✓		
Explain signs of pregnancy and describe the major stages of human development from conception to early infancy. **(C)**	✓	✓	✓				Invite a female Elder to talk about traditional birthing, midwifery, birthing ceremonies, and other life passage rituals.
Outline the factors that contribute to good prenatal care. **(LL)**				✓	✓		
Understand the basic principles of heredity. **(LL) (CCT)**				✓			
Explain how genetic traits are passed from parents to offspring **(VaD) (CCT)**				✓			Examine family albums to look at traits passed through generations. Use Punnet Squares to predict eye colour and relate this to probability in Level Three Math.

Life – continued

Specific Learning Outcomes and Generic Skills	Order and Organization	Measurement	Systems	Patterns of Change	Ethics and Values	Technology	Suggested topics, strategies, activities, instructor tips:
The learner will							
Reproductive System (con't)							
Describe how dominant and recessive genes result in variations in offspring. **(VaD)**		✓					Look at hereditary traits like Morton's toe, tongue rolling, blue eyes/brown eyes, and genetic diseases such as cystic fibrosis. Invite a group of Elders to come and share their perspectives on controversial issues related to science such as the manipulation of life in genetic engineering.
Discuss the nature of various hereditary conditions and disorders. **(VaD)**			✓	✓			
Discuss current issues involving genetic engineering (plant or animal). **(LL)**					✓	✓	

Interrelationships

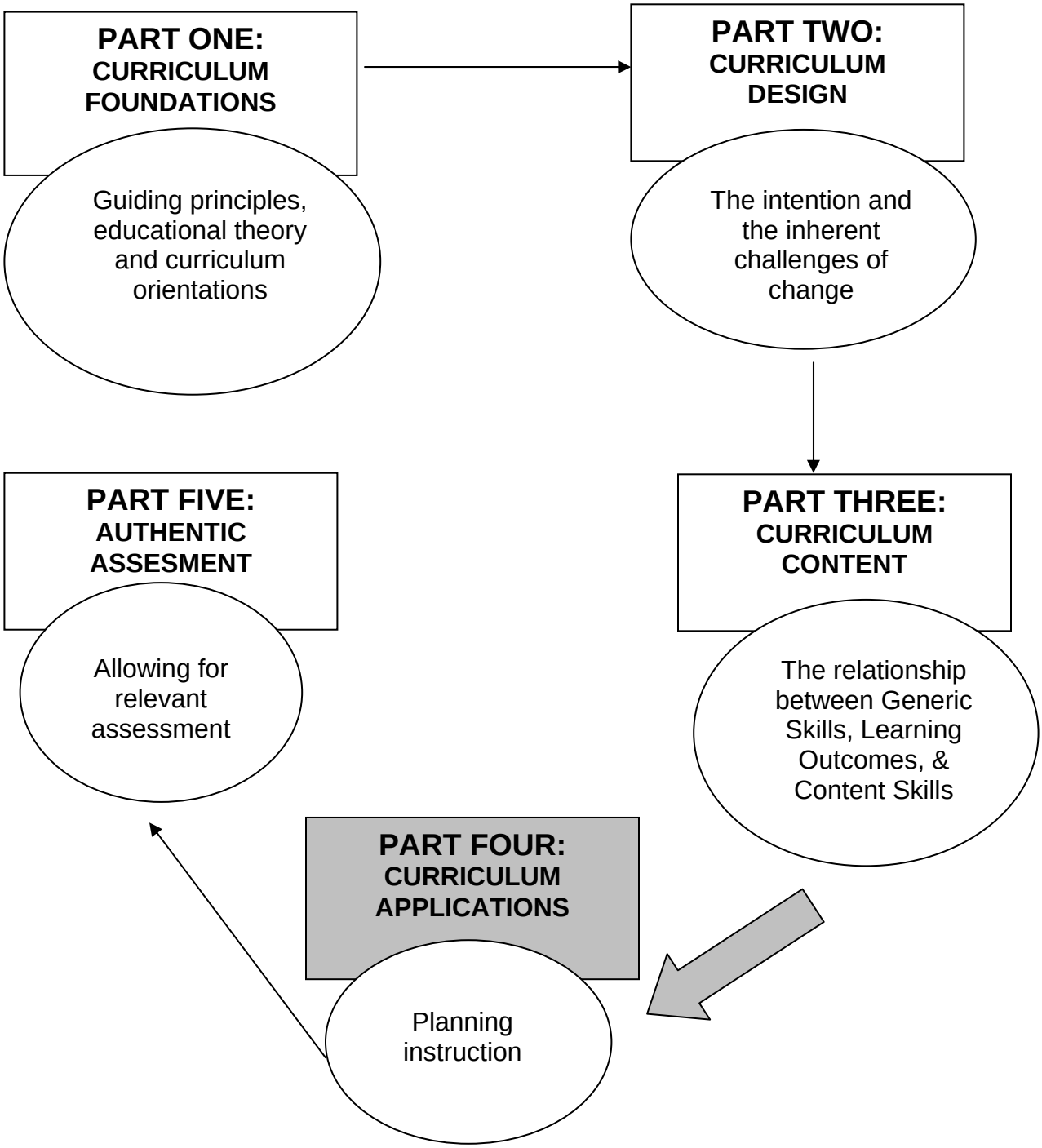
- Study chemical reactions within the human body. (e.g. digestion of food, respiration process, and the "burning" of food to produce energy)
- Address the Unifying Concept of Systems by looking at the water and nitrogen cycles as supports to sustaining life.
- Do water quality tests and look at chemical compounds added or removed.
- Look at the cycle of life of plants and animals and incorporate other ways of knowing (how other cultures might understand the cycles).

Reflective Questions

- Have learners acquired information and knowledge through a problem-solving or inquiry-based approach?
- Did I integrate community resources and supports (health care organizations, public health nurses etc.) and talk about learner access to them?
- Do my instructional strategies and assessment techniques parallel one another?
- What evidence is there that learners are building Generic Skills in the context of science?

PART FOUR:
CURRICULUM APPLICATIONS

The Curriculum Roadmap:



Chapter Seven: From Curriculum to Course

Part Three of the curriculum guide outlined the content and general and specific learning outcomes, and explained how these can be used to weave together the common threads of the curriculum – Unifying Concepts and the Foundations of Scientific Literacy. By approaching instruction in this way learners develop their own understandings of science and become scientifically literate, as defined in Part Three.

Designing a course from the curriculum requires the incorporation of the fundamental components of the curriculum, including:

Foundations of Scientific Literacy	Unifying Concepts	Content Strands
• Habits of Mind • Generic Skills • Processes of Science • Ways of Knowing	• Order and Organization • Measurement • Systems • Patterns • Ethics and Values • Technology	• Interrelationships • Integrated Science • Matter • Energy • Life

In this chapter, strategies for designing instruction have been organized into five sections. The following are defined and described to help instructors when they design their courses:

- **Tenets of Effective Instruction;**
- **Teaching Conceptually;**
- **Being Culturally Responsive;**
- **Teaching Contextually; and**
- **Planning: The Bridge between Theory and Practice.**

This chapter also provides several suggestions to help instructors plan or design courses in which the components of Part Three are included intentionally, not incidentally. There are practical suggestions for activities, themes, and strategies, as well as sample planners to help instructors align activities, lessons, or themes to the curriculum.

1. Tenets of Effective Instruction

What does it mean?

A provincial mathematics forum, the theme of which was “Creating a Culture of Success”, was held May 5, 2006, at the University of Saskatchewan. In the First Nations/Métis working group, discussions included what mathematics should be, how it can be taught, and how learners could benefit. It was agreed that these instructional approaches would prove effective for all learners in any subject, including Science. According to the working group, instruction should be:

- Application based;
- Purposeful to the learner;
- Accepting of a variety of answers;
- Holistic and based on high context;
- Based on personal strengths; and
- Focused on the depth, rather than the breadth, of a subject.

What will it look like?

The *National Science Education Standards (NSES)* outlines changes in emphases that can be made to meet the teaching standards and content standards for science. These are in alignment with, and support the direction of, Level Three Science and as described, correlate with the summary above. The following are adapted from the NSES (Center for Science, Mathematics, and Engineering Education, 1996, chapters 3 and 6).

Less Emphasis On:	More Emphasis On:
Focusing on student acquisition of information.	Focusing on student understanding and use of scientific knowledge, ideas, and inquiry processes.
Presenting scientific knowledge through lecture, text, and demonstration.	Guiding students in active and extended scientific inquiry.
Knowing scientific facts and information.	Understanding scientific concepts and developing abilities of inquiry.
Studying subject matter disciplines (physical, life, sciences) for their own sake.	Learning subject matter disciplines in the context of inquiry, technology, science in personal and social perspectives, and history and nature of science.
Covering many science topics.	Studying a few fundamental science concepts.
Testing students for factual information at the end of the unit or chapter.	Continuously assessing student understanding.

How does this translate to Adult Basic Education Level Three Science?

By combining the best practices for teaching adults, the philosophy underlying Adult Basic Education curriculum renewal, and the foundations of science education discussed in Parts Three and Four, it is evident that an effective instructor should:

Begin where the learner is …

- Recognize prior knowledge and understanding in all forms, including personal, cultural, and scientific. Learners are not empty vessels to be "filled" with knowledge: they already possess knowledge.
- Address perceived notions learners have of their abilities, expect excellence, and instil in learners the belief they can succeed.

Teach learners how to learn…

- Develop the Habits of Mind and Generic Skills necessary to become lifelong learners.
- Utilize the Processes of Science to encourage participation in society at different levels: within the family unit, the workplace, community, province, and country by asking questions, solving problems, and making decisions.

Teach conceptually…

- Use the content as the means, not the focus, to teach holistically, concentrating on the deeper, conceptual understandings more than on the shallow, fact-based dissemination of information.
- Encourage learners to develop, define, and understand their own opinions of what science is and its role in society.

Guide and facilitate learning…

- Create a balance between instructor and learner by sharing responsibility for learning. Learners should be inquiring and asking questions, as well as making connections to their world. Let learners' questions guide their learning.
- Adapt instruction to respond to the individual's needs (learning styles, experience, strengths, and interests).
- Make learning relevant to learners' lives.

Assess continually and authentically…

- Align curriculum, instruction, and assessment.
- Use assessment tools that indicate what learners know rather than what they do not.
- Create and use multiple methods of assessment.
- Use assessment to evaluate and reflect on instructional strategies.
- Assess for reasoning, not recall, by assessing continually.
- Involve learners in the assessment process.

2. Teaching Conceptually

What does it mean?

To understand concepts, learners draw on their repertoire of skills, habits of mind, knowledge, and processes of science to make decisions and to solve problems. The straight recollection of facts or the performance of step-by-step tasks and exercises does not result in meaningful learning. Low level memorization and rote learning are not sufficient. Learners must understand concepts and internalize knowledge to be able to use that knowledge in the performance of complex tasks.

Looking at science topics and facts through a conceptual lens consolidates knowledge for learners. Rather than concentrating on the facts and content, the learning will be focused on the essential understandings of the Unifying Concepts of Science. For instructors, this means a paradigm shift from teaching topics to "using" them to teach and to assess deeper, conceptual understandings*. The topics and facts should be used as tools to help learners develop deeper understanding and a more holistic knowledge of science.*

The choice the instructor makes when beginning to teach conceptually will depend on her comfort level and own framework of understanding of science content. If an instructor has a strong background of scientific knowledge, she may not need to spend as much time on the content or the specific learning outcomes. She can begin to orchestrate instruction around the Unifying Concepts, aligning the content with the concepts. All content in the five strands is taught through a conceptual lens, which is outlined in Unifying Concepts in Part Three.

An example of conceptual teaching is using the Unifying Concept of Measurement to make links between the five strands by always connecting the content in each of the strands back to the ideas of measurement. This solidifies learners' understanding by taking a constructivist approach, and building continually on what they know about measurement. Rather than learning about the five strands of measurement, they learn about measurement in five ways.

The following chart on the illustrates this type of conceptual teaching strategy.

Order and Organization	***Measurement***	***Systems***	***Patterns of Change***	***Ethics and Values***	***Technology***
Interrelationships Integrated Science Matter Energy Life	Interrelationships Integrated Science Matter Energy Life	Interrelationships Integrated Science Matter Energy Life	Interrelationships Integrated Science Matter Energy Life	Interrelationships Integrated Science Matter Energy Life	Interrelationships Integrated Science Matter Energy Life

An instructor who needs to spend more time familiarizing himself with the content may begin by focusing on content and including the Unifying Concepts where appropriate, or by asking learners how they see the content fitting into their understanding of what science is.

The following chart shows how an instructor may choose to deliver the course by ensuring that the Unifying Concepts are taught within each content strand. For science to be unified with the aforementioned concepts, each concept should be presented in each unit. The specific learning outcomes should then be used as ways to address the larger ideas in science – the Unifying concepts.

Interrelationships	***Integrated Science***	***Matter***	***Energy***	***Life***
• Order and Organization • Measurement • Systems • Patterns of Change • Ethics and Values • Technology	• Order and Organization • Measurement • Systems • Patterns of Change • Ethics and Values • Technology	• Order and Organization • Measurement • Systems • Patterns of Change • Ethics and Values • Technology	• Order and Organization • Measurement • Systems • Patterns of Change • Ethics and Values • Technology	• Order and Organization • Measurement • Systems • Patterns of Change • Ethics and Values • Technology

What will it look like?

Content should be taught as a means of understanding concepts, so during the planning process instructors should consider how the lesson, activity, or project is a part of the Unifying Concepts or how it links to the Unifying Concepts and Foundations of Science.

For example, the Law of Conservation of Energy is a topic from the Energy strand, and the Law of Conservation of Mass is a topic from the Matter strand. Rather than teaching them as separate and seemingly unrelated topics, these can be taught as examples of Systems or Patterns of Change. Building on the concept focuses on what learners already know and minimizes the seemingly large amount of content. There is depth to learning, rather than breadth.

When teaching about the human body, instructors could start with the content at the cellular level, move to tissues and organs, then to particular organs with the body, and finally to the human body. The relationship to the Unifying Concepts of Systems, Patterns of Change, and Order and Organization should be addressed at all times.

Conversely, if instructors begin with the human body as the concept (with a Systems and Patterns of Change approach) and focus on decisions that have an impact on the body, then this would necessitate looking at the intricate workings and makeup of the human body as a whole. The human body can be seen as an organized and orderly

system that reacts to forces and changes made upon it, such as foods, drugs, disease, sleep, and exercise. Learning the content reinforces the connectedness of the Unifying Concepts.

3. Being Culturally Responsive

What does it mean?

According to Stephens (2000), to be culturally responsive is to

> attempt to integrate Native [multicultural] and Western knowledge systems around science topics with goals of enhancing the cultural well being and the science skills and knowledge of students. It assumes that students come to school with a whole set of beliefs, skills and understandings formed from their experiences in the world, and that the role of school is not to ignore or replace prior understanding, but to recognize and make connections to that understanding. (p. 7)

Instructors need to have their own understanding of what science is. It is not wrong to teach "Western science" and be confident of how it is understood. Perceptions are powerful, but instructors may impose their perceptions on others without realizing it because their understandings are part of their own cultural and personal frameworks of understanding. But there are other ways to understand science, and it is necessary to be highly sensitive to this and recognize, as Dr. Cecil King, Elder, stated in his opening address at the Provincial Math Forum held at the University of Saskatchewan, "… culture [and personal understanding] is an integral part of a person's being, [and is] not to be seen as an impediment" (May 2006).

Aboriginal Perspectives

Only Elders and other Traditional Knowledge Keepers who hold and share the knowledge can guide instructors and learners in using traditional teaching methods. But what the instructor can do is use the different gifts of people and Aboriginal ways of conveying that knowledge to teach science[23]. As Sammel (2005) states "To teach from these Saskatchewan Aboriginal perspectives, means teaching and learning about the sacredness of everything and how interconnectedness and patterns offer insights into a person's ability to generate change" (p. 17).

[23] Many of the ideas in this chapter were suggested by Herman Michell (First Nations University of Canada), in an unpublished working document titled *Science Education in Aboriginal Contexts: Instructional Strategies* (2007).

What will it look like?

- Teach science, not just as a subject for the mind, but also as one for the spirit, heart, and body. Ask learners how they feel about a scientific issue such as genetic engineering or methods of crop and food production.
- Teach science holistically by taking a topic and learning everything possible about it. Teach from the whole to the parts.
- Teach particular subject matter at the appropriate times and follow natural cycles. Just as the Medicine Wheel represents natural cycles, so can the course.
- Make learning purposeful, and be respectful of the interconnectedness of all things.
- Ask, if not sure, of the proper protocols when approaching Elders. Be aware that some Elders may not share openly for many reasons, some of which have to do with historical traumas, intellectual piracy, and misuse of Traditional Knowledge.
- Meet with guests prior to having them in class and let them know what piece of knowledge they have that is connected to what is being learned.
- Use Aboriginal approaches to educating: experiential learning, hands-on activities, observation, natural contexts, Elder guidance, apprenticeship, storytelling, drawing, painting, singing, drumming, drama, ritual and ceremony, dreaming and imagination, and intergenerational teaching.
- Be as concrete as possible and form a connection to why something is being learned in the first place. Begin with the practical and connect to the theory. Emphasize the application of knowledge.
- Use language from the learners' culture if possible. Ask the learner if necessary. If there are no equivalent scientific terms learners can explain processes in their own language.

4. Teaching Contextually: Connecting to Science

What does it mean?

Knowledge needs to be relevant, transferable, and purposeful. "Deep knowledge transfers across time and cultures and provides a conceptual structure for thinking about related and new ideas" (Erickson, 1998, p. 7). The contexts in which these essential understandings are taught can, and should, vary to meet unique learner needs and situations. Factors such as geographical location, regional characteristics, prior learning experience, interest, cultural and personal knowledge, as well as current social issues and concerns, should be guiding factors in how the facts and content will be used to teach the essential understandings of science. As the Centre for Occupation Research and Development (2007) found

> contextual learning theory focuses on the multiple aspects of any learning environment, whether a classroom, a laboratory, a computer lab, a worksite, or a wheat field. It encourages educators to choose and/or design learning environments that incorporate as many different forms of experience as possible (social, cultural, physical, and psychological) in working toward the desired learning outcomes. (para 6)

What will it look like?

Various instructional strategies support contextual learning, including

- teaching science through workplace applications;
- incorporating Aboriginal perspectives;
- using a thematic approach;
- researching a topic using a project-based approach;
- encouraging an inquiry-based approach; and
- ensuring interdisciplinary connections.

Links and connections between and among these six strategies can be identified as they have common components.

a. Connecting Science and the Workplace

A foundational element of adult education is to make the learning of any subject relevant to the learners' lives. Teaching science through a workplace context is one way to address the "real world" applications of scientific knowledge and skills. Investigating workplace uses of science and technology can be more engaging for learners by making subject matter more relevant, which in turn fosters real learning. Britton, Huntley, Jacobs, and Weinberg (1999) found that

> Students should not just *know* science and mathematics; they should be able to *do* science and mathematics. While school science and mathematics activities typically lean toward prescribed laboratories and exercises, workplace problems usually are open-ended investigations with multiple solution paths; these are experiences that not only reflect the way the real world works, but also that better reflect the type of learning called for. (p. 7)

Workplace requirements have changed dramatically and have had a direct impact on curricula. The Conference Board of Canada (2006) identifies the scientific, technological, and mathematical competencies for the workplace, which provides a direct link between The Level Three Science Curriculum and a workplace context. These are

- A Sound Footing: the foundation to use science, technology and mathematics as a way of knowing, communicating and making decisions;
- A Basic Understanding: the competencies needed to understand how science, technology and mathematics are used in the world of work; [and]
- An Ability to Apply: the competencies needed to make science, technology and mathematics work for you. (http://www.conferenceboard.ca/education/pdf/literacy.pdf)

Britton, Huntley, Jacobs, and Weinberg, (1999) suggested six ways in which science can be connected to the workplace. The first four are considered to be conceptually

rich (or stronger) while the last two are the most common kinds of connections found in resources or in the classroom:

- Providing students with workplace experiences;
- Simulating workplace activities in the classroom;
- Adding mathematics, science, or topics found in the workplace to the school curriculum [course];
- Using workplace examples to explain subject matter;
- Illustrating how mathematics, science or technology is used in different occupations; and
- Obtaining information from workplaces. (p.11)

The fields of forestry, agriculture, mining, oil and gas production, and aesthetics can be used as contexts for learning. Food handling safety courses, Workplace Hazardous Materials Information System (WHMIS), and Material Safety Data Sheets (MSDS) provide workplace contexts in which science can be taught, helping learners gain marketable skills and further employment options by attaining certifications in these areas.

b. Incorporating Aboriginal Perspectives

The integration of traditional knowledge with "Western" science is achieved by looking at the commonalities between the two. Stephens (2000) describes an approach to science which can provide learners with a rich and relevant education that honours and respects both ways of knowing. Some of the approaches will seem familiar from previous sections of this curriculum:

Organizing Principles
- Universe is unified
- Body of knowledge stable but subject to modification

Habits of Mind
- Honesty, inquisitiveness
- Perseverance
- Open-mindedness

Skills and Procedures
- Empirical observation in natural settings
- Pattern recognition
- Verification through repetition
- Inference and prediction

Knowledge
- Plant and animal behaviour, cycles, habitat needs, [and] interdependence
- Properties of objects and materials
- Position and motion of objects
- Cycles and changes in and sky (p. 11)

Stephens (2000, p. 17) goes on to suggest topics that blend traditional knowledge and "Western science". These could be used as themes or units of instruction to incorporate Aboriginal perspectives, address the learning outcomes of this curriculum, and encourage the learners to move towards scientific literacy, all the while honouring all ways of knowing and understanding science.

Topics for Common Ground

Medicinal and Edible Plants
River dynamics
Food Gathering and Preservation
Animal Behaviour and Habitats
Tides
Tools and Technology
Land forms
Anatomy
Weather
Seasons
Navigation
The Making of Pemmican[24]
Erosion and Relocation
Snow and Ice
Shelter and Survival
Use of Local Materials

Promising Practices[25]

- Be aware that Aboriginal cultures are diverse and there are cultures within cultures. Work to become aware of differences and similarities.

- Many Aboriginal learners learn best by seeing the practical applications of science in their everyday lives. Start from what the learner is familiar with and incorporate one aspect at a time with the newer learning aspects. Focus on community concerns, issues, and problems. Use local language terms. The idea is to make learning relevant by connecting with their everyday lives.

- Show how Traditional Aboriginal values are relevant to modern day society and how they can guide scientific decision-making and social action.

- Aboriginal learners may have cultural customs that prohibit them from performing certain observations or manipulation of plant and animal life in hands-on inquiry-based science lessons. Use alternate activities to study the same scientific principles without violating their beliefs. For example, if they are prohibited by their culture to kill other than for survival, they can ask local hunters to invite them to a "kill site" in order to examine the anatomy within context.

- Allow learners an opportunity to explore Indigenous ways of coming to know the natural world by using Indigenous methodologies. The practices of traditional ways of seeking, receiving, recording, sharing, and celebrating knowledge as integral aspects of the process develop a more complete understanding of the world.

[24] See Appendix B: Instructor Resources – Background Information on the Making of Pemmican.
[25] Adapted from an unpublished working document by Herman Michell (First Nations University of Canada), *Science Education in Aboriginal Contexts: Instructional Strategies* (2007).

- Introduce classroom discussions that revolve around cultural traditions, beliefs, taboos, and protocols that will be enriching for all students, while promoting cross-cultural appreciation.

- Instructors need to be aware of unique interpersonal mores of the cultures of learners, including eye contact, body contact, direct questioning, and issues related to control and authoritarianism over nature. Some Aboriginal learners prefer praise in private so that they do not appear to be more superior to their peers.

- Use resources that acknowledge contributions of diverse cultures and people, and include multiple narratives of scientific discoveries to personalize science. Students of diverse backgrounds will relate better and more proudly to science and scientists if they are able to study contributions from diverse cultures.

c. Thematic Approach

A theme-based approach creates a holistic learning environment that recognizes the knowledge learners bring with them. Themes integrate learning outcomes from other subject areas as well as from other parts of the curriculum guide. Themes usually address a topic, issue, or concern that learners wish to discuss or learn about. One way to develop a theme is to draw an individual or group concept map during a brainstorming session. The process could be instructor or learner-driven.

A thematic approach organizes the curriculum by connecting learning outcomes to authentic learning contexts. This facilitates learning by:

- Building on learners' life experiences and creating relevance and motivation for the learners, especially when they have a role in choosing the theme;
- Building knowledge through connections that relate prior knowledge and new knowledge;
- Illustrating the purpose behind the learning because it incorporates real world applications; and
- Erasing lines between subject areas in an interdisciplinary approach.

Theme ideas

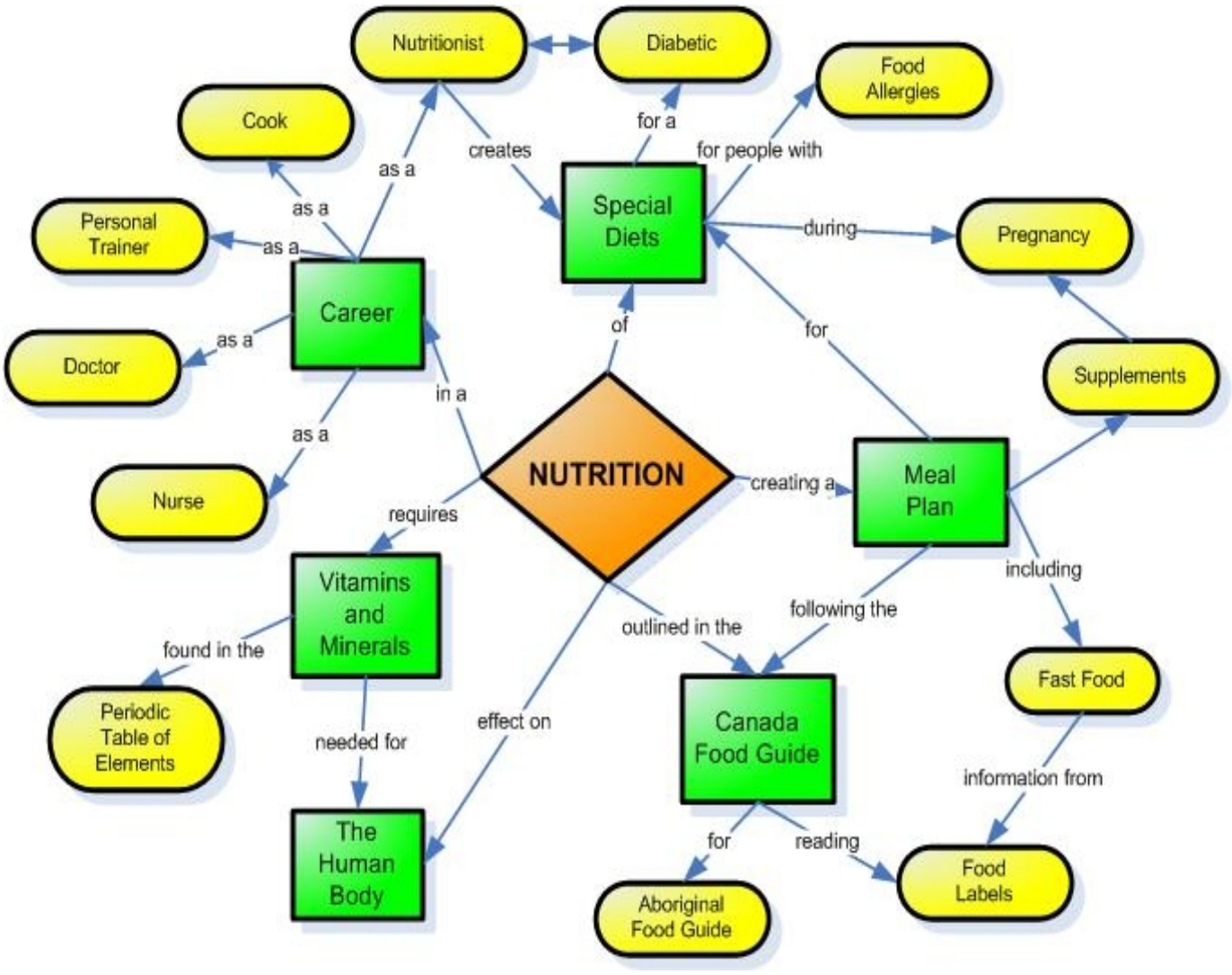
- Healthy Living
- Chemicals in Consumer Products
- Science in the Media
- Drug, Alcohol, and Tobacco Awareness
- Science and the Law
- Natural Phenomena
- Climate Change
- Water Quality
- Sustainability of Resources
- Resource Extraction and the Impacts on Environment and Community
- Medical "Advancements"
- The Environment
- Moose Hunting Activities
- Go to a traditional culture camp site to learn about the anatomy and physiology of various animals.

Developing a Theme-Brainstormed Web

Developing a Theme

The following diagram is an example of a web which uses nutrition as a theme. There are endless possibilities to the connections among the topics. Once the connections have been identified, the instructor can then correlate the topics to strands and learning outcomes in the curriculum, and connect to the Foundations of Scientific Literacy, the Unifying Concepts, and align assessment.

Example of a Theme-Brainstormed Web



d. Project-based Learning

Project-based learning emphasizes learning that is complex, long term, interdisciplinary, learner-centred, and integrated with real world issues and practice. The projects are authentic, yet adhere to a curricular framework. While it may seem that this approach is unstructured, it is not – it is the learning processes that are structured. Instructors can guide learners in these processes to study real world topics or issues in-depth.

The project is usually a part of the course. It could be used as a final assessment for a unit or the course: it is not likely something that can be completed in one or two classes.

When choosing a project, instructors should identify those topics that reflect the most important ideas and concepts in the curriculum and then incorporate the topics into projects. Those are the topics on which the learners should focus: the remaining topics can be dealt with through direct instruction.

The results of project-based learning will be unique to each learner and it is important to remember that there is no one right methodology or answer. It is essential that each project emphasizes critical reflection, that is, the learners are asked to reflect on

- how the project was handled;
- why it was handled in a particular way; and
- what the end product was.

Project Ideas

- Compare and contrast a traditional technology or way of knowing with “Western” science.
- Study the impact of agriculture on species such as the burrowing owl or the Swift fox.
- Investigate “low tech”, economical ways to make a home more energy efficient. (e.g. putting plastic coverings on windows, closing and opening blinds, using draft stoppers)
- Plan garden projects that have direct benefits for communities, such as a community garden.
- Examine the size of the “ecological footprint” and ways to reduce it.
- Investigate environmentally-friendly consumerism.
- Compare and contrast a traditional and a modern solution to a problem.
    - What factors were used to make the decisions?
    - What were the impacts of the solutions?
- Research a local issue (e.g. garbage disposal, the impact of mining on a community or ecosystem, initiating a recycling program).
- Look at how different places deal with the same issues (e.g. public transportation, water treatment, city development).
- Maintain a worm farm (See www.garbagedelight.com)
- Apply scientific principles when constructing snowshoes, a canoe, or a kayak.

e. Inquiry-based Learning

Learning science through an inquiry-based approach should not be an isolated, one-time occurrence. It should be an ongoing, comprehensive, flexible process that goes beyond the learner asking questions and following a sequence of steps labelled as "the scientific method". Haury (2001) states

> Though inquiry-based teaching strategies typically engage students in investigations, it is not the physical activity that defines inquiry. Teaching through inquiry is distinguished by its emphasis on a questioning attitude, gathering data, reasoning from evidence, and communicating explanations that can be justified by available data. (p.1)

This instructional approach is being strongly endorsed by the *National Science Education Standards* (1996). According to The National Research Council (2000) there are five essential features involved in inquiry teaching and learning:

- Learners are engaged by scientifically oriented questions.
- Learners give priority to **evidence**, which allows them to develop and evaluate explanations that address scientifically oriented questions.
- Learners formulate **explanations** from evidence to address scientifically oriented questions.
- Learners evaluate their explanations in light of alternative explanations, particularly those reflecting scientific understanding. (Table 2-5)

Llewellyn (2002) found that "In inquiry-centred classrooms, teachers provide open-ended experiences that lead students to raise their own questions and design investigations to answer them" (p.8). Inquiry is a learning strategy. This, again, is a shift in the method of instruction. While the content is not emphasized, knowledge gained as a result of the inquiry process. It is the process that is important.

Ways to promote inquiry

- Science fair projects[26]
- Go to a museum
- Use the Internet
- Watch a film
- Discuss family traditions and remedies
- Do a demonstration that contradicts commonly-held beliefs about how something works.
- Pursue any inquiries given voluntarily in class with more questions.
- Read an article.
- Create an environment of wonder.
- Facilitate the process of learners finding something out on their own rather than giving them answers.
- Allow learners to develop and use a multitude of scientific approaches to inquiry.

[26] See Appendix B: Instructor Resources – Topic Ideas for Science Fair Projects

f. Interdisciplinary Connections

Although curricula are written as separate documents, there are common threads that flow through all five Level Three subject areas. Instructors who teach more than one subject at Level Three can take advantage of the possibilities for interdisciplinary learning, while instructors who are subject-specialists may be able to collaborate with other instructors when planning.

One project or assignment can be assessed in more than one course. For example, a novel study using a scientifically-based book can be assessed for understanding and description of scientific principles and methods. The learner can write about the ethics and values of the characters. The writing process can be assessed in Communications, and the analysis of scientific content and understandings can be assessed in Science. The learner completes only one project, but applies a variety of skills from all areas. Instructors do not need to design five projects or assignments: learners complete one in-depth assignment which can be assessed in more than one way. This provides depth of learning over breadth and shows connections between subjects, necessitating the transfer and application of skills.

The following are examples of how Communications can be assessed in Science.

Communications Assessment	Oral	Uses speaking and listening skills to assess learners.	- Interview - Debate - Oral Presentation - Conference - Talking Circles - Story telling - Drumming/singing
	Written	Uses reading and writing to determine learners' achievement.	- Research Report - Lab report - Essay/research paper - Quizzes/exams - Open-ended questioning - Journaling
	Visual	Utilizes looking, creating, and interpreting visual materials to convey understandings.	- Build a game - Prepare a PowerPoint© or video presentation - Film critique - Portfolio - Graphic Organizer - Artwork - Dance - Role play

Suggestions for Interdisciplinary Studies:

- Conduct a case study on second-hand smoke, focusing on people such as Heather Crowe (a non-smoker who was diagnosed with lung cancer as a result of her work environment), and provincial smoking bans.
- Research a person who, in the field of science, acts or acted single-handedly to make a difference to society.
- Keep a reflective journal or log of "Science and the Media", including print and electronic sources.
- Job shadow a person who uses science in her job.

5. Planning - The Bridge between Theory and Practice

What does it mean?

Planning is a key component to bridge what research says are promising practices to what is being practised in the classroom. Planning can be a beneficial tool to show instructors that what they already do is in alignment with the curriculum. Instructors can apply the constructivist approach in self-reflection, beginning with what they already know or do, as well as in their instructional and planning methods by aligning a familiar project to the curriculum's learning outcomes and foundations.

Effective planning ensures that all the ideas and philosophies in this curriculum are being addressed in the delivery of the course. Instructors may wish to plan something new for a strand, unit, theme, or activity, but designing a new course does not mean that every activity or strategy that has been used before needs to be redesigned or removed from an instructor's repertoire.

What to teach is outlined in the learning outcomes. Why we teach in particular ways – promising practices – are guided by the foundations and the philosophies of the curriculum

What will it look like?

The following are sample planning tools for instructors to use in their own course design. The graphic design may or may not appeal to instructors, so they should feel free to take the premise of the planners and organize it in a manner that is workable for them. These are samples only, and are provided to take instructors through the process of planning. The end products may look quite different when used by different instructors. As the examples illustrate, they may be used with an existing instructional activity or for planning something new. Three planners are provided:

- Instructional Design Planner
- Interdisciplinary Theme-based Planner
- Comprehensive Planning Document

Instructional Design Planner – Sample

Activity/Project/Lesson/Unit/Theme: _____

Curriculum Content

These General Learning Outcome(s) will be covered:

These Specific Learning Outcome(s) will be covered:

Curriculum Foundations and Philosophies

What Foundations of Scientific Literacy (p. 42) do I want to emphasize?

How will I do this?

Curriculum Applications

How will I design my lesson/unit? (Group taught or individualized instruction, project-based, inquiry-based, a theme approach)

How will I teach conceptually?

What connections are there to the Unifying Concepts (p. 52)?

How am I being culturally responsive (p. 94)?

How have I incorporated Aboriginal perspectives (p. 97)?

What resources will I use?
Print materials

Media

People

Technology

Authentic Assessment

How will I assess learners?

How will I evaluate learners?

How will I reflect on the effectiveness of this lesson/unit/activity?

Instructional Design Planner – Sample

Activity/Project/Lesson/Unit/Theme: ***My Ecological Footprint***

Curriculum Content

What General Learning Outcome(s) will be covered?

Interrelationships
- Learners will explore the interconnectedness of matter, energy, life, culture, society, technology, and environment to determine the purpose of science and its role in people's decision-making and problem-solving.

Energy
- Learners will demonstrate a working knowledge of common types of energy used in everyday life so that they can make decisions about their daily use of energy and their dependence on it.
- Learners will make choices and decisions about how energy production and usage affects the environment.

What Specific Learning Outcome(s) will be covered?

Interrelationships
- Realize the impact one person has on problems and solutions.

Energy
- Explore the consequences of decisions about individual and societal resource-use.
- Investigate the personal and collective consumption of energy and the need for conservation of energy.
- Assess use and conservation of electricity and heat in everyday life.
- Explain the law of conservation of energy in relation to heat and electrical energy.
- Assess the efficiencies of conversions of forms of energy.

Curriculum Foundations and Philosophies

What Foundations of Scientific Literacy do I want to emphasize?

Ways of Knowing
- Personal Knowledge and Aboriginal Knowledge

Habits of Mind
- Choices – Type/amount of energy use and ways to change the way energy is used.
- Creativity – Ways to change lifestyle to reduce ecological footprint.

How will I do this?

Ask learners:
- What is the impact of my lifestyle on the environment?
- How can people live with a smaller ecological footprint?
- How does the traditional knowledge of Aboriginal people respect Mother Earth?
- What traditional knowledge can I use in my life to respect Mother Earth?

Curriculum Applications

How will I design my lesson/unit? (Group taught or individualized instruction, project-based, inquiry-based, a theme approach)

- Individualized/independent project – learners determine focus of project
- Research sites on eco-living and calculating the size of their ecological footprint.
  http://www.footprintnetwork.org/gfn_sub.php?content=footprint_overview
  http://www.reginaecoliving.ca
  http://www.royalsaskmuseum.ca/gallery/life_sciences/footprint_mx_2005.swf

How will I teach conceptually?

- Discuss the Concept of Sustainability (http://www.green-innovations.asn.au/sustblty.htm#scope)
- Use metaphors and illustrations drawn from daily life.

What connections are there to the Unifying Concepts?

- Systems – All systems are interconnected (all life on earth is interconnected).
- Ethics and Values – Have students ask themselves "Should I reduce the size of my ecological footprint?" "Why or why not?" "How can I do this?"
- Technology – What is the impact of technology on the environment? (e.g. hydroelectric dams, solar collection etc).

How am I being culturally responsive?

- Discuss a "Canadian" point of view with reference to energy use.
- Use examples from the cultures represented in the classroom.
- Use examples from cultures not represented in the classroom.

How have I incorporated Aboriginal perspectives?

- Ask a Traditional Knowledge Keeper to talk about traditional ways.
- Ask learners to provide examples from their own ways of knowing to connect with Western scientific thought.

What resources will I use?

Print materials
- Heating and power bills.
- Free materials from Environment Canada and local environmental organizations.

Media
- Movie “An Inconvenient Truth”.
- Television.
- Radio.
- Online newspapers, magazines.

People
- Elders or Traditional Knowledge Keepers.
- Representatives from Department of Natural Resources.
- Members of local environmental groups.

Technology
- Use the computer for research.
- Use the computer to create a portfolio (journal, PowerPoint © presentation, etc).

Authentic Assessment

How will I assess learners?

- Log of electricity/energy use.
- Research skills checklist.
- Rubric for final portfolio or journal entry.

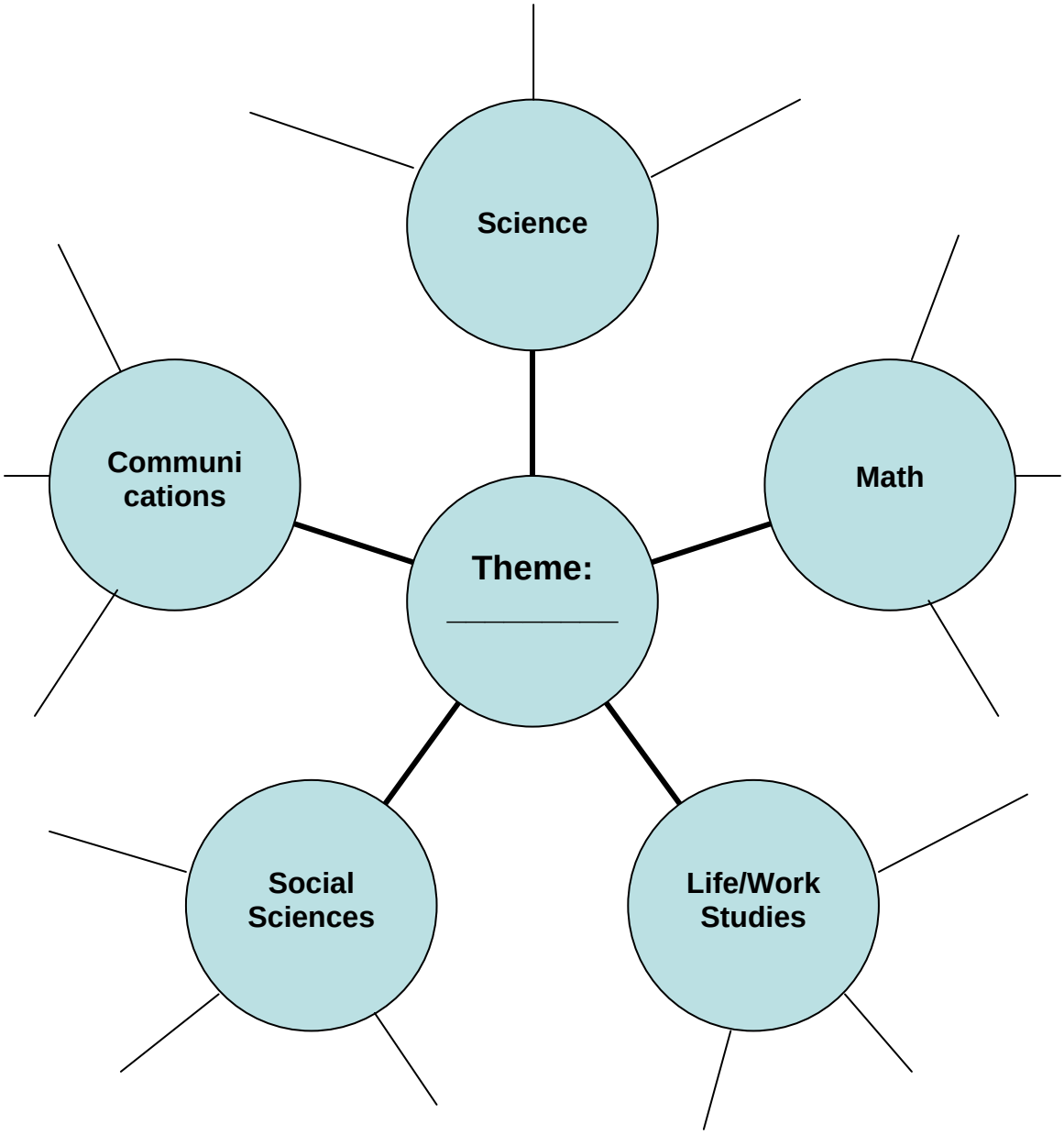
How will I evaluate learners?

- Hand in a final portfolio or journal entry which includes
- Justification for reducing or not reducing an ecological footprint;
- Assess sustainability of current lifestyle;
- Evidence of research on sustainability and the ecological footprint; and
- A plan to reduce it.

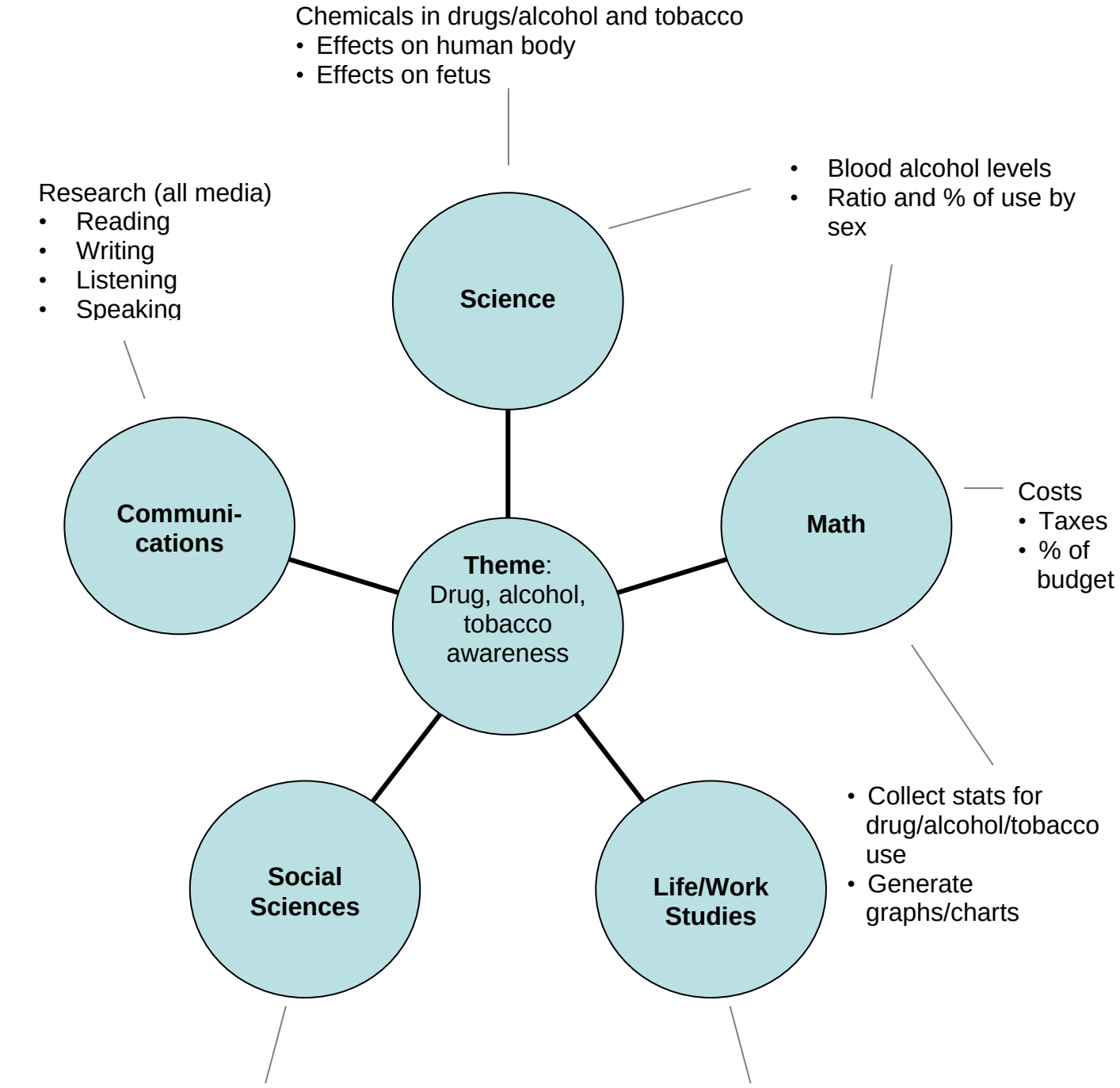
How will I reflect on the effectiveness of this lesson/unit/activity?

- Were learners able to accomplish the task independently?
- Were learners able to relate their consumption of energy to local, regional, and global issues?
- Did learners come up with some practical alternatives for their lifestyle?
- Was this change something they implemented in their life or only on paper?

Interdisciplinary Theme-based Planner



Interdisciplinary Theme-based Planner – Sample



Comprehensive Planning Document – Sample

Foundations of Scientific Literacy (page 42)

Habits of Mind
Generic Skills
Processes of Science
Ways of Knowing

Unifying Concepts (page 52)

Order and Organization
Measurement
Systems
Patterns of Change
Ethics and Values
Technology

Activity/Lesson

Unit/Project

Interrelationships And Interdisciplinary Connections

Learning Outcomes (Specific and General)

Strand:

Learning Outcomes:

Assessment (page 122)

Methods *Strategies* *Tools*

Comprehensive Planning Document – Sample[27]

Habits of Mind (page 42)

***Wonderment/Inquisitiveness**:* How will my pie turn out? What will it taste like?

***Creativity**:* Is there anything I can do to make my pie different from everyone else's?

***Perseverance**:* Does the learner persevere even if the project becomes a bit frustrating?

Confidence: Science as an inquiry process builds the learners confidence.

***Careers**:* Some learners may be interested in a career in cooking. Students will also be taking a related Food Safety class.

***Safety**:* Learners will learn to assess and handle potential dangers properly and apply safety procedures. Ex. Use a knife to cut pumpkin

Processes of Science

***Observation**:* Can learners make quantitative and qualitative observations of the processes?

Research and Experimentation: Do learners recognize some of the scientific processes involved in the baking of pie?

***Inferring and Reasoning**: C*an the learners transfer this knowledge to their lives? Could they make pumpkin cookies?

***Predicting**:* Identify patterns and transfer to other baking.

***Communication**:* The students are working in groups communicating to each other about the ingredients and the amounts to use.

Ways of Knowing

***Personal and Scientific Knowledge**:* The learner can bake a pumpkin pie and understand some of the scientific processes that are involved.

Generic Skills

***Communication**:* Does the learner ask questions when having difficulty? Can the learner read and follow the recipe directions?

***Interpersonal Teamwork**:* Do learners work well with others in the group?

***Numeracy**:* Can the learner measure the ingredients accurately?

***Lifelong Learning**:* Will the learner have enough confidence to try doing an activity like this at home?

Baking a Pumpkin Pie

Unifying Concepts (page 52)

***Order and Organization**:* Learners will see that there are different ways to organize and categorize spices, recipes, or the way a meal is organized, meats, desserts, etc.

Measurement: Learners will make accurate measurements of ingredients, and recognize fractions used in baking.

***Patterns of Change**:* Can the learners recognize trends and patterns in the process of baking.

***Ethics and Values**:* The use of preservatives in store bought pie filling.

***Technology**:* We can buy prepared pumpkin pie. What processes are involved in producing such a product? What are some of the side effects from the use of these chemicals?

[27] As submitted by Larry Hrycan, Carlton Trail Regional College

Baking a Pumpkin Pie

Interrelationships and Interdisciplinary Connections

Matter
Chemical and Physical Changes

Energy – Caloric Intake

Life – Nutrition

Learning Outcomes (Specific and General)

Interrelationships:
- Choose a topic and identify the matter, energy, and life components of it.

Integrated Science*:*
- Explain the advantage and need for standards in measurement.
- Make both quantitative and qualitative observations.
- Make observations using the five senses.
- Minimize error in measurement by choosing appropriate tools and understanding precision and accuracy.
- Exhibit safe practices.

Matter:
- Identify the differences between chemical and physical changes.
- Recognize that a chemical reaction involves reactants and products.
- Recognize chemical reactions that occur in everyday life.

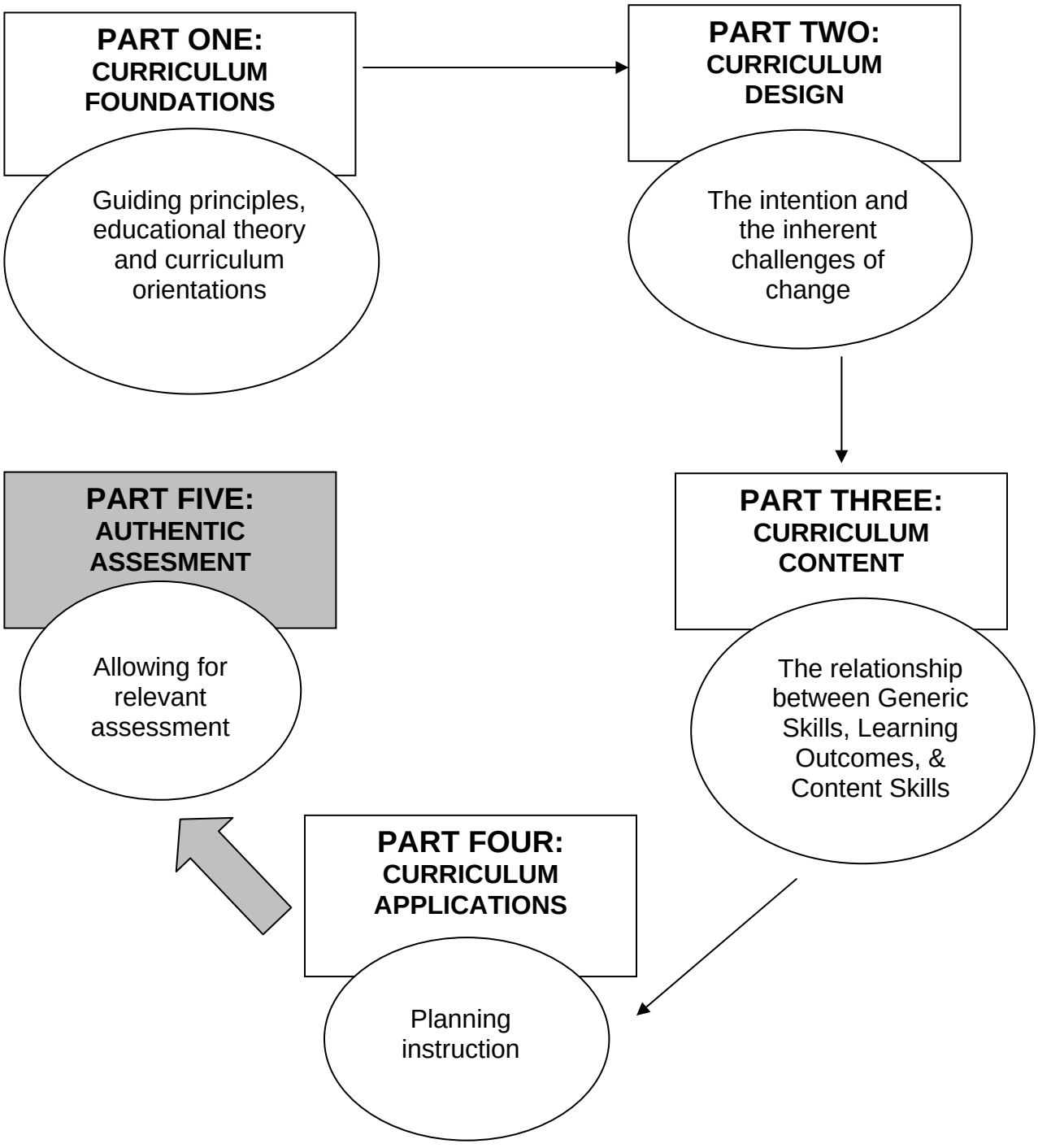
Life
- Consider the effects of good and poor nutrition on the human body.
- Understand the unit used to measure food energy is the Calorie.

Assessment (page 122)

Methods	***Strategies***	***Tools***
Performance Assessment	Follow a recipe and bake a pie	Checklist
Holistic Assessment	Pie judging contest	Rubric

PART FIVE:
AUTHENTIC ASSESSMENT

The Curriculum Roadmap:



Chapter Eight: Aligning Curriculum, Instruction, Evaluation, and Assessment

Evaluation and assessment should be integrated into the planning of the Level Three Science course so they are in alignment with curriculum philosophies and learning outcomes, and are parallel to instructional strategies. A transactional and transformative approach to instruction moves away from the rote processes of memorization and lock-step procedures towards problem or project-based, holistic, applied instruction. Learners should be developing the abilities to problem-solve and apply and recognize science in the context of work, life, and community. This approach has implications on the types of assessment tools used.

Evaluation and assessment are different. Assessment can be thought of as what the learner does, while evaluation is what is done to the learner. "Assessment, a broader term, involves collecting information on the progress of students' learning. Evaluation is making a judgment about the degree of merit or worth of the information collected" (Government of Saskatchewan, 1991).

Evaluation

Evaluation refers to the weighting of the assessments for a final grade, and shows the extent to which learners are meeting the learning outcomes of the curriculum. Not every piece of assessment needs to be nor should be included in the evaluation. That is, assessment has purposes other than deriving a "final mark". Diagnostic assessments should not be incorporated into evaluation unless those assessments provide evidence of the extent to which a learner is meeting the learning outcomes. Prior learning assessment is an example of this.

Evaluation Schemes

The evaluation scheme should be discussed with learners at the earliest opportunity. It should be easily and clearly understood in its derivation of weightings and which assessments will be included in the evaluation. Effective evaluation schemes contain a variety of assessment methods and tools. If the majority of a learner's final grade comes from written tests then the evaluation scheme should be adjusted. An evaluation scheme can always be adapted as the course progresses, based on the learners and how the course unfolds.

In the following examples, the Sample A assessments are divided into categories, with each category contributing a certain percentage to the final grade. Within each category is a variety of assessment tools. For example, under the A*ssignments* category, there may have been a presentation (with a rubric for grading), a set of open-ended response questions, and a calculation assignment on metric conversions. Unit assessments could be a project, a written examination, or a presentation.

Within the assignment categories, each assignment can be of equal value and contribute 30% towards the final grade, or each assignment can be weighted as the instructor deems suitable. No matter what the scenario, the learner needs to be aware of, and understand, the evaluation scheme.

Sample A

Categories	*Percentage of Final Mark*
Major Project	20%
Assignments	30%
Labs	10%
Unit Assessments	20%
Final Assessment	20%

In Sample B, each strand is worth one quarter of the final grade. The Integrated Science Strand is taught within each of the other four strands. The assessments used within each strand may be very different from those used in Sample A.

Sample B

Strand	*Percentage of Final Mark*
Interrelationships • Project on the adoption of natural technologies by humans (e.g. sonar and echolocation)	25%
Matter • Design and put on a demonstration • Present the benefits of recycling	25%
Energy • Media Log • Assignment on energy conservation	25%
Life • Create a meal plan for a week • Quiz on the human body systems	25%

Again, learners should have input into, and understand, the value of each separate assessment. The project final evaluation of 25% can come from formative assessments on such diverse topics as research skills and the learners' habits of mind. The 25% can include a written, verbal, or visual presentation. A Power Point© presentation can provide an assessment of the learner's ability to use technology appropriately. Evaluation is a final judgement by the instructor on what the learner has done throughout the course, project, or unit.

Assessment

Assessment should be authentic and reflect broadly-based, transferable skills and conceptual understandings. Assessment needs to be continuous, authentic, valid, and incorporate multiple assessment tools. The assessor can be the instructor, the learner, or the learner's peers. Learners should have some input into assessment. Assessment must align with strategies and approaches to instruction as instructors move toward a transactional and transformational approach to teaching and learning.

Assessment utilizes a variety of tools and techniques to gather information about a learner's achievements so the instructor can guide and facilitate instruction and learning. Assessment can be based on observation as well as measurement, using tools such as anecdotal records, checklists, and formal observations.

Assessment tools should allow for an unlimited number of learner responses, encourage creativity, and engage the Processes of Science and problem solving. Assessment tools such as journal writing, portfolios, projects, experimentation, inquiry, and research need to be integrated into the design of the course. Ways of knowing and a variety of perspectives need to be taken into account when planning for assessment.

There are several forms of assessment:

Diagnostic assessment determines what knowledge a learner comes with. It can be helpful to instructors by providing important information on placement in programming and addressing individual learner needs. It occurs at the beginning of a course or unit of study.

Formative assessment is continuous and provides feedback to both the instructor and learner about performance, thereby providing directives for continuing learner improvement. Formative assessment guides instructors' professional judgements on delivery and design of the course.

Summative assessment gives evidence as to the learners' acquisition of the General and Specific Learning Outcomes of a particular strand. This should be the best work of the learner.

Types of Assessment

Because of the different instructional strategies provided by the instructor and the varying learning styles of the learners, it is suggested that a variety of types of assessment methodologies be used to gather evidence of learner achievement. These methods may include but are not limited to:

Methods of Assessment	***Description***	***Strategies***
Performance Assessment	Learners are given a variety of tasks and situations where they can demonstrate understandings and apply knowledge, skills, and the Foundations of Science to a variety of contexts.	- Design and conduct an experiment - Demonstrate a skill or set of skills - Design a classification or measurement system
Authentic Assessment	Assessments tie directly to the applications of the knowledge, skills, and attitudes in the real world.	- Project-based instruction - Simulate a workplace training experience - Build a tipi - Make pemmican
Holistic Assessment	Incorporates a wide range of assessment pieces to provide a total picture of the learner.	- Portfolio - Focus on Mind, Heart, Spirit, and Body - Problem or project-based learning - Invention

Designing Assessment Tools

It is important to remember that the assessment tool should be appropriate for the assessment of the learning outcome, that is, the tool has to "fit" the reason for learning. Enger and Yager (2001) found that

> The assessment practices used should be linked to student outcomes, and the practices should mirror the ways in which students are learning the information. With any assessment, the underlying purpose for conducting the assessment should guide the assessment design and the use of the results. (p. 14)

When planning assessment:

Plan assessment while planning instruction.

- Assessment could be thought of as a guide to instructional design. It provides the structure for what a learner should know or do so the instructor can align the instructional strategies accordingly.

Diversify assessment.

- Incorporate a number of different types of assessment strategies and tools which reflect the purposes for assessment.

Ensure assessment strategies are culturally responsive.

- Use concept mapping, observations, informal interviews, self evaluations, performance tasks, portfolios, creative performances, and exhibitions. (Stephens, 2000)

When creating an assessment tool:

Know the purpose of the assessment tool.

- Know which learning outcomes, Ways of Knowing, Generic Skills, Processes of Science, or Habits of Mind are to be assessed and why they are being assessed. Share this with learners.

Align the assessment tool to the type of instruction and learning.

- Assess for reasoning skills, application of science in real life applications, understanding of the nature of science, and growth of cultural knowledge as well as recollection of information and facts.

Incorporate the learners into the design.

- When learners take part in designing the assessment tool there is more awareness of the expectations for success, a framework for beginning the task, and self-empowerment as a result of choosing the criteria themselves.

Reflect on the reliability and validity of the assessment tool.

- Use fair practices by checking for bias and stereotypes, as well as by identifying gender and cultural sensitivities.
- Make modifications to meet the needs of students.
- Ask if the tool assesses what it was intended to.

When using an assessment tool:

Embed it in instruction

- Discuss expectations, methods of assessment, due dates, instructional goals, and assessment standards.
- Discuss assessment to generate discussion about what will be learned, why it is being learned, and how it will be learned.

Use it as a tool for reflection to improve instruction or learner performance.

- Analyze results to identify where learners mastered an area or if an area needs to be readdressed.
- Examine the instructional strategies to see if there are patterns where there were successes or struggles and adapt accordingly.

Involving Learners in Assessment

It is imperative to have discussions with learners about their learning and learning goals when including learners in assessment. There are many ways to do this, including:

- **Participating in the design of an assessment tool.** Ensure learners understand the learning outcomes and the criteria used to assess them. For example, explain how to use a rubric and provide exemplars for learners to use when creating a rubric. In this way, learners set the criteria and know what feedback is important.

- **Interpreting the evidence from an assessment tool and using it to see *how* they learn as well as *what* they learn.** Assessment will have far more meaning when it becomes a process. Learners and instructors seek and interpret evidence to use as feedback to make decisions about where the learners are in their learning, where they need to go, and how best to get there. Involving learners in assessment by having them use the evidence helps develop an awareness of how they are learning as much as what they are learning.

- **Reflecting on progress and improvement**. When learners are assessed, the focus should be more than the given "mark" or grade. Assessment shows progress and helps learners identify ways to improve. A method of giving this feedback should be integrated into the assessment piece, so instructors and learners have strategies to build weaknesses into strengths. One strategy for instructors and learners is to find three strengths and a weakness in each assessed assignment.

Sample Assessment Tools

There are a vast number of teacher resources that include assessment tools. The following pages present sample assessment tools that can be used "as is" or adapted to suit the needs of the learners and instructors. Instructors should use their professional judgement in the selection and use of any assessment tool. The following assessment tools are provided:

- Assessment Inventory/Planner
- Reflective Journal/Prior Learning Assessment
- Research Paper
- Scientific Literacy Portfolio Chart
- Project-based Learning Checklist
- Lab Assessment

Assessment Inventory/Planner

(Note: This can be used for a strand, a project, or a yearly plan.)

What I already use to assess…	**What I want to incorporate…**	**Where I will incorporate it …**
□ Checklist □ Test □ Rubric □ Rating scale □ Quiz □ Peer evaluation □ Self evaluation □ Group evaluation □ Written response □ Research paper □ Interview □ Learning log □ Portfolio □ Problem □ Game □ Panel assessment □ Experiments □ Teacher demonstrations □ Learner demonstrations □ Journal □ Film analysis □ Conference □ Presentation	□ Checklist □ Test □ Rubric □ Rating scale □ Quiz □ Peer evaluation □ Self evaluation □ Group evaluation □ Written response □ Research paper □ Interview □ Learning log □ Portfolio □ Problem □ Game □ Panel assessment □ Experiments □ Teacher demonstrations □ Learner demonstrations □ Journal □ Film analysis □ Conference □ Presentation	
I will use it to assess…		
It will look like…		

Reflective Journal/Prior Learning Assessment

Concept or Topic: _____

What I already know about the concept or topic…

What I want to know about the concept or topic…

How I found out what I wanted to know about the concept or topic…

What I know now…

Research Paper

Name:_____ Essay Topic:_____

Criteria	Comment	Mark
Topic Choice		
	Very good; appropriate	**3**
	Good; science related	**2**
	Poor; not science related	**1**
	Unacceptable	**0**
Introduction		
	Excellent; well composed	**2**
	Shorter than necessary	**1**
	No introduction	**0**
Content		
	Covers topic well	**7 – 8**
	Good; a little lacking	**5 – 6**
	Fair, more could be used	**3 – 4**
	Poor; little coverage	**1 – 2**
	Unacceptable content for topic	**0**
Closing/Summary		
	Excellent; flows logically	**2**
	Shorter than necessary	**1**
	No closing paragraph	**0**
Organization		
	Excellent; flows logically	**4 – 5**
	Good, but jumps a bit	**2 – 3**
	Very hard to follow	**1**
	Has no logical flow	**0**
Writing Style		
	Clearly your own writing	**3 – 4**
	Too close to references	**2 – 3**
	Too much direct copying	**0 – 1**
Grammar/Spelling		
	Excellent; few errors	**3**
	Good; but a few errors	**2**
	Many errors	**1**
	Several errors, meaning is lost	**0**
References/Bibliography		
	Several sources used are referenced using correct format	**3**
	Some sources are referenced, but incorrectly	**2**
	Listed only 1 or 2 sources	**1**
	No resources cited	**0**

Mark: _____
30

Scientific Literacy Portfolio Chart

Name:

Date:

Criteria	Evidence of Scientific Literacy			
Ways of Knowing				
The learner acknowledges and respects many ways of knowing in the field of science.				
The learner can see science in the world around her/him.				
The learner can see connections between other subjects and science.				
The learner builds on own personal knowledge and applications of science.				
Habits of Mind				
The learner asks questions and pursues the answer.				
The learner is exploring choices within the field of science, as well as the ones that the field of science opens.				
The learner is open to new approaches or ideas.				
The learner is building confidence in the area of science.				
The learner exhibits and practices safe experimentation procedures.				
The learner is persistent in seeing something through to the end.				

Generic Skills				
The learner communicates about science.				
The learner works well in a group setting.				
The learner has used science to work on and improve communication skills.				
The learner can apply math concepts and skills in the context of science.				
The learner has used some technology in learning or understanding of science.				
The learner uses many resources and perspectives to construct knowledge.				
Processes of Science				
The learner can carry out research on a scientific topic.				
The learner can conduct a lab.				
The learner can explain and justify the conclusions made from conducting the lab.				
The learner reasons through information and concepts to make sense of them in a framework.				
The learner can make predictions from personal knowledge and through reasoning ability.				

Project-based Learning Checklist[28]

Teacher Name: _____ **Date:** _____

Student Name: _____ **Reviewer Name:** _____

Project: _____

CATEGORY	RESPONSIBILITIES
Relating Concepts	I can explain why this lesson/project was important.
	I connected this project to other things we have studied in this class.
	I related this lesson to things we have studied in other classes.
	I am aware of how this project relates to larger ethical issues.
	I know how this lesson relates to social issues outside of Science.
	I understand how this lesson/project relates to other issues of importance to our society or community.
	I know how this lesson/project relates to the work done by other scientists and/or historians.
	I explained how technological advances have changed our understanding of this topic.
Background Research	I used resources that had data to support my main points.
	I used a variety of pertinent resources.
	I collected enough information to understand the topic well.
	I used up-to-date resources.
	My resources were from reliable sources.
	I utilized information from scientific journals.
	I utilized information from textbooks.
	I utilized electronic resources.
	I wrote down the source of each piece of information I collected.
	I cited my resources in the correct format.

[28] Generated from http://pblchecklist.4teachers.org. Note that this type of program allows instructors to adapt checklists to suit the learner. For example, an instructor may want to add, "I completed the work myself" under "Background Research".

CATEGORY	RESPONSIBILITIES
Laboratory Safety	I wore safety glasses throughout any lab in which they were required.
	I wore appropriate shoes for the lab.
	I used all equipment carefully.
	I used all equipment as it was meant to be used.
	I didn't fool around or roughhouse in the lab.
	I picked up any mess (using proper safety precautions) that I created during the lab.
	I reported any accidents to the teachers, no matter how minor they were.
Experimental Research	I observed something interesting that made me want to understand it better.
	I chose a title for the project that was interesting and descriptive.
	I explained why I chose the topic and the questions I was trying to answer.
	I clearly described my questions.
	I gathered information that helped me better understand what I am investigating.
	I stated what kind of variable might affect my results.
	I developed an hypothesis and worded it so it could be tested.
	I designed an experiment to try to answer my questions.
	I controlled the variables to the extent possible.
	I described the experiment carefully and precisely.
	I used appropriate equipment and materials to perform my experiment.
	I used appropriate techniques to perform my experiment.
	My human or animal subjects were treated in ethical and humane ways.
	I performed the experiment carefully, just as it was described.
	I recorded the results.
	I summarized the results and then drew conclusions.

Lab Assessment

Lab _____ **Date** _____

Name _____

CATEGORY	4	3	2	1
Experimental Design	Experimental design is a well-constructed test of the stated hypothesis.	Experimental design is adequate to test the hypothesis, but leaves some unanswered questions.	Experimental design is relevant to the hypothesis, but is not a complete test.	Experimental design is not relevant to the hypothesis.
Variables	All variables are clearly described with all relevant details.	All variables are clearly described with most relevant details.	Most variables are clearly described with most relevant details.	Variables are not described OR the majority lack sufficient detail.
Safety	Lab is carried out with full attention to relevant safety procedures. The set-up, experiment, and tear-down posed no safety threat to any individual.	Lab is generally carried out with attention to relevant safety procedures. The set-up, experiment, and tear-down posed no safety threat to any individual, but one safety procedure needs to be reviewed.	Lab is carried out with some attention to relevant safety procedures. The set-up, experiment, and tear-down posed no safety threat to any individual, but several safety procedures need to be reviewed.	Safety procedures were ignored and/or some aspect of the experiment posed a threat to the safety of the student or others.
Scientific Concepts	Report illustrates an accurate and thorough understanding of scientific concepts underlying the lab.	Report illustrates an accurate understanding of most scientific concepts underlying the lab.	Report illustrates a limited understanding of scientific concepts underlying the lab.	Report illustrates inaccurate understanding of scientific concepts underlying the lab.
Analysis	The relationship between the variables is discussed and trends/patterns logically analyzed. Predictions are made about what might happen if part of the lab were changed or how the experimental design could be changed.	The relationship between the variables is discussed and trends/patterns logically analyzed.	The relationship between the variables is discussed but no patterns, trends or predictions are made based on the data.	The relationship between the variables is not discussed.
Generated by: http://rubistar.4teachers.org/index.php				

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(Parts Three, Four, and Five)

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Appendix A

Technological Literacy: Computer Skills and Knowledge Checklist

Technological Literacy: Computer Skills and Knowledge Checklist

Technological literacy skills – in particular, computer skills – have become a necessity in today's society, regardless of an adult's personal or career goals. Computers are present in educational settings, in the work place, in the home, and in the community.

Technological Literacy is recognized in the Adult Basic Education redesign process through inclusion as one of the Generic Skills. Generic Skills are those skills that are **developed and applied in all courses of study**.

Technological literacy includes the following sub-skills:

- Reflect upon and interpret the ways in which technology is used in the community;
- Use computers and other tools to locate, process, and manage information;
- Use technology for research, communication, and creative purposes; and
- Demonstrate what you understand about technological literacy.

The *Computer Skills and Knowledge Checklist* contains guidelines for the minimum skills expected of Level Three learners. To the extent that hardware resources are available, instructors will use the *Checklist* as a guide to the development of basic computer skills. Based on learner goals and the capacity of the delivery organization, instruction beyond that included in the *Checklist* may be provided.

The *Checklist* was developed with the following assumptions in mind:

1. **To the extent that resources and hardware are available, the skills and knowledge identified in the checklist outline the minimum expectations of learners upon completion of Level Three.** The instructor and/or the delivery organization determine how to best structure their program to deliver and develop learners' computer skills. Some delivery organizations will need to develop a systematic way of addressing computer skills. Many delivery organizations already have an approach that makes the most sense for their learners and the organization's resources. The *Checklist* can be used to build on what already exists.

2. **Computer knowledge and skills are integrated and applied within all subjects.** Computer knowledge and skills are developed and applied in a relevant context within the framework of the existing five courses. The computer is viewed as a tool that can assist in achieving certain goals or in completing certain tasks (e.g., finding, organizing, or presenting information). Delivery organizations may prefer to provide learners with a basic introduction to computers in a group setting and then apply those skills in various subjects. Some organizations will choose to develop certain skills through activities in the Communications course; others will choose to develop those same skills through Social Sciences activities.

3. **Learners' prior knowledge is determined** before instruction is provided. The delivery organization and/or the instructor determine the skills that the learner has already mastered and those that need to be reviewed or developed before applying them to a task.

The *Computer Skills and Knowledge Checklist* is organized into the following three broad categories:

- **Computers in Society** – a reflection on the role of computers in one's life and in society;
- **Knowledge of Computers** – basic functions and terminology related to computer hardware; and
- **Software Applications** – an introduction to a variety of software that can be used to locate and manage information, and for research, communication, and creative purposes.

Computer Skills and Knowledge Checklist

A. Computers in Society

	Already knows?		Instructor Notes
	Yes	No	Integrated/Applied with … (subject, activity, assignment)
Learners will: • Describe a range of computer applications in society (ATMs, the Internet, computer record systems, Employment Insurance applications, income tax, food store checkouts, etc.).			
• Analyse the effect of computers on their everyday lives.			
• Provide examples of and discuss ethical issues involving computers in society, such as protection of privacy, security issues, copyright, plagiarism and following workplace (or school) policies with respect to computer use.			

B. Knowledge of Computers

	Already knows?		Instructor Notes
	Yes	No	Integrated/Applied with … (subject, activity, assignment)
1. Introduction to computers			
• Learners will: • Identify ergonomic issues related to computer use and demonstrate operating a computer in a healthy and safe manner.			
• List the basic parts of a computer system (system unit, monitor, keyboard, mouse, floppy disk drive, hard disk drive, and printer).			
• Describe commonly used computer terminology and acronyms.			
• Demonstrate the ability to properly start and shut down a computer system.			
• Use a mouse.			
• Describe the difference between hardware and software.			
• Describe a diskette/CD-ROM and its care.			
• Demonstrate the ability to operate a printer (power on, put on line/off line and load paper).			

	Already knows?		Instructor Notes
	Yes	No	Integrated/Applied with … (subject, activity, assignment)
2. Keyboarding			
Learners will: • Demonstrate correct keyboarding techniques.			
3. Operating System			
Learners will: • Describe the basic functions and operations of an operating system.			
• Demonstrate the ability to open and close a program.			
• Demonstrate the ability to correctly name and locate files.			
• Demonstrate the ability to perform basic file operations using the operating system (create, copy, move, send to, delete and rename).			

C. Software Applications

	Already knows?		Instructor Notes
	Yes	No	Integrated/Applied with … (subject, activity, assignment)
1. Word Processing			
• Learners will: • Open a new word processing document.			
• Format a page (margins, justification, font, bold, italics, line spacing, page numbers, etc.).			
• Insert headers and footers.			
• Edit a document, including cutting and pasting text.			
• Use tools such as a spell/grammar check or thesaurus.			
• Print a document.			
• Save a document (disk, hard drive).			
• Retrieve a document (disk, hard drive).			
• Demonstrate the ability to use help features and tutorials.			
2. Email			
Learners will: • Send and receive email messages using language, tone, and structure appropriate for the audience and the purpose.			

	Already knows?		Instructor Notes
	Yes	No	Integrated/Applied with … (subject, activity, assignment)
3. Internet			
Learners will: • Define terminology related to the Internet (download, URL, WWW, search engine, web browser).			
• Navigate a website to locate information.			
• Conduct basic searches on the Internet/World Wide Web.			
4. Graphics and Presentations (Optional)			
Learners will: • Insert/import graphics to a document.			
• Prepare and deliver a presentation using the computer.			
• Use spreadsheets to organize and present data and to create graphs.			
Other (Specify)			

Appendix B

Instructor Resources and Handouts

- Calculating Percentage Error
- Lab Safety
- Chemical Apple Pie
- How does an Infectious Disease Spread?
- Background Information on the Making of Pemmican
- Topic Ideas for Science Fair Projects
- Science Fair Assessment
- Graph Paper

Calculating Percentage Error

Experiment: **Calculating the Density of Water**

Learners conduct a lab directly measuring the volume and mass of water in order to derive the measure of density in each trial. Below are examples of data.

DATA

Trial	Volume	Mass	Density = mass/volume
1	10.1mL	10.9 g	1.08g/mL
2	20.0mL	19.3 g	.965g/mL
3	30.3mL	31.0 g	1.02g/mL
4	42.0mL	42.3g	1.01g/mL
5	51.0mL	51.2g	1.00g/mL

- The accepted value for the density of pure water is 1.00 g/mL.
- Percentage error can be calculated using an average of the experimental values.
- Average Experimental Value = 1.02g/mL

$$\textbf{\% Error} = \frac{\textbf{theoretical value – experimental value}}{\textbf{Theoretical value}} \times 100$$

$$\textbf{\% Error} = \frac{1.00\text{g/mL} - 1.02\text{g/mL}}{1.00\text{g/mL}} \times 100$$

% Error = 2%

Note that percentage error is always reported as a positive value and as a per cent.

A group with an average density for water of 0.98g/mL would have the same percentage error.

Lab Safety

General Guidelines

1. Conduct yourself in a responsible manner at all times in the laboratory.
2. Be alert and proceed with caution at all times in the laboratory. Do not touch any equipment, chemicals, or other materials unless you are instructed to do so.
3. Follow all written and verbal instructions carefully. Ask questions if you do not understand a direction or part of a procedure.
4. Never work alone in the laboratory.
5. Do not eat food, drink beverages, or chew gum in the laboratory. Do not use laboratory glassware as containers for food or beverages.
6. Always work in a well-ventilated area and observe good housekeeping practices. Work areas should be kept clean and tidy at all times.
7. Follow instructions about the disposal of chemicals.
8. Keep your hands away from face, eyes, mouth, and body while using chemicals or lab equipment. Wash your hands with soap and water after performing all experiments.
9. Know the locations and operating procedures of all safety equipment including: first aid kit(s) and fire extinguishers. Know where the fire alarm and the exits are located. Know what to do if there is a fire drill during a laboratory period; containers must be closed, and any electrical equipment turned off.

Clothing

10. Wear safety glasses any time chemicals, heat, or glassware are used.
11. Dress properly during a laboratory activity. Long hair, dangling jewellery, and loose or baggy clothing are a hazard in the laboratory, so should be secured. Shoes should cover the foot completely.
12. A lab coat or smock should be worn during laboratory experiments.

Handling Chemicals

13. All chemicals in the laboratory are to be considered dangerous, and handing them with fingers should be avoided. Use a spatula or tweezers. Do not taste or smell any chemicals.
14. Check the label on all chemical bottles twice before removing any of the contents. Take only as much chemical as you need.
15. Never return unused chemicals to their original container.
16. Never remove chemicals or other materials from the laboratory area.

Handling Glassware and Equipment

17. Never handle broken glass with your bare hands. Use a brush and dustpan to clean up broken glass and place broken glass in the designated glass disposal container.
18. Examine glassware before each use. Never use chipped, cracked, or dirty glassware.
19. Do not immerse hot glassware in cold water. The glassware may shatter.

Heating Substances

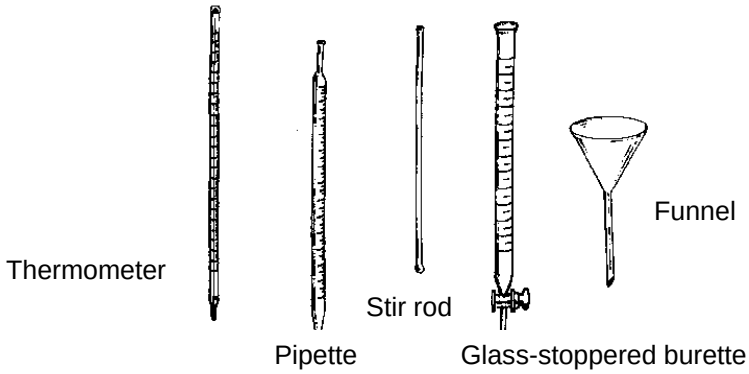
20. Take care that hair, clothing, and hands are a safe distance from the hot plate at all times.
21. Heated glassware remain very hot for a long time, and should be set aside in a designated place to cool before being picked up. Use tongs or heat protective gloves if necessary.
22. Never look into a container that is being heated.
23. Do not place hot apparatus directly on the laboratory desk. Always use an insulated pad. Allow plenty of time for hot apparatus to cool before touching it.

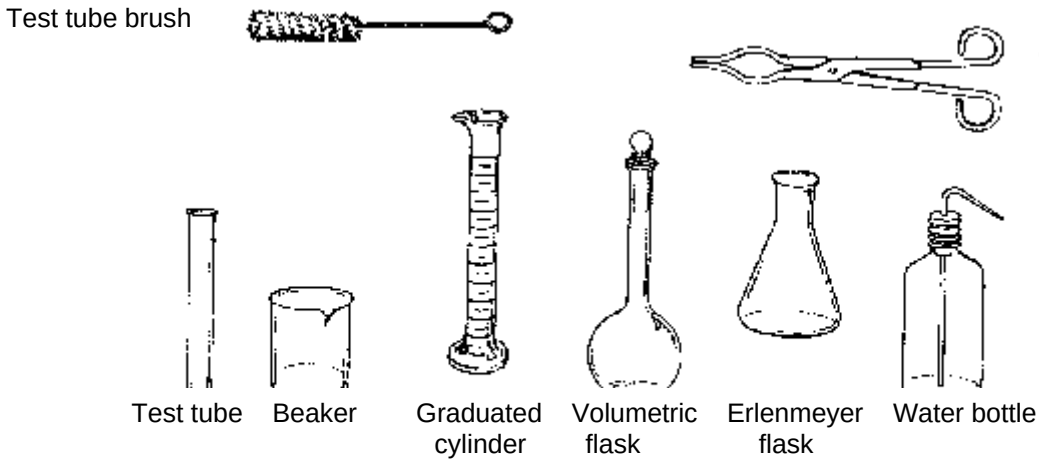
Accidents and Injuries

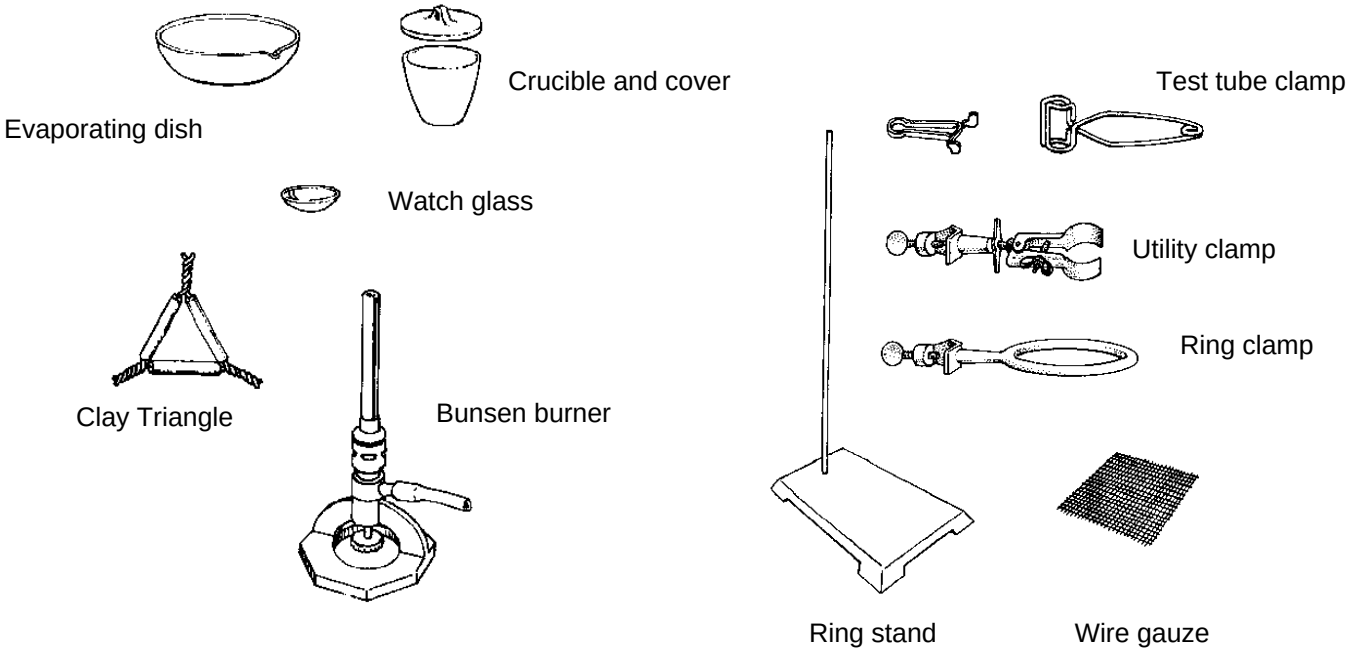
24. Report any accident (spill, breakage, etc.) or injury (cut, burn, etc.) immediately, no matter how trivial it seems.
25. If a chemical should splash in your eye(s) or on your skin, immediately flush with running water for at least 20 minutes. Contact the instructor immediately.

Adapted from http://nobel.scas.bcit.ca/debeck_pt/science/safetyContract.htm

Common Lab Equipment







Chemical Apple Pie

Our senses are very easily fooled. A chemist can prepare a synthetic flavour that our senses cannot differentiate from the "real thing". Follow the chemical recipe below to make an "apple" pie.

Materials and Ingredients (Reagents)

Figure it out and make a list. A good cook always has the necessary materials.

Procedure

1. Bring 500mL of $H_20_{(l)}$ to a boil in a large Fe or Al pot.

2. Mix 1.5 cups of $C_{12}H_{22}O_{11\,(s),}$ sugar, with 1.50 teaspoons of potassium bitartrate, cream of tartar.

3. Add this mixture to the boiling water.

4. Add 25 whole saltine crackers, one at a time, to the boiling $H_20_{(l)}$. (May use RITZ crackers as a substitute.)

5. Boil for 181 seconds but DO NOT STIR.

6. Line a pie pan with a pastry shell, the frozen ones work well.

7. Pour the mixture from #5 into the shell from # 6 and sprinkle with cinnamon and then cover with a pastry shell that should be lightly dotted with butter.

8. Pierce the dotted pastry shell top several times with a knife to allow steam to escape.

9. Bake at 232 °C (450° F) for 30 minutes.

10. Cool and enjoy the results of your experiment after you have cleaned the lab, kitchen.

11. Optional: You may want to add ice cream.

How does an infectious disease spread?

(Used with permission[29])

An infectious disease is any disease caused by germs that can be spread from one person to another. Germs include viruses, bacteria, and protozoa. Scientists call these germs pathogens. What are some infectious diseases? What are some diseases that are not infectious?

The activity we will be doing today will simulate the spread of an infectious disease. A simulation is a simplified demonstration of how an infectious disease can spread through a population. Our simulation will show how one person who is infected with a disease can infect other people, who in turn infect others.

Procedure

3. Your instructor will give everyone a cup filled with a clear solution. This solution represents your body. One person in the class will have a cup that has been "infected."

   Obviously, you should **not drink** from the cup. (In laboratory activities you should never drink or eat anything unless your instructor tells you that it is safe to do so.)

2. In this part of the laboratory, you will interact with *two* other students.

   To interact with another student, pour all of your solution into your partner's cup. Then have your partner pour all of the mixed solution back into your empty cup. Finally, pour half of the mixed solution back into your partner's empty cup.

   Wait for the signal from your instructor, and then move to another part of the classroom and interact with a second student. After you have finished your second interaction, return to your seat.

   Estimate how many people you think will be infected. _____

3. Your instructor will come around and put an "infection indicator" in your cup. If you have exchanged solutions with the original infected person or someone else after they became infected, you are now infected and your solution will turn pink. If you have not exchanged solutions with anyone who was infected, your solution will not turn color.

   Next, your instructor will ask everyone who is infected to raise their hand.

   How many people were infected? _____

[29] Copyright 2005 by Jennifer Doherty and Dr. Ingrid Waldron, Department of Biology, University of Pennsylvania. (http://serendip.brynmawr.edu/sci_edu/waldron/pdf/InfectiousDiseaseProtocol.pdf)

4. You will do another set of interactions, again beginning with only one student with an infected cup. This time there will be *three* rounds of interactions.

   Estimate how many people you think will be infected after three interactions.

   _____

   After the instructor has come around with the indicator, write down how many people were actually infected. _____

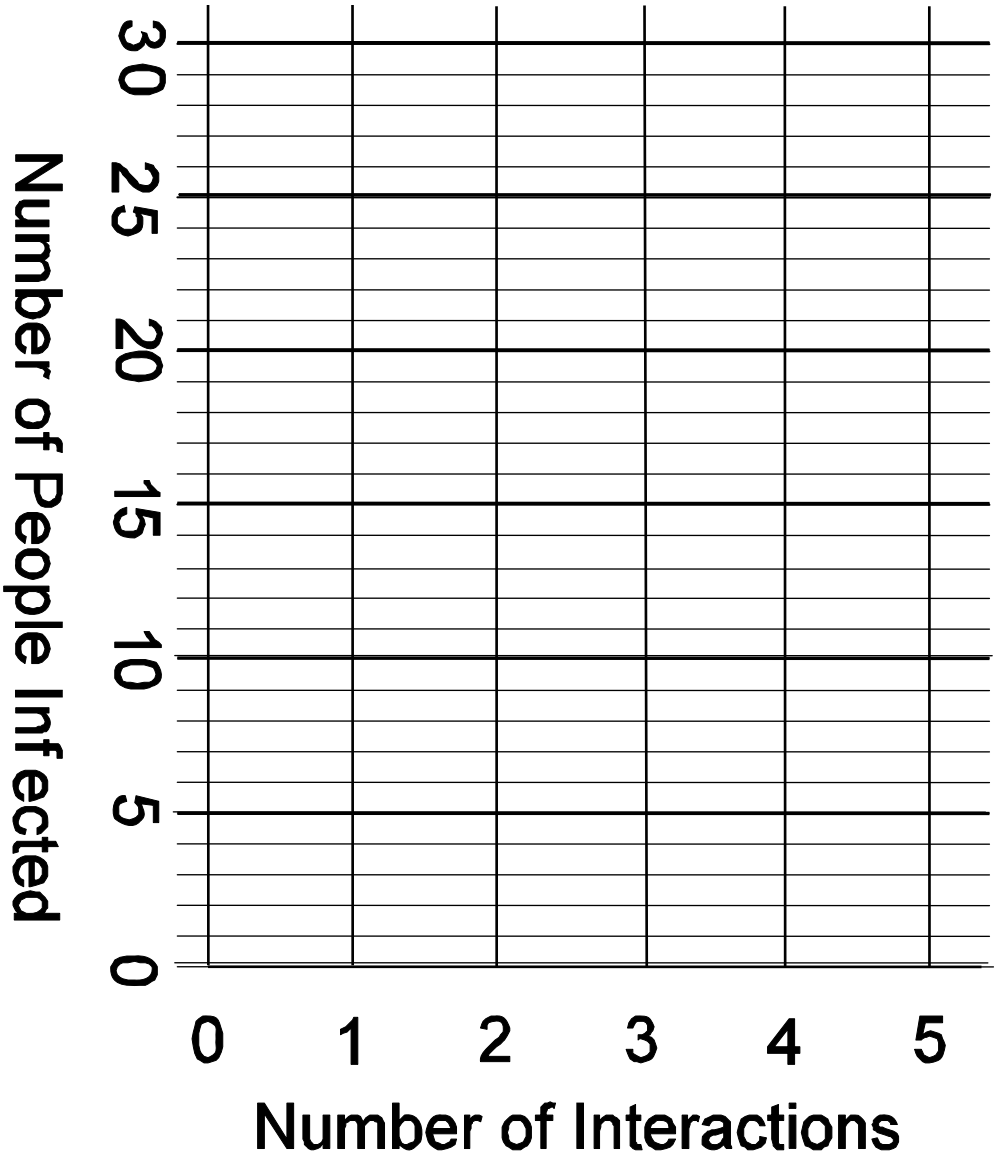
Recording Data

5. Create a table of values.
   a. Record the values to indicate that one person was infected before any interactions.
   b. How many people would be infected after just one interaction? Record this pair of values in the chart.
   c. Record the number of people who were actually infected after two interactions (from #3 in the Procedure) and the number of people who were actually infected after three interactions (from #4 in the Procedure).

Number of Interactions	Number of Infected People

Displaying Data

6. Plot the ordered pairs from the table of values on the graph provided.



Analysis of Data

7. Use the graph to predict how many people would become infected if you had four interactions. _____

   How many interactions do you think it would have taken before the whole class became infected? _____

Discussion

1. What are some ways that infectious diseases are transmitted from one person to another?

2. What are some ways you can prevent the spread of an infectious disease?

3. Our simulation showed the way a disease could spread if the spread of disease depends on person-to-person contact. Examples of these kinds of disease include pink eye, chickenpox, and herpes (lip sores). Other kinds of diseases, such as colds and tuberculosis, can be spread by germs in the air. How might the spread of these diseases differ from the spread of diseases that depend on person-to-person contact?

4. The spread of the disease in our simulation was very rapid. Within a few minutes many people were infected. In real life, infections do not spread as rapidly as in this simulation. Why is the spread of infections slower in real life?

5. What are your responsibilities if you find out you or your child has an infectious disease?

6. What role does Saskatchewan Public Health play in dealing with communicable disease?

7. In addition to exposure to germs or pathogens, what other factors influence your risk of getting an infectious disease? What defences does your body have that can prevent you from getting sick, even when you have been exposed to a pathogen?

8. Once you have caught a cold or flu, you do not stay sick forever. How does your body eventually get rid of the viruses that cause a cold or flu?

9. A person who becomes infected with HIV antibodies is unable to get rid of the antibodies. With highly effective modern medical treatment, a person may survive a long time with an HIV infection, but an untreated HIV-infected individual is very likely to develop AIDS and die. Why is a person with an HIV infection unable to get rid of this infection the way a person can get rid of an infection with a cold or flu virus?

10. What are the social stigmas or stereotypes that a person with certain communicable diseases may face?

Background Notes: "How Does an Infectious Disease Spread?"

Equipment and Supplies

- Small Dixie cups or plastic cups (2 cups per student)
- Baking soda or another chemical to mix with water to produce a solution with a basic pH
- Phenolphthalein pH indicator (or you can substitute other basic indicators such as Thymophthalein or Thymol blue)
- Small container with eye dropper for phenolphthalein
- A one litre container for mixing basic solution

Teacher Instructions

1. Prepare the infected solution by mixing 2 tablespoons of baking soda with 500mL of water in the mixing container.

2. Before each set of interactions, prepare one cup for each student. Fill one of the Dixie cups one quarter full with the baking soda and water solution. Fill all the other cups with plain water.

3. Explain that each student will receive a cup containing a clear solution. Tell the students that the solutions represent bodily fluids. Explain that after they receive their solutions each of them should first interact with one other student. The interaction is accomplished by one student pouring all of their solution into the partner's cup. Then that partner pours all of the solution back into the empty cup. Then the two partners each take half of the solution in their cups and move to their next interaction. After the first interactions have been completed, give them the signal for their second interaction.

4. After students have completed two rounds of exchanging solutions, have them go back to their seats and predict the number of infected people. Go around the classroom and drop the phenolphthalein indicator in the cups; as you're doing so, tell the students that you are putting an infection indicator into their cups. If they have exchanged solutions with the original infected person in the class or someone who came into contact with the infected person, they are now infected and their solution will turn red. If they have not exchanged solutions with anyone who was infected, their solution will not turn color. Have a show of hands to determine the number of people who were infected.

5. Now repeat the process, but have three interactions instead of just two.

6. If you have enough time and your class size is large enough, it may be helpful to have another round with four interactions.

7. Dispose of the liquid by rinsing it down the sink with plenty of water.

Background Information for Data Analysis

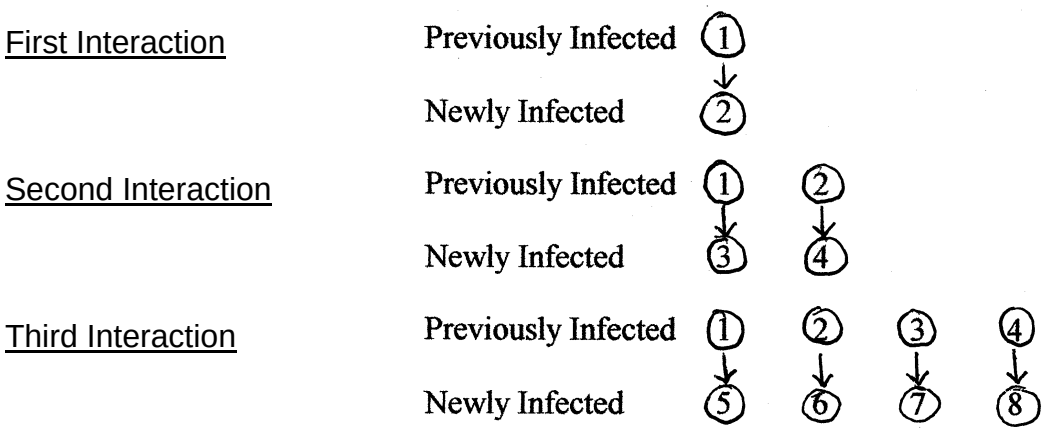
1. Remind students that the horizontal or *x* axis is labelled with the independent variable and the vertical or *y* axis with the dependent. Have discussions with students on how the independent and dependent variables were chosen for the graph by checking the true statement.
    a. The number of interactions depends on the number of people infected. (false)
    b. The number of people infected depends on the number of interactions. (true)

2. Have students look at how an appropriate scale for each axis was chosen.

3. Incorporate technology, if possible, by using computer-generated graphs.

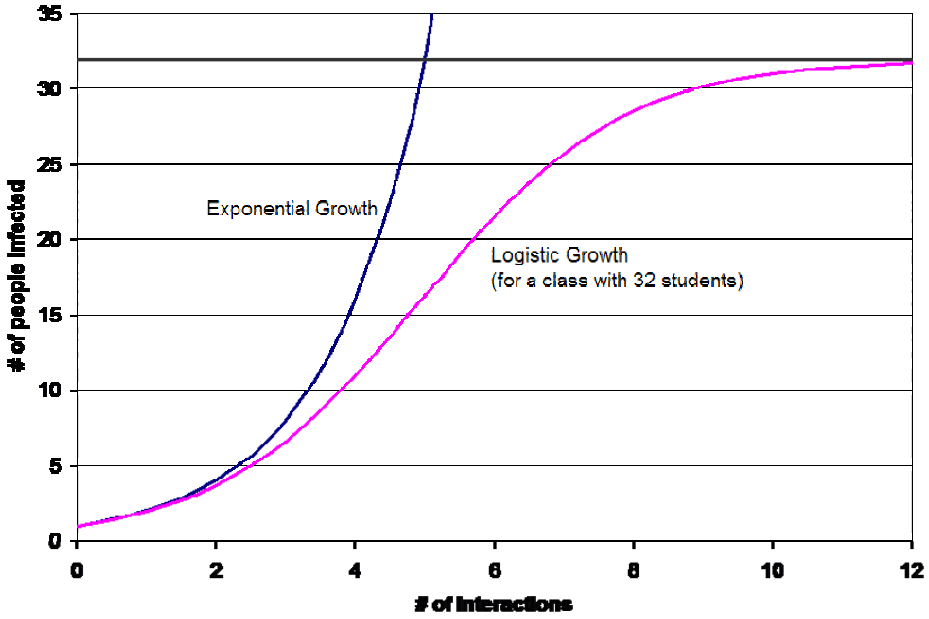
4. Discuss interpolating and extrapolating information from the graph.

5. In order to predict the subsequent spread of the disease, students should notice the approximate doubling of the number of infected people after each round of interactions. The following graphic may help your students to understand this process.



This doubling in each generation results in exponential growth, similar to growth in a population with abundant resources (see the figure below). If your students have done the Micro-organisms Everywhere or Mouldy Jell-O activities, it is helpful to link the pattern of exponential increase seen in the spread of infectious disease with the similar pattern seen in the bacterial or fungal growth observed in these previous labs.

As the number of infected students gets larger, it is increasingly likely that one infected student will interact with another infected student, which will slow the rate of increase in the number of infected individuals. This results in a logistic growth curve, with the maximum number of infected students equal to the total number of students in the class (see the figure below). This resembles population growth, which may be rapid when resources are abundant, but then slows as population size approaches the carrying capacity of the environment.



Background Information for Discussion Questions in Protocol:

1. Ways that diseases are transmitted from one person to another:
   - droplets in the air (e.g. cold, flu, tuberculosis)
   - via food or water (e.g. Salmonella, food poisoning)
   - via mosquitoes, ticks (e.g. malaria, West Nile virus, Lyme disease)
   - physical contact (e.g. pinkeye, herpes, chickenpox, sexually transmitted diseases)

   You can catch an infectious disease due to a virus by getting it on your hands and then touching your mouth or eyes or eating food you have touched with unwashed hands. The AIDS virus IS NOT spread this way.

   Ways that HIV/AIDS is transmitted from one person to another:
   - by having vaginal or anal intercourse with a person who is infected with HIV
   - by sharing needles with someone who is infected with HIV
   - from an infected mother to her baby during pregnancy, birth, or nursing

2. Ways to prevent infection:
   - Avoid close contact with people who are infected.
   - Use tissues if you have a cold or flu and throw them away.
   - Wash your hands – especially before eating, after using the toilet, or after contact with someone who has an infection.
   - Don't touch other people's blood or bodily fluids (e.g. soiled tissues from someone who has a cold).
   - Don't share toothbrushes, eating utensils, makeup etc.
   - Eat nutritious food to keep the body healthy.

Ways to prevent HIV infection:
- Abstain from sexual contact, or reduce risk by monogamous (mutually faithful) relationship and the use of condoms.
- Don't use intravenous drugs.
- Treatment of a pregnant woman can reduce the risk of infecting her baby.

3. Differences in spread of airborne vs. person-to-person contact diseases
   - Airborne diseases can be spread to multiple people at the same time and can be spread to people who are nearby but not in direct contact.

4. Why is the spread of infection slower in real life? The rate of interactions with other people is typically slower. Even when you have contact, you don't always transmit any germs or enough germs to start an infection. If a person does get enough germs to start an infection, it takes a while for the germs to reproduce to high enough levels for that person to become contagious.

4. What are your responsibilities? To notify others that you (or your child) have been in Contact with an infected person. This will help prevent the spread of disease.

6. What role does Saskatchewan Public Health play? The Communicable Disease Control (CDC) Unit collects, compiles, and analyzes statistical information on about 70 communicable diseases that are reportable by law in the province. The unit conducts surveillance on communicable diseases and supports regional health authorities in communicable disease outbreak investigations and the early warnings of disease trends. The unit also:
   - purchases and distributes vaccine products for the routine infant, pre-school and school immunization programs as well as vaccines for targeted programs for persons at high risk; as well, the unit purchases and distributes medications for the outpatient treatment of sexually transmitted infections;
   - develops policies relating to immunization programs, vaccine maintenance and control of communicable disease;
   - develops and distributes educational materials on selected communicable diseases and vaccine-preventable diseases as well as disease data collection forms;
   - participates in research relating to communicable disease issues, usually in partnership with regional health authorities, agencies of the federal government and community agencies; and
   - houses the office of the provincial HIV/BBP [blood borne pathogens] & IDU [injecting drug user] Consultant, which develops provincial policies and supports community-based activities, in addition to acting as the secretariat for the Saskatchewan Advisory Committee on AIDS. (As retrieved April 24, 2007 from http://www.health.gov.sk.ca/ph_ph_cdc_unit.html)

7. What other factors influence your risk of getting an infectious disease? Susceptibility to infection can be reduced by good hygiene practices, such as washing your hands after possible exposure to pathogens before touching your eyes, mouth, or mucous

membranes where infection may occur. Susceptibility may be increased by a weak immune system due to age, medication, previous illness, inadequate nutrition, etc. Resistance to a specific infectious disease can be increased if you have had this infectious disease previously or been vaccinated against this disease (see 8 below).

What defences does your body have that can prevent you from getting sick, even when you have been exposed to a pathogen?
Important defences include barriers such as the skin and mucous membranes, chemicals such as acid in the stomach, inflammation, and phagocytic cells. The specific immune system also contributes to defences against infection, but more slowly, as discussed in 8 below. (Any good biology text will provide additional information.)

8. How does your body eventually get rid of the viruses that cause a cold or flu? If a cold or flu virus gets past the first set of defences (such as the mucous membranes) and infects your body, your immune system is stimulated to produce specific immune system cells (B cells and T cells) that can effectively fight the particular virus that has infected your body. This response takes time, especially the first time you are exposed to a specific virus, so you are sick with a cold or flu until the specific immune cells become effective enough to rid your body of the virus.

   After an infection, your body will have memory cells which can produce a rapid defence if you are exposed a second time to the same virus, so you are able to fight off a second infection rapidly and effectively, so the level of viruses is kept low and you never feel sick. A vaccination induces the production of memory cells which can mount a rapid defence against that particular infection, so the flu vaccine helps people to avoid infection with the specific strains of flu included in a particular flu vaccine.

9. Why is a person with an HIV infection unable to get rid of this infection the way a person can get rid of an infection with a cold or flu virus? There are many reasons why our bodies are unable to get rid of an HIV infection. One important reason is that HIV infects an important type of T cell, the Helper T cell, which is crucial in mobilizing other immune cells to fight infection. As more and more Helper T cells are killed by HIV infection, the body becomes less and less able to fight infections, including HIV infection. Another reason why the body cannot get rid of HIV infection is that the genetic material of the HIV virus is incorporated in the DNA of infected Helper T cells, and some of these infected cells can survive undetected by the immune system over long periods of time.

10. Many people with certain communicable diseases are affected by social stigmas. Such diseases as leprosy, HIV, tuberculosis, Hepatitis A and B and many other sexually transmitted diseases have such social stigmas that often people hide the disease and therefore may not receive proper treatment.

Teaching Points

Mathematical Perspective

- Spread of infectious disease from person to person in a population results in exponential increase in the number of infected people (similar to population growth). This is a non-linear mathematical relationship.
- Ways infectious diseases spread.
- Ways to prevent spread of infection.
- Concept of germ population growing in an infected person's body and defences against infection.

Social Aspects

- Moral responsibilities of having a communicable disease or a child with one.
- Existing community and governmental supports.
- Address the social stigmas and stereotypes which surround people with infectious diseases such as HIV/AIDS and other sexually transmitted diseases.

Background Information on Making of Pemmican[30]

The making of pemmican takes a year of preparation from September to mid August when it is made.

Preparing Ingredients ⟶ Making the Pemmican ⟶ Eating

September – August August November – February

Preparing Ingredients

Fall
- Make trails to maple trees and mark them for tapping in the spring.
- Gather wood to make charcoal.

Spring
- Tap trees
- Prepare birch pots for storage of syrup
- Gather approximately 100 rocks from the river. They will be about the size of your fist and a reddish-grey colour.
- Prepare willow branch tongs for lifting the rocks.
- Heat rocks in the charcoal
- Boil sap by putting hot rocks in.
- Keep the sap boiling by having it at right height on tripod over fire.
- Use a flat stick with a hole in it to test the sap and see if it is ready.
- The sap has boiled enough when you can blow a bubble of sap through the hole.
- Put slightly cooled sap into small birch bark cups which are stored in a larger basket, sealed with pine pitch.

Summer
- In mid-June, wild strawberries are ready.
- They are picked and placed in a leather bag with holes.
- The juice is squeezed out and given to Elders and babies as the juice is full of nutrients.
- The flesh of the berries is dried out into cakes on a clean fawn hide.
- When it is hottest, during the last week in June or early July, animals are hunted for meat. At this time, they have not yet begun to store fat for winter, and animals are leanest.
- Buffalo or moose could be used. The plains buffalo and the wood buffalo each gave a different flavour to the pemmican.
- The wood buffalo was believed to have more medicinal qualities due to the diet of the animal.
- It is believed that a reason for migration is that people were following the buffalo.

[30] As told by Danny Musqua, Saulteaux Elder, June 2, 2006.

- In July the meat is dried in the sun smoked with willow, maple, or chokecherry. Each type of tree gives a different flavour. Some women were better at smoking the meat because they were making observations about the amount of smoke – the taste, feel, and smell.
- In the second week in August the Saskatoon berries are ready to be picked and dried.
- By mid to end August, all the ingredients have been collected and the pemmican can be mixed.

Recipe

2 strawberry cakes	Saskatoon berries
1 or 2 cups of maple sugar	Meat

- Women knew by feel, taste and appearance how much of each ingredient to include.
- Pemmican was stored in birch or leather bags lined with cedar to keep the bugs away. The bags were sealed and stored in the tipi.
- The pemmican could last up to 10 or 15 years.
- The pemmican would be eaten in the months when it was too cold to go hunting, and the animals aren't moving. This could be as early as mid-November to February depending on the weather.
- To last the winter, ½ bag of pemmican per adult and ¼ bag per child were needed.

How to connect to the curriculum…

One suggestion is to use this traditional knowledge as a way to contextualize science, and it would be ideal if learners could be taken through the process as participants in the making of pemmican. Whether participating or hearing of the process, learners can learn scientific concepts and content in this context. Examples of this are:

- Boiling point could be studied when preparing the sap and keeping it at a particular height above the fire.
- An analysis of the food value and content of pemmican could be made. Why were Elders and babies given the juice of the berries?
- Determine which part of the animal were used for pemmican and why.
- Perhaps a project idea would be to have learners create a nutrition food label for pemmican following government standards.
- Pemmican could last for 10-15 years. Discuss food preservation and inhibiting the chemical reaction of food decomposition.
- Study the effects of different woods used in the smoking process, including length of burn, type of smoke, taste, and texture of the meat.
- Look at the entire process of making pemmican as example of a cycle and how to recognize patterns within the cycle. How does this relate to nomadic lifestyles?
- Why were reddish-grey rocks chosen and not other colours? Talk about heat transfer and capacity.
- Explore how elements of earth, fire, water, and air are involved in the process of making pemmican.

Science Fair

Topic Ideas for Projects

As generated and submitted by: Level Three Science Students DTI, Prince Albert 2007

1. Crystals Everywhere!
2. Earth's Magnetic Field
3. Colors of Aurora Borealis
4. Tsunami Effects
5. Solar Hot Dog Cooker
6. Osteochondritis Dissecans Talus
7. Batteries, Batteries Everywhere (Used Household Materials)
8. Can 99.9% bacteria be killed?
9. Wings of a Butterfly
10. The Gift of Life
11. Bread Moulds
12. Crystal Methamphetamine Effects
13. Texture of Clay
14. Effects of Herbal Medicine
15. Effects of Aspirin on Plant Growth
16. Static Electricity
17. Saltiness of Water
18. Saturn's Magical Rings
19. Why do We Need Turbines?
20. Ouch, It Hurts! (Making sand paper)
21. Neutralization of Battery Acids
22. Tornadoes!
23. The Workings of a Gasoline Engine
24. Organic versus Chemical Fertilizers
25. Seismograph Functions
26. Which Stain Removers Best Eliminate Stains on Shoes?
27. What is a Rainbow?
28. How Does the Moon Affect the Earth's Ocean?
29. Are there any Electrical Currents in Fruits?
30. Splitting of Hydrogen and Oxygen
31. The Effect of Gravity on Plant Roots
32. Crystallization of Salt versus Sugar

These are the ideas students suggested during their studies of science.

Assessment

As submitted by Elizabeth Majocha, Instructor, Dumont Technical Institute, Prince Albert, SK

Science Fair Mark Allotments

Name: _____

Research Essay	15%
Display Backboard	10%
Graphing or Chart Drawing	5%
Experiment Preparation	5%
Hypothesis Verification #1	10%
Hypothesis Verification #2	10%
Hypothesis Verification #3	5%
Journal Note Taking	15%
Presentation #1	5%
Presentation #2	10%
Final Presentation (judges' marks)	10%
TOTAL	**100%**

Explanation for Science Fair Mark Allotments

Research Essay – After completing the thesis statement sheet, the student and instructor will discuss the evidence that students found. (Instructor will set up a rubric for essay writing with the class.) English writing skills and Science are well correlated in expression of ideas.

Display Backboard — Students will use their creativity within the boundaries of the rules of setting up a backboard. Visual Art and Science coordinate in self expressions students want to convey.

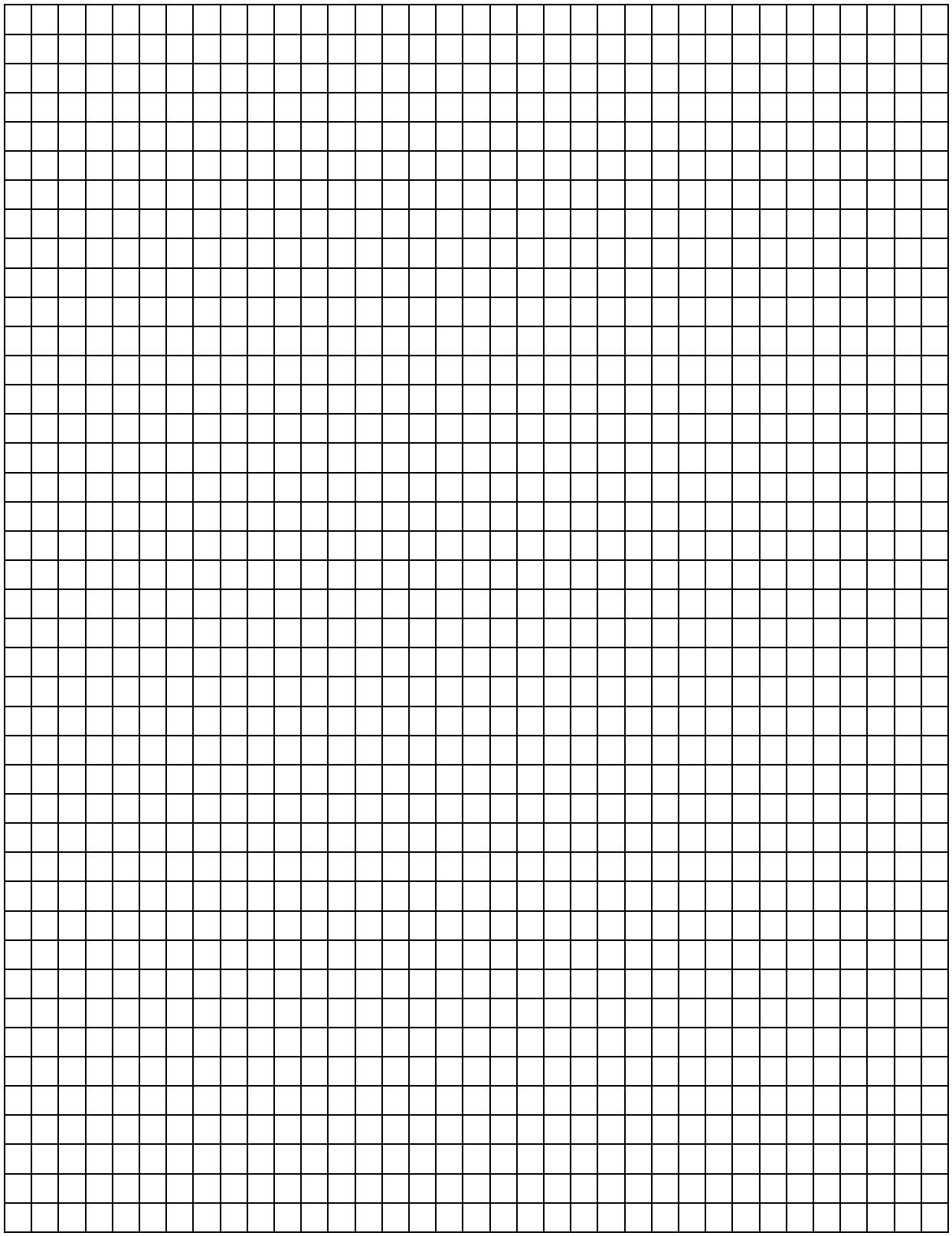
Graphing or Chart Drawing — Math and Science blend well!

Experiment Preparation — Students actually acquire apparatus needed for the experiment themselves. They may need to purchase items, ask another institute for permission to borrow the items needed to execute the experiment. English communication (in the ability to seek and ask for something outside of their school) and Science certainly go hand in hand.

Hypothesis Verification #1, #2, #3 — Students must learn to be thorough in their scientific experiment and learn that observation and recording must be meticulous.

Journal Note Taking — Students must be reflective in what they see (and hear) about their experimental process. For the student, the process of writing down their ideas is one of the greatest tools for learning and creative thought. When a student writes down a thought, it encourages him/her to write down more thoughts in the future. It works on the power of reinforcement in which the student will see progression of results from the experimental procedures. It is an excellent review for the student and allows the student to explore further on the methods use for the science experiment. Written Communication and Science seem to be parallel with one another.

Presentation #1, #2, and Final — Students will learn to communicate effectively as they must present their facts in a simple and concise manner. They use visual, the backboard, as a backup of some interesting concept that they are trying to portray to the audience. They learn to communicate their findings so that their research can be shared and repeated. Oral presentations develop poise and confidence in students and it develop organizational skills. Oral Communications, Life Skills, and Science make a great team!



Annotated Bibliography

Annotated Bibliography

Print Resources

Abbgy, T. (2001). ***Elements and the periodic table***. United States: Mark Twain Media, Inc. ISBN 1-58037-166-3

This black line master is a comprehensive look at the periodic table covering the organization of the table, the uses of the elements, and the origin of names and symbolism of the table. With each lesson there is a teacher's guide, student activities and assessments ready to be copied. The reading level is at grade 5-8+.

AGS Globe. (2007). ***Life skills health.*** Shoreview, MN: Pearson AGS Globe. ISBN 0-7854-4133-6

With a high interest, lower level (grade three to four reading level), this book is also appropriate for ESL students. Chapters cover human body systems, human development, and nutrition.

Barhydt, F. & Morgan, P. (1995). ***The science teacher's book of lists.*** San Francisco, CA: Jossey-Bass. ISBN 0-13-793381-9

This reproducible resource is divided into various disciplines of science, such as plants, animals, human health and nutrition, chemistry and physics. This compilation of lists can be used as a quick and easy reference, as a motivational set, or for review.

Bazin, M., & Tamez, M., & Exploratorium Teacher Institute. (2002). ***Math and science across cultures: activities and investigations from the exploratorium.*** New York, NY: The New Press. ISBN 1-56584-541-2

These activities and explanations can be used to explore the math and science of different cultural traditions. This book can help make science and math more relevant to people of all backgrounds and promote an inquiry-based approach to instruction in a multicultural classroom.

Bernstein, L. & Winkler, A. & Zierdt-Warshaw, L. (1996). ***Multicultural women of science.*** Saddlebrook, NJ: The Peoples Publishing Group, Inc. ISBN 1-56256-702-0

Five chapters highlight the achievements of women through three centuries in the areas of life science, medicine, and space science, chemistry and physics, environmental science and technology. A biographical sketch, a hands-on activity, and a page with critical thinking questions with at least four activities are provided for each person. This is a good resource to look at personal, multicultural and gender differences in science.

Bernstein, L. & Schachter, M. & Winkler, A. & Wolfe, S. (2003). ***Concepts and challenges: life science fourth edition.*** Shoreview, MN: Globe Fearon, Pearson Learning Group ISBN 0-130-23858-9

This student textbook is part of a program that comes with a teacher CD-ROM with blackline masters, visuals, colour transparency templates, rubrics, and more. The book covers branches of life science: living things, characteristics and needs, cells, organs and body systems, heredity, and the reproductive system. There are connections to work and everyday life organized in a separate table of contents in the Teacher's Edition.

Britton, E. & Huntley, M., & Jacobs, G., & Shulman-Weinberg, A. (1999). ***Connecting mathematics and science to workplace contexts: a guide to curriculum materials*****.** Thousand Oaks, CA: Corwin Press, Inc.

A compilation of reviews for science and math resources as they pertain to the teaching of these subjects in a workplace context. Each review contains information on the target audience, the workplace connections, instructional approaches, materials, assessments, teacher resources and more. This is a time-saving device for instructors wanting to review possibilities for new resources.

Colburn, H. et al. (2003). ***Science.connect ^{TM}2***. Whitby, ON: McGraw-Hill Ryerson Ltd. ISBN 0-07-089094-3

This Canadian developed text book is accompanied by a student multimedia CD-ROM which correlate to the topics and concepts in the textbook. Units in the book include Matter and Chemical Change, Energy Transformations, Disease Defence and Human Health, and Safety in Transportation. This text takes a real world contextual approach to science by looking at things such as the environment, home, and work. Within the text there are links to the McGraw Hill website for access to more information.

Dick, A. (2004). ***Alaska science camps, fairs and experiments.*** Alaska, USA: Alaska Native Knowledge Network.

A practical book on how to set up a camp including types of camps, staff, students, and Elders. There are suggestions for culturally-relevant science fairs with sample assessment tools and over 200 project ideas. There are also numerous experiments which give background information on traditional ways of knowing, as well as ideas for promoting inquiry and building habits of mind.

Enger, S. & Yager, R. (2001). ***Assessing student understanding in science: a standards-based K-12 handbook.*** Thousand Oaks, CA: Corwin Press, Inc. ISBN 0-7619-7649-3

This offers a practical approach to assessment standards in science. The authors include alternative assessments, rubrics, grade level exemplars, and suggested ways to evaluate teaching practices. It can be used as a black-line master or sample assessment tools can be modified to suit learner needs.

Fraser Health Authority. (2002). ***Beyond fast foods.*** Delta, BC: Author.
This compilation of activities and resources focuses on personal relationships with food as well as the importance of iron, calcium, and fat. There are activities that centre around the foods specific to different cultural backgrounds. Learners examine the type of foods prepared and served on special days during holidays, celebrations, or feasts. Although geared toward grades ten through twelve, all activities can be easily adapted.

Government of Saskatchewan. (1995). ***Diverse voices: selecting equitable resources for Indian and Métis education.*** Author: Regina, SK.
This is a guide for choosing resources for Indian and Métis education to ensure equity and value other cultures.

Grant, J. (2006). ***Discarded science: ideas that seemed good at the time….*** AAPPL Artists and Photographers Press: Surrey, UK ISBN 1-9043-3249-8
This instructor resource depicts changes in science theory, and has chapters on: Worlds in Upheaval; Lost Worlds; Lost People; Lost Creatures-Atlantis; Amazons; Mu; Survival of the Brightest; and Hard Science.

Greenberg, B., & Patterson, D. (1998). ***Art in chemistry; chemistry in art*****.** Englewood, CO: Teacher Ideas Press. ISBN 1-56308-487-2
This book is designed to integrate visual art with chemistry. All the concepts of chemistry are taught through art. Topics include color, jewellery, photography, molecular structures as sculptures, forgery, art conservation, and restoration. Although this resource is written for Grade 10 – 12 chemistry, the ideas can be adapted easily for ABE Level Three.

Kardos, T. (2003). ***Easy science demos and labs: physics.*** Portland, ME: J. Weston Walch. ISBN 0-8251-4502
The resource provides 75 demonstrations to use in physics for the topics of electricity, force and motion, heat, circuitry, calorimetry and more. Instructors may photocopy the demonstrations for classroom use. At the back of the book there is a glossary as well as a comprehensive appendix with reference material on topics such as units and conversions, melting points, boiling points, and densities.

Lantz, H, Jr. (2004) ***Rubrics for assessing student achievement in science grades K-12.*** Thousand Oaks, CA: Corwin Press. ISBN 0-7619-3101-5
This collection provides a collection of assessment tools in the context of standards-based performance, assessment, and evaluation. This book provides very specific assessment tools in three formats: performance list rubrics, holistic rubrics, and analytic rubrics. Some examples of rubrics include the language of science writing, measuring scientifically, oral presentation in science, scientific drawing, writing to inform in science.

Llewellyn, D. (2002). ***Inquire within: implementing inquiry-based science standards***. Thousand Oaks, CA: Corwin Press, Inc. ISBN 0-7619-7745-7

This is a practical book with numerous examples, grounded in research, on how to teach science through the inquiry process. This book is suitable for both experienced teachers and those new to the profession.

Llewellyn, D. (2005). ***Teaching high school science through inquiry***. Thousand Oaks, CA: Corwin Press, Inc. ISBN 0-7619-3938-5

With case studies, tips and tools to guide reform in the instruction of science, this book is a practical guide on how to incorporate inquiry based instruction, modify labs to be inquiry based, and look at assessment strategies.

Marshall, R. & Jacobbs, D. & Rosskopf, A. & LaRue, C. (2004). ***General science teacher's edition.*** Circle Pines MN: AGS Publishing. ISBN 0-7854-3647-2

With chapters on physical science, science, life science, and the human body, this text addresses several of the learning outcomes in the matter, energy, life, and integrated science strands. Material is presented in manageable amounts. Reading level is placed at Spache 3.8. The Teacher's Edition addresses the concept of multiple intelligences and has tips for lesson planning, portfolio inclusions, and a workplace connection in side bars.

Mix, F. (1999). ***House wiring simplified: tells and shows you how.*** Tinley Park, IL: The Goodheart-Willcox Company. ISBN 1-56637-542-8

Teach the applications of electricity, safety, and circuitry with this easy to read, how-to book that includes detailed diagrams and photographs in colour. There are chapters on safety, electrical terms, electrician's tools, and equipment. This book would be a good bridge from theory to application for learners.

Roberts, R. (1989). ***Serendipity: accidental discoveries in science***. New York, NY: John Wiley & Sons, Inc. ISBN 0-4715-0658-3

This is a great reference book for happenstance science. It has topics for biology, chemistry, and physics, as well as general interest topics such as Velcro©, Teflon©, and cornflakes. The book also contains the legend of the discovery of quinine First Nations people in the Andes Mountains of South America. There are many photographs and illustrations.

Sax, M., & MacDonald, D., &Hansen, M. (2005). Ecoliving***: Your guide to sustainable living.*** Regina, SK: Regina Ecoliving Inc.

This publication is a directory and citizen's resource that introduces the topic of ecoliving with references to initiatives and alternatives for everyday living. Although the book is published in the city of Regina, many websites, ideas, organizations, and suggested actions can be applied in the learners' communities.

Slesnick, I. (2004). **Clones*, cats and chemicals: thinking scientifically about controversial issues.*** Arlington, VA: NSTA Press. ISBN 0-87355-237-7

This resource presents several controversial issues in the fields of biology, chemistry, physics, Earth science, mathematics, and technology. It is organized so learners can examine the issue and come to some resolution. Topics such as genetic screening, hunting, stem cell transplants, and cloning are provided with a teacher section highlighting the science, followed by a student version ready to copy. This is an excellent way to spur discussion around ethics and values.

Stephens, S. (2000). ***Handbook for culturally responsive science curriculum.*** Fairbanks, AK: Alaska Science Consortium.

An integrated approach to Native and Western knowledge systems around science topics. Discusses bringing Elders in the classroom, best practices for instruction and assessment that not only meet standards, but honour other cultures.

Strohmaier, R. (1998). ***Science within reach***. Kingston, ON: Kingston Literacy. ISBN 1-895999-15-4

This manual is written specifically for the teaching and learning of science in adult literacy programs. The book offers readings, experiments, and activities as well as follow up activities in four areas: chemistry, health and the body, weather and machines, and energy. Most materials and equipment needed for the activities are common household items or can be bought at the hardware or grocery store.

Saskatchewan Industry and Resources. (2005). ***25 Saskatchewan science & technology achievements.*** Regina, SK: Author. ISBN 0-9738066-0-5

This resource showcases 25 Saskatchewan people and their accomplishments in science and technology in the areas of general research and development, agriculture and biotechnology, medical research, IT and telecommunications, and energy. The achievements are provincial, national, and international. A companion website to the book is available online at www.sk25.ca.

Texley, J. & Kwan, T. & Summers, J. (2004). ***Investigating safely: a guide for high school teachers.*** Arlington, VA: NSTA Press. ISBN 0-87355-202-4

This is a very detailed science safety book, with 11 chapters dealing with safety for specific disciplines, including chemistry, physics, biology, Earth, and space science. It also includes general safety information and material safety data sheets. There are links to the Internet via the National Science Teachers' Association to help learners and instructors use the Internet effectively and safely.

Video

CTV Television Network. (2002). ***Saskatchewan's 7 wonders.*** Saskatoon, SK: CTV Saskatoon.

Host Jennifer Jellicoe takes viewers on a journey through Saskatchewan looking at the seven natural wonders of the environment. This film shows the diversity of Saskatchewan's landscape.

Knowledge Network. (2002). ***F.A.S.: when the children grow up.*** Montreal, QC: National Film Board of Canada.

This program tells the stories of adults living with fetal alcohol syndrome and fetal alcohol effects – some who were diagnosed early and others who were not – and the events, programs, and people who made a difference in their lives.

No One to Blame Productions. (2002). ***Biodemocracy: making a difference.*** Montreal, QC: National Film Board of Canada.

This documentary is a compelling critique of how science is done as well as issues surrounding government funding and the lack of risk assessment in the field of biotechnology and genetic engineering. Featuring David Suzuki, the film examines the morals and ethics of science.

Red River College. (2000). ***Our children, our ways: exploring the natural world.*** Winnipeg, MB: Red River College.

This reflects the fundamental value of Inuit and First Nations people, which is to live in harmony with the natural world. This is one video of a series for early childhood education in First Nations and Inuit communities. It can be used to support the Interrelationships Strand as well as inquiry based learning and creating a sense of wonder. The film takes the viewer across Canada through all seasons, in an exploration of the outdoors.

University of Maryland and the Educational Film Centre. (1990). ***The world of chemistry. (series).*** S. Burlington, VT: Annenberg Media. ISBN 1-55946-223-X

Learners get a front row seat and witness several processes, some of which are too dangerous or impractical to experience directly. The series covers topics in chemistry, physics, and Earth science. This may also be used as an instructor review.

Young, R. (2002). ***Organic prophecies.*** Montreal, QC: National Film Board of Canada.

This documentary chronicles the innovative approach taken by Dr, Ken Taylor, an organic farmer in south-western Quebec. Taylor has a PhD in chemistry, and presents information about the damage that can be done because of genetically-engineered and pesticide-laden foods.

Electronic Resources

Advanced Education and Employment – Adult Basic Education

As retrieved on April 24, 2007. http://www.aee.gov.sk.ca/abe/curriculum/

This site has all five Level Three curricula listed in two formats – online and PDF. Each online version has links to sites that support the learning outcomes as well as the suggested topics, strategies, activities, and instructor tips.

Bottle Biology

As retrieved on May 28, 2007. http://www.bottlebiology.org/

This site, funded by the National Science Foundation, is full of ways to use pop bottles and other recyclable materials to learn and teach about science and the environment. There are several step by step activities online.

Centre for Indigenous Peoples' Nutrition and Environment (CINE)

As retrieved on April 15, 2006. http://www.cine.mcgill.ca/index.htm

CINE, a university research centre affiliated with McGill University, was created in response to a need expressed by Aboriginal Peoples for participatory research and education to address their concerns about the integrity of their traditional food systems. This site examines the benefits and risks of traditional foods and presents information on the impact that the deterioration of the environments has had on the health and lifestyle of Indigenous Peoples.

Garbage Delight

As retrieved on June 22, 2006. www.garbagedelight.com

The website documents the actions of a small group of people from Regina who are trying to reduce the size of a person's ecological footprint by using worm farms to reduce household waste. A starter manual is available for downloading, and everything that is needed to start a worm farm is listed for sale on the site.

Health Canada

As retrieved on May 17, 2006 http://www.hc-sc.gc.ca/

This Government of Canada website provides information to help Canadians improve and maintain their health. There is a multitude of resources in food and nutrition, diseases, consumer product safety, as well as First Nations and Inuit health. Current research is also presented. Apply online for free classroom resources.

Media Group

As retrieved on June 5, 2006. http://videodb.mg.sk.ca/

In collaboration with Saskatchewan Learning, Media Group provides educational video duplication services for a wide variety of titles. Fees include: standard duplication fee of $1.00 per video; duplication fees according to the length of the video; as well as the cost of the video tape and postage. Clients may provide their own videotapes.

National Research Council of Canada

As retrieved on March 11, 2006.
http://www.nrc-cnrc.gc.ca/education/main_e.html

This site provides resources for both instructors and learners in the areas of science and technology, presents information on current Canadian research. There is an interactive microscope and periodic table as well as other activities.

Native Access to Engineering Programme (NAEP)

As retrieved on May 5, 2006. http://www.nativeaccess.com/index.html

This organization advocates for the success of Aboriginal students in the sciences. Their site provides supports in curriculum with culturally relevant lessons and professional development opportunities. The goal of the NAEP is to reach out to elementary and secondary students to encourage them to stay in school and study science and math.

Project-based Learning (PBL) Checklists

As retrieved on February 1, 2006. http://pblchecklist.4teachers.org

This site enables instructors to create customizable project checklists for written reports, multimedia projects, oral presentations, and science projects. These checklists are designed to help instructors begin using Project Based Learning in their programs.

Regina EcoLiving

As retrieved on January 6, 2006. http://www.reginaecoliving.ca

This is a Regina-based non-profit group. The website provides tips for sustainable living, a listing of scheduled eco-events, and a link to calculate an individual's ecological footprint. This is an example of what a small number of people can do to make a difference to the environment.

Rekindling Traditions: Cross Cultural Science and Technology Units

As retrieved on November 28, 2005. http://www.usask.ca/education/ccstu/

This website is presents culturally-responsive units that were developed by and for Saskatchewan Aboriginal residents, in conjunction with Glen Aikenhead and the University of Saskatchewan. There is a Teacher's Guide and units that make Western science available to Aboriginal learners in a way that nurtures their cultural identities.

Saskatchewan Adult Basic Education Association

As retrieved on March 26, 2006. http://www.sabea.ca/

This site provides an opportunity for Adult Basic Educators in Saskatchewan to join a professional organization, network with one another, as well as gain access to relevant links and professional growth opportunities. Members of SABEA can participate in online forums, read and write posts, and share resources in subject-specific areas. There are articles dealing with current issues and links for resources pertinent to adult education.

Saskatchewan Health

As retrieved on June 8, 2007. http://www.health.gov.sk.ca/

This learner and instructor resource offers a "reading room", where information is presented alphabetically.

Science and Mathematics Initiative for Learning Enhancement

As retrieved on November 9, 2005. http://www.iit.edu/~smile/index1.html

This site offers over 900 lesson plans in of biology, chemistry, physics, and mathematics. Lesson plans include the materials, a suggested strategy, and expected outcomes with areas covering matter, electricity, anatomy and physiology, and many more.

Science and Technology for Canadians

As retrieved on April 7, 2006. http://science.gc.ca/

This site has links to other Government of Canada websites on a wide spectrum of topics such as energy, the environment, food and health, space, and technology, with subcategories in each. This is an excellent site for learners to conduct a web quest.

Serendip

As retrieved June 3, 2006. http://serendip.brynmawr.edu

Click on the science education link to connect to some ready to use, hands-on activities for biology which have been created by faculty from the University of Pennsylvania and local K-12 teachers. Topics include genetics, natural selection, micro-organisms, and human physiology. There is also a link to "Off the Shelf Chemistry". This set of 18 chemistry activities, designed by a high school chemistry teachers for high school students, uses consumer products for experiments and does not require a lab and specialized equipment.

Texas Collaborative for Teaching Excellence

As retrieved February 14, 2006. http://www.texascollaborative.org/tools/TSI.pdf

This teaching style inventory provides instructors with an opportunity to obtain a snapshot of their teaching preferences and styles. A 12 question inventory ranks statements which are then placed on a matrix, providing an excellent reflective tool. Instructors could use the inventory to examine the way they teach different subjects, or it could be used to determine the teaching styles for a group of teachers.

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Website: http://www.learner.org/

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Fax: (877) 444-3354
Website: http://videodb.mg.sk.ca

Mind Resources
130 Shoemaker Street, Unit #1
Kitchener ON N2E 3G4
Phone: (877) 414-6463
Fax: (519) 895-0331
Website: http://www.mindresources.com/

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PO Box 6100 Station Centre-ville
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Fax: (514) 283-7564
Website: http://www.nfb.ca/

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