

Mathematics, Level III

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Introduction

The Changing Context of Adult Education

Adults who return to formal learning are likely entering a different world of education than they previously experienced. Many adult learners juggle multiple responsibilities related to parenting, employment, and community involvement.

As globalization makes world markets more accessible, workplace demographics and the scope of business are changing. New, affordable tools must be factored into adult education to create a skilled workforce that can compete in these global markets.

Adult education must respond to these challenges by providing successful learning environments. Today's workers are expected to have knowledge and skills that were unimagined a few decades ago. Nova Scotians are called upon to solve more problems, make more connections, think more critically and creatively, and communicate in more ways than ever. To meet these demands, workers must embrace lifelong learning.

Essential Skill Requirement for the Workplace

There is evident pressure for adults to achieve a high school graduation diploma. Nova Scotian employers expect a high school education from people applying for most entry-level jobs. Entrance into skilled trades and technologies (as well as entry-level workplace training programs) usually require a high school diploma. Newly created jobs may even require post-secondary education.

Educational Research

The fields of education, psychology, and sociology are exploding with research. Quality curriculum development needs to be grounded upon substantive results from these studies. This document integrates key research findings that help form the foundation for outcomes, learning activities, and the assessment suggestions provided in adult learning programs.

Nova Scotian Response: NSSAL/ALP

The Nova Scotia School for Adult Learning (NSSAL) coordinates and supports the delivery of adult education programs. It was created in response to global, national, and provincial issues and helps adults to prepare for life and work in the 21st century.

The Department of Labour and Workforce Development provides funding and coordinates the activities of three types of delivery partners: community-based programs, the Nova Scotia Community College, and Adult High Schools. This funding supports tuition-free programs for Nova Scotian adults. Two of these delivery partners, community-based programs and community colleges, develop programs based on the Adult Learning Program (ALP), which is flexible in delivery and recognizes a variety of credits. The Department of Labour and Workforce Development develops this curriculum in partnership with the Public School branch of the Department of Education and (when appropriate) with employers and labour

market specialists. Information about the ALP can be found through the Nova Scotia School for Adult Learning website (<http://gonssal.ca>).

Five Crosscutting Themes of the Adult Learning Program (ALP)

NSSAL partners have discovered five crosscutting themes—themes that apply across the curriculum—that affect learner success. These themes have been applied to all aspects of curriculum planning and program delivery. They include employability, literacy, numeracy, technology, and inclusivity.

Employability

ALP learners are in transition. Their return to learning provides an opportunity to improve their skills and better their credentials. When learners can make the link between classroom learning and the real world, they usually respond with increased motivation.

Instructors can enhance these connections by helping learners recognize links between past experiences, natural abilities, genuine interests, and the realities of their lives. By the end of every ALP course, learners should be able to connect skills they learned in the classroom with skills they need to find work. They should have a repertoire of employment-related resources for independent use and should understand the meaning of employability skills

To understand what employers are looking for, the Adult Learning Program uses as a benchmark The Conference Board of Canada's Employability Skills (www.conferenceboard.ca/education/learning-tools/pdfs/esp2000.pdf). These include the Essential Skills as defined by Human Resources and Social Development Canada and are considered necessary to enter, stay in, and progress in the world of work, either independently or as part of a team. They are presented with the permission of The Conference Board of Canada in three sections: Fundamental Skills, Personal Management Skills, and Teamwork Skills on the following page.

Employability Skills 2000+

The skills you need to enter, stay in, and progress in the world of work—whether you work on your own or as a part of a team.

These skills can also be applied and used beyond the workplace in a range of daily activities.

Fundamental Skills

The skills needed as a base for further development

You will be better prepared to progress in the world of work when you can:

Communicate

- read and understand information presented in a variety of forms (e.g., words, graphs, charts, diagrams)
- write and speak so others pay attention and understand
- listen and ask questions to understand and appreciate the points of view of others
- share information using a range of information and communications technologies (e.g., voice, e-mail, computers)
- use relevant scientific, technological and mathematical knowledge and skills to explain or clarify ideas

Manage Information

- locate, gather and organize information using appropriate technology and information systems
- access, analyze and apply knowledge and skills from various disciplines (e.g., the arts, languages, science, technology, mathematics, social sciences, and the humanities)

Use Numbers

- decide what needs to be measured or calculated
- observe and record data using appropriate methods, tools and technology
- make estimates and verify calculations

Think & Solve Problems

- assess situations and identify problems
- seek different points of view and evaluate them based on facts
- recognize the human, interpersonal, technical, scientific and mathematical dimensions of a problem
- identify the root cause of a problem
- be creative and innovative in exploring possible solutions
- readily use science, technology and mathematics as ways to think, gain and share knowledge, solve problems and make decisions
- evaluate solutions to make recommendations or decisions
- implement solutions
- check to see if a solution works, and act on opportunities for improvement

Personal Management Skills

The personal skills, attitudes and behaviours that drive one's potential for growth

You will be able to offer yourself greater possibilities for achievement when you can:

Demonstrate Positive Attitudes & Behaviours

- feel good about yourself and be confident
- deal with people, problems and situations with honesty, integrity and personal ethics
- recognize your own and other people's good efforts
- take care of your personal health
- show interest, initiative and effort

Be Responsible

- set goals and priorities balancing work and personal life
- plan and manage time, money and other resources to achieve goals
- assess, weigh and manage risk
- be accountable for your actions and the actions of your group
- be socially responsible and contribute to your community

Be Adaptable

- work independently or as a part of a team
- carry out multiple tasks or projects
- be innovative and resourceful: identify and suggest alternative ways to achieve goals and get the job done
- be open and respond constructively to change
- learn from your mistakes and accept feedback
- cope with uncertainty

Learn Continuously

- be willing to continuously learn and grow
- assess personal strengths and areas for development
- set your own learning goals
- identify and access learning sources and opportunities
- plan for and achieve your learning goals

Work Safely

- be aware of personal and group health and safety practices and procedures, and act in accordance with these

Teamwork Skills

The skills and attributes needed to contribute productively

You will be better prepared to add value to the outcomes of a task, project or team when you can:

Work with Others

- understand and work within the dynamics of a group
- ensure that a team's purpose and objectives are clear
- be flexible: respect, be open to and supportive of the thoughts, opinions and contributions of others in a group
- recognize and respect people's diversity, individual differences and perspectives
- accept and provide feedback in a constructive and considerate manner
- contribute to a team by sharing information and expertise
- lead or support when appropriate, motivating a group for high performance
- understand the role of conflict in a group to reach solutions
- manage and resolve conflict when appropriate

Participate in Projects & Tasks

- plan, design or carry out a project or task from start to finish with well-defined objectives and outcomes
- develop a plan, seek feedback, test, revise and implement
- work to agreed quality standards and specifications
- select and use appropriate tools and technology for a task or project
- adapt to changing requirements and information
- continuously monitor the success of a project or task and identify ways to improve



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**Literacy/
comprehension**

Literacy/comprehension recognizes the importance of learners' abilities to understand, synthesize, and think critically about reading material, as well as express ideas clearly in writing. As a fundamental skill, literacy is emphasized throughout the ALP curriculum. When literacy is highlighted as a crosscutting theme, the challenge for instructors is to find ways to include reading, writing, and comprehension skills as they teach a subject. When learners see—and show—how they read effectively, they become an integral part of the solution.

There seems to be a strong correlation between fluent literacy skills and successful daily living. Research identifies how reading needs to be strategically taught in order to improve comprehension. For learners who struggle with literacy/comprehension skills, reading materials without guided instruction are ineffective.

All ALP instructors must build the skills and confidence their learners need to focus on reading comprehension and writing development during classroom activities.

Numeracy

The ability to solve daily living and workplace problems using math skills is becoming increasingly important. Although digital tools help with computation, independent problem-solving strategies are highly valued by employers. This is especially evident in trades and technologies where math skills are required to apply for a job and to keep it.

According to statistical data, educators face serious challenges to improve the numeracy skills of Nova Scotian learners. During the years 2002–2005, there was a decrease in learners who successfully completed the math portion of the General Equivalency Diploma (GED). In spite of this, learners have made great strides in math when offered a chance to take on leadership and work in a collaborative environment.

Instructors need to use practical examples to teach learners why particular mathematical skills are the ones they use to solve problems. It is important for learners to integrate the math skills they learn at home and at work.

ALP instructors can help learners to improve their numeracy skills by making direct connections to the mathematics and problem-solving skills required in their subject areas.

Inclusivity/diversity

ALP learners come from diverse backgrounds and cultures. Some have diagnosed disabilities; others have serious blocks to learning that have not been identified. Having the instructor know and respect them as individuals is essential for learners to reach their potential, especially since low self-esteem often prevents ALP learners from achieving. In order to address low-self esteem issues, the ALP environment was created from respect for adult learners, their heritage, and their individual ways of learning. Teaching the value and acceptance of personal differences is one of the most rewarding things an ALP instructor can do.

The key is positive communication. When the instructor facilitates the crosscutting themes of inclusivity and diversity, all learners feel welcome, supported, and respected. This allows ALP instructors to help learners build their confidence and define their goals.

The ALP curriculum uses several strategies to encourage learners and instructors to explore and celebrate who they are:

- making personal and cultural explorations part of course outcomes and demonstrations
- suggesting activities that require learners to reflect on their backgrounds, culture, communities, attitudes, learning strengths, and challenges
- providing appendices with activities to help learners and instructors recognize their backgrounds and prior knowledge before going on to learn new knowledge or skills
- incorporating assistive technology into teaching and learning activities and resources

Technology

Technology affects everyone in Nova Scotia. Whether it's gas pumps that accept credit cards, high-speed Internet, or programmable household appliances, technology is everywhere. Labour-intensive jobs that have not disappeared have merged with technology, requiring applicants to have skills in this area.

Integrating technology into all aspects of the Adult Learning Program helps ALP learners gain confidence and skills in using these technologies.

Technology (cont'd)

The ALP curriculum guides reflect a variety of uses and functions of technology:

- **Basic Operations and Concepts:** These concepts and skills help people use information technologies efficiently and safely.
- **Productivity Tools and Software:** These help people select and use technology efficiently to perform tasks including these:
 - exploring ideas
 - collecting data
 - working with data, which includes discovering patterns and relationships
 - solving problems
 - showing what has been learned
- **Communications Technology:** These are specific, interactive technologies that support collaboration and sharing.
- **Research, Problem Solving, and Decision Making:** These tools help learners use technology to organize, reason, and evaluate.
- **Social, Ethical, and Human Issues:** Learners need to understand how to use the technologies that encourage them to build and improve their learning environments and to foster strong relationships with their peers and others who support their learning.

ALP instructors help learners to embrace technology by providing them with choices of tools to work with, including CDs and the Internet. In addition, ALP instructors offer Assistive Technology options for learners who want to find out if certain hardware/software applications can help them learn. Finding these applications helps learners gain the confidence and skills they need to ensure their employability in the changing workplace.

Benefits of Outcomes-Based Curriculum for Adult Learners

Curriculum outcomes are the foundation for all ALP curriculum guides. They clearly state what learners are expected to know, do, and value at the end of every ALP course.

Demonstrations provide details and help clarify what knowledge, skills, and attitudes learners are expected to gain with each learning outcome.

Using outcomes and demonstrations clarifies the goals for instruction. It also helps instructors and students to focus on the learning experiences that are relevant to achieving these results. Only a student can achieve an outcome; instructors, textbooks, or groups of students cannot. When planning, it is important to consider what criteria indicate whether a student has achieved the desired outcome and how the instructor may lead the student to that point. This process is as diverse as the learners.

Outcomes-Based Curriculum Encourages Effective Adult Learning Principles

<p>Provides Opportunities for Prior Learning and Recognition (PLAR)</p>	<p>Organizing an adult program around specific outcomes and demonstrations lets learners identify what parts of a course they already know and what skills and attitudes they have. This process of prior learning and recognition (PLAR) can help learners avoid unnecessary repetition as they navigate through the ALP toward their goals.</p>
<p>Encourages Learner Self-Reflection, Self-Assessment, and Goal Setting</p>	<p>Clear outcomes place learners at the centre of the goal-setting and assessment process. Self-assessment is a metacognitive process involving self-observation and self-awareness, leading to the active steps of self-regulation and the continuation of this cycle.</p> <p>Learners are the active agents in this process. Instructors can encourage learners to identify their strengths and weaknesses and to set both personal and career goals, and they can help them establish self-assessment criteria for measuring their success.</p>
<p>Promotes Flexibility of Delivery</p>	<p>ALP curriculum guides suggest sequences of instruction and ways to organize the outcomes into units. However, instructors can choose how best to teach the outcomes and demonstrations based on the needs and interests of their learners.</p>

Features of ALP Curriculum Guides

The four-column format of the ALP curriculum guides does several things:

- illustrates how learning experiences flow from learning outcomes
- provides suggestions for teaching and learning for specific outcomes
- shows the relationship between outcomes and assessment strategies
- allows instructors to read the curriculum outline in many different ways
- makes it easier to search for specific information

The Two Page, Four-Column Spread

Each Adult Learning Program curriculum guide uses these elements:

Column One: Outcomes and Demonstrations	<ul style="list-style-type: none"> • This column contains outcome statements that describe what learners are expected to know, to be able to do, and to value by the end of the course.
Column Two: Suggestions for Teaching and Learning	<ul style="list-style-type: none"> • This column provides clarifications and elaborations of the outcome found in column one. This is accomplished by recommending specific learning opportunities for the learners.
Column Three: Suggested Teaching and Evaluation Items	<ul style="list-style-type: none"> • This column contains a variety of teaching and assessment items that learners should be exposed to. The intention of this column is to illustrate the wide range of questions that can be used to address specific outcomes. Some items in this column are challenging and may best be addressed through group work or with instructor assistance.
Column Four: Resources and Notes	<ul style="list-style-type: none"> • This column suggests specific print resources, online resources, and manipulatives that may help learners achieve learning outcomes. These resources also motivate, reflect an appropriate reading level, and support a range of differing learning preferences, styles, and needs. Instructors are not restricted to resources listed in this column. Instructors are encouraged to identify and use other resources that meet the needs of the students and support the outcomes in the curriculum document.

Characteristics of Effective ALP Delivery

Sharing an understanding about effective instruction will help NSSAL partners to deliver the ALP curriculum successfully. The following principles of adult learning are part of an effective program.

Principle of Adult Learning	Role of Instructors and Administrators
Learning is a process of actively constructing meaning.	<ul style="list-style-type: none"> • create learning environments that foster investigation, debate, participation, exploration, communication, questioning, collecting, and finding ways to predict • provide learners with meaningful experiences • help learners to develop methods of learning
Learners construct knowledge and make it meaningful by relating it to their prior knowledge and experiences.	<ul style="list-style-type: none"> • find out what learners already know and can do • create learning environments and plan experiences that build on learners' prior knowledge • acknowledge and respect learners' learning experiences that may influence their ways of perceiving, thinking, feeling, and approaching the world • respect and support learners' racial, cultural, and social identities • recognize, value, and use the great diversity of experiences and information learners bring with them • make sure that the learning materials reflect the diversity of learners • make sure learners are challenged to build on their prior knowledge, integrating new knowledge with what they already understand
Learning is enhanced when it takes place in a social and collaborative environment.	<ul style="list-style-type: none"> • make discussion, group work, and collaborative ventures central to classroom activities • structure opportunities where learners can interact in diverse social activities • make sure learners recognize the importance of transferring social and collaborative skills into their everyday lives • help learners to see themselves as members of a community of learners

Principle of Adult Learning	Role of Instructors and Administrators
Learners are able to see their learning as an integrated whole.	<ul style="list-style-type: none"> • plan opportunities to help learners make connections across the curriculum and link them with the outside world • provide learners with opportunities to apply strategies from across the curriculum to problems in real situations
Learners must see themselves as capable and successful.	<ul style="list-style-type: none"> • make sure that all learners experience genuine success on a regular basis • value experimentation and approximation as signs of growth • provide learning experiences and resources that reflect the diversity of the local and global community • provide learning opportunities that develop self-esteem without using self-esteem as a goal in itself
Learners have different ways of representing knowledge.	<ul style="list-style-type: none"> • recognize each learner's preferred style of constructing meaning and provide opportunities for exploring alternative ways • recognize, acknowledge, and build on learners' diverse ways of representing knowledge—showing what they have learned • plan a variety of open-ended experiences and assessment strategies
Reflection is an integral part of learning.	<ul style="list-style-type: none"> • observe and reflect on their own learning processes and experiences • challenge their own beliefs and practices through continuous reflection • encourage learners to observe and reflect on their own learning processes and experiences • encourage learners to acknowledge and articulate their learning needs, styles, and preferences • help learners use their reflections to change their behaviours and adjust their learning strategies

Creating an Effective ALP Level III Learning Environment

ALP LIII learners have struggled to learn adequate literacy skills and are now returning to learning to try one more time. ALP LIII instructors need to meet their act of courage with an equal response of respect. The ALP LIII curriculum is designed to use several elements that help ALP LIII instructors encourage their learners by creating a safe and effective environment:

- creating a welcoming environment
- building mutual respect
- taking different roles with learners
- identifying different learning profiles
- differentiating instruction to support learning profiles
- engaging learners
- organizing learning experiences to engage learners

Creating a Welcoming Environment

As teachers select learning experiences that engage and motivate, they must remember that they are not just teaching a group of learners, they are teaching a group of individuals, many of whom take great pride in being—and staying—unique. A “one-size fits all” approach will likely have little effect. Engaging learners starts with knowing the learners—each of them. Beyond learners believing in their own abilities and capabilities, teachers must believe as well, and communicate their belief through the efforts they make to include learners as partners in their learning.

Building Mutual Respect

An effective learning environment is built on a foundation of respect where the expectations of learners as well as the expectations of teachers are supported. Through their work as educational researchers, Michael Smith and Jeffrey Wilhelm have determined that learners have “an implied social contract with their teachers,” with the following understanding:

A Social Contract

- My teacher will try to get to know me as an individual.
- My teacher will care about me.
- My teacher will address my interests in some way (either outside or inside the classroom).
- My teacher will help me learn and will work hard to make sure I have learned.
- My teacher will be passionate about the subject and about teaching.

(Going With the Flow, Michael Smith and Jeffrey Wilhelm, Heinemann, 2006)

Taking Different Roles with Learners

To support learners as they engage with learning, and to help them stay with it, instructors need to take on many roles: model learners, instructors, assessors, supporters, and advocates. They need to try many approaches: motivate, model, provide explicit instruction, coach, integrate literacy skills, and integrate technology.

Identifying Different Learning Profiles

ALP LIII Mathematics is focused on developing functional numeracy skills. The majority of ALP learners have struggled their whole lives with mathematics and related problem solving situations. We have an opportunity during their time in ALP LIII to ask questions with learners that may identify their learning profiles:

- What factors are necessary for this learner to learn?
- Where do any breakdowns occur?
- Can weaknesses be strengthened using interventions, or is it best to find ways around these problems, using accommodations?
- How can we make the most of natural inclinations and affinities?

To help develop learning profiles, Appendix contains information about Dr. Mel Levine's eight Neurodevelopmental Learning Constructs. Dr. Levine has spent his career helping learners with learning difficulties, and he has developed a process to pinpoint the breakdowns in learning that interfere with an individual's academic success. This process involves input from learners and teachers and a close examination of learner work. Each of the functions of the brain that can affect a learner's learning and performance is considered, including memory, language, attention, and the ability to organize information. Also considered are neuromotor functions such as fine and gross motor skills or physical coordination, as well as social cognition (the ability to understand as well as to have successful social

interactions) and higher-order cognition (being able to solve problems, think critically, or reason about one's self and the world).

The appendix includes overview information about how to support learners who are struggling. In order to best support learners who struggle, we need to understand the demands of the tasks we are asking them to complete. If tasks require learners to use their weak areas, instructors need to be flexible with their methods of instruction, try different approaches, and whenever possible, ask learners to use their strengths when working in areas where they struggle.

Differentiating Instruction to Support Learning Profiles

Partnerships between learners and teachers, and based on their understanding of the learner's learning profile, allow instructors to help learners find ways to become more productive learners. The whole process encourages learners to feel optimistic, to collaborate, and to recover their motivation by giving them a positive vision of their futures.

In the appendix, the curriculum guide offers teaching suggestions to reinforce constructs that get in the way of meeting outcomes. It also offers a range of teaching suggestions that use a variety of media, technology, and other ways to vary the teaching and learning environment.

Engaging Learners

Teachers should consider the following suggestions for engaging learners:

- Seek to know the person within the learner. Although learner surveys or inventories can be helpful, nothing beats a one-to-one conversation. Each of us appreciates when someone shows sincere interest in our lives, in who we are, and in what matters to us. Be willing to share a little about yourself—as a person. Letting learners know who we are helps build trust, the foundation for the teacher-learner relationship.
- Build in opportunities for learners to have a voice. Many learners feel that they have been excluded from their past learning experiences. Invite their views and opinions in meaningful contexts and create genuine opportunities for them to see their voices in action.
- Collaborate when you set criteria for learning and for individual assignments. Your involvement will ensure that certain goals are included; inviting learner input will help them own the learning and related tasks; they will be more interested, motivated, and engaged, and they will learn more.
- Set goals that are attainable and that will promote a sense of accomplishment and self-satisfaction. It is essential to invite learners to be part of setting learning goals.
- Offer choice, whenever possible
 - of reading material
 - of methods to present knowledge and information
 - of the topic for assignment or the focus within a topic

- Remember this: as important as it is to be positive and encouraging in our response to learner work, it is equally important to be honest and sincere in order to develop a trusting relationship.

Engaging Learners through Interactive Learning

Interactive learning is built on this premise: we learn best when we engage our minds, and we are more apt to engage when we interact with others. Instructors take the lead in guiding learners to become more-effective learners when they create opportunities using explicit teaching and modelling, and monitor focused, interactive strategies for learning.

Many strategies are described in this document. Taking the time to read the research behind these strategies will help instructors understand why certain strategies work, how to make suitable adaptations, and how to create supports to help them make learning more relevant and engaging to all learners.

Here are a few strategies that put interactive learning into practice. Most require learners to interact in small discussion groups. Research suggests that this can be more effective than open dialogue between the teacher and the whole class where often only a small number of learners participate while others remain uninvolved.

Front Loading

Effective teaching practice recognizes that many learners approach a new concept or piece of text with limited familiarity. These learners then have a difficult time making sense of new information since they have few “hooks” on which to connect new learning. Front loading is a pre-reading strategy in which learner groups are given time to share their understandings of the key terms and background information, helping all learners build prior knowledge, which, in turn, creates those “hooks” or links to new learning so necessary to constructing meaning.

Using Authentic Materials for Real Purposes

Authentic materials and resources give learners instant feedback about how their literacy and numeracy skills are increasing.

When they read newspapers, magazines, graphs, tables, websites, menus, workplace documents, and other materials found throughout their communities, it reinforces that they have joined the “club” of readers, writers and math savvy adults. In apprenticeship circles, learning by doing is widely recognized as the most effective path to personal mastery.

Developing Self-Esteem through Expertise

Activities that embody a series of outcomes and relate them to one another and that use a range of resources let learners make more connections that mean something to them. After they work with one topic over a significant period of time, learners are able to build up a body of knowledge and expertise. The goal is that they will become enthusiastic about the topic. Powerful by-products of this process are that they change learners’ perspective about their self-worth and their self-esteem grows.

“The Big Six”

“The Big Six” refer to reading comprehension strategies that support readers as they aim to construct meaning and become aware of what they understand through interacting with text. These strategies are (1) making connections, (2) inferring, (3) synthesizing, (4) questioning, (5) determining importance, and (6) visualizing. Teachers could present focused mini-lessons that teach and model each strategy and then offer authentic opportunities for learners to apply them.

Organizing Learning Experiences to Engage Learners

Focus	Description	Examples of Learner Products
Projects	Products built around <ul style="list-style-type: none"> • prior knowledge and experiences • topics of interest • questions to answer 	<ul style="list-style-type: none"> • write questions with answers • build a model with explanation • put together a photo album with written explanation • create a poster or brochure • create a game
Issues	Investigations of topical questions that consider several perspectives	<ul style="list-style-type: none"> • participate in a debate • use persuasive writing • do a survey with analysis
Workshops	Hands-on, active learning, characterized by learning through doing; this includes reader, writer, video, photo, or drama workshops	<ul style="list-style-type: none"> • read final versions of writing • publish written work • put together a photo gallery • present a drama • create something together
Themes	Creation and response to a range of texts focused on a central idea	<ul style="list-style-type: none"> • put together a learning fair or expo • exhibit something in a public space • do a themed publication of various learners’ work

Focus	Description	Examples of Learner Products
Author study	Explorations and investigations of specific authors, including historical and cultural contexts	<ul style="list-style-type: none"> • make a presentation in the library • participate on a panel • give a reading and mini-lecture • do a PowerPoint presentation
Media study	Creation and comparison of ideas and cultural contexts expressed through a variety of media	<ul style="list-style-type: none"> • use WebQuest • create a website • put together a video festival • screen advertisements
Historical, geographic, cultural exploration	Exploration of particular times, events, places, and cultures	<ul style="list-style-type: none"> • develop an annotated time line • write a historical drama • put together a cultural fair • translate information to show how it matches today's language and culture
Science exploration	Exploration of particular topics, concepts, and processes using inquiry, exploration, and experimentation	<ul style="list-style-type: none"> • demonstrate lab results • guide people on a field trip with handouts • develop a question-and-answer book

Sharing Ideas through the NSSAL Instructor Website

The learning activities suggested in this document are meant to inspire ALP Level III instructors to create their own ideas, working with their learners, based on the interests, ages, affinities, available resources, and goals of their learners. NSSAL instructors are encouraged to create and share these ideas/activities with other instructors using the NSSAL instructors' website (<http://instructors.gonssal.ca/>). The website already possesses a wide range of activities and supplementary documents designed to engage ALP learners in learning that makes a difference. The password and login information are available through the Department of Labour and Workforce Development, Adult Education Division.

Providing Meaningful Assessment

Assessment differs from evaluation. Effective assessment helps guide learners to continue to learn and explore. Instructors may give informal feedback, such as in a conversation, or more formal feedback, such as through written comments or by placing a learner within a rubric. A rubric is usually a chart that describes a learner's work on a scale from poor quality to exceptional quality. It can be created with learners or for them and provides particular criteria for whatever you are trying to assess. This gives learners more detailed feedback about where their work sits on a scale and provides a road map for improving. Assessments are usually given frequently, to help both learners and teachers plan their instructional activities. In the curriculum document, each outcome suggests assessments that are appropriate to challenge Level II learners.

Evaluation provides learners with a rank or mark so that they can see how their progress compares with other learners. Evaluation is often provided at the end of a learning cycle.

Both assessments and evaluations are useful; ALP instructors will need to be selective in their use.

To determine when to use an assessment, consider the following questions:

- Is the feedback providing clear and useful information to the learner about their progress?
- Can the learner make use of this feedback in order to progress?
- What effect will this feedback have on the motivation of the learner to continue learning?
- Does the feedback lead the learner and instructor to set specific goals?
- Does the feedback help the teacher to plan the most suitable learning activities for this learner?

To determine when to use an evaluation consider the following questions:

- Is the feedback providing a final summary about the learner's progress for a section of learning?
- Will the feedback help to inform learners about why they are moving on or not moving on to a new section of learning?
- Will the feedback help learners understand the parts of the learning where they excelled and where they require more attention?

Characteristics of Effective ALP Assessment

Assessment is the systematic process of gathering information on learner learning in order to improve learner success and provide a basis for evaluation. High-quality assessment practices are essential to high-quality education. Effective assessment practices contain the following characteristics:

Assessments promote learning.	<ul style="list-style-type: none"> ▪ Assessments should be used to help learners recognize their learning strengths and identify ways they can further develop. ▪ Assessments can provide valuable insights about learners' learning needs and styles, and instructors can use assessments to give learners useful feedback and guide their efforts toward improvement.
Assessments influence the instructor's approach.	<ul style="list-style-type: none"> ▪ Reflecting on this information helps instructors to evaluate the effectiveness of their instructional approaches and to adjust them accordingly.
Assessments inform evaluation.	<ul style="list-style-type: none"> ▪ Evaluation is the process of analysing, reflecting upon, and summarizing information from assessments and making decisions based upon the information gathered.
Assessments vary with contexts and needs.	<ul style="list-style-type: none"> ▪ A variety of assessment strategies can provide valuable insight about learners' strengths to ensure that the instructor is recognizing their diverse learning needs.
Assessments help learners to set realistic career and life goals.	<ul style="list-style-type: none"> ▪ Assessments provide foundations and milestones for setting time lines for ALP learners and instructors. ▪ Achievement gives learners the motivation to set goals. • ALP learners will develop their portfolios based on these goals, which in turn will act as a tool to help them reach future goals.

Number Concepts**Outcome 1 – Students will be expected to assess and examine personal mathematics strengths and weaknesses.**

Demonstrations	Suggestions for Teaching and Learning
<p><i>Students will be expected to</i></p> <p>1.1 explore and discuss mathematics strengths and preferences using a variety of assessment activities and tools</p> <p>1.2 identify potential strategies to compensate for, accommodate or substitute for problem solving weaknesses</p>	<p><i>Instructors can</i></p> <ul style="list-style-type: none"> ▪ Assign a text feature activity to emphasize the reading of the math text, particularly noting table of contents, text specific learning features and appendices (see <i>Text Feature Activity</i> appendix) ▪ Discuss how students can find help and resources to help with their study of math (e.g., instructor help, videos, additional text material, etc.) ▪ Have students begin a math learning log where they can place new vocabulary, concepts, challenges, reflections and samples of work. (see <i>Math Level III Learning Log</i> in appendix) ▪ Discuss when and how math is used in everyday life. Put information in the math learning logs ▪ Make a chart of the math they will be learning in this unit and see how they could use these skills in everyday life and in various work places. Review the chart at the end of the unit as well ▪ Model mathematical thought by explaining strategies you use in thinking about mathematics (see <i>Modeling Math Thought Activity</i> in appendix). This may include drawing diagrams, going from concrete to abstract, mental math for approximation, vocabulary building, etc. ▪ Discuss effective reading and note-taking skills ▪ Discuss effective test preparation and test-taking methods (see <i>Test Taking Inventory</i> in appendix) ▪ Have students develop hockey card sized concept cards that they can use to record and review. The cards could include rule cards, symbol cards, vocabulary cards and operation cards. They could be put in binders with pocket protector sheets. It would be good to photocopy some examples. Have students add to their math learning logs

Number Concepts

Outcome 2 – Students will be expected to use whole numbers as a foundation for more advanced math concepts.

Demonstrations	Suggestions for Teaching and Learning
<p><i>Students will be expected to</i></p> <p>2.1 perform accurate calculations using the four math operations</p> <p>2.2 use order of operations, exponential notation and square roots in calculations</p> <p>2.3 identify and factor prime and composite numbers</p>	<p><i>Instructors can</i></p> <ul style="list-style-type: none"> ▪ Have students add new vocabulary and concepts to their math learning logs. Use and define the terms: whole numbers, natural numbers, standard notation, expanded notation, word names for numbers, digits, place value, sum, addition, add, difference, subtraction, multiplication, product, division, quotient, remainder, dividend, division ▪ Explore the history of mathematical concepts (based on examples given in the text) to reinforce the application, as needed ▪ Demonstrate and provide practice in using the four operations of addition, subtraction, multiplication and division. Have students add to their math learning log ▪ Introduce students to word names that can be substituted with math operations. For example, “the sum” means to add. Then, practice translating words into mathematical expressions. Have students add to their math learning logs ▪ Use and define the terms: factor, factorization, multiple, prime number, composite number, prime factorization, least common multiple. Have students add to their math learning logs (see <i>Prime Numbers</i> in appendix) ▪ Ensure the students use the correct mathematical language consistently ▪ Demonstrate and practice finding the factors and multiples of numbers ▪ Demonstrate the difference between a prime number and a composite number by defining what they are ▪ Demonstrate and practice how to find a prime factorization of a composite number. Have students add to their math learning logs ▪ Demonstrate and practice how to find the “lowest or least common multiple” (LCM) of two or more numbers using two methods. Method 1 uses a list of multiples and method 2 finds the LCM using prime factorization. Ensure that the students know the difference ▪ Explain that finding the LCM of numbers has applications later, such as adding fractions with different denominators ▪ Have students practice finding LCM using both methods

Number Concepts

Outcome 2 – Students will be expected to use whole numbers as a foundation for more advanced math concepts.

Suggestions for Assessment	Notes and Resources
	<p><i>Key Resources</i></p> <p><i>Basic College Mathematics</i>. 2nd Ed., Chapters 1 and 3, videos and teachers guides</p> <p>Harry Huth and Mark Huth, <i>Practical Problems in Mathematics for Carpenters</i>. 7th Ed. (New York: Delmar, Thomsen Learning, 2001) (subsequently referred to as <i>Delmar Practical Problems in Series</i>)</p> <p>Stephen L. Herman and Crawford Garrard, <i>Practical Problems in Mathematics for Electricians</i>. 6th Ed. (New York: Delmar, Thomsen Learning, 2002) (subsequently referred to as <i>Delmar Practical Problems in Series</i>)</p> <p>Stephen L. Herman and Richard Sullivan, <i>Practical Problems in Mathematics for Electronic Technicians</i>. 5th Ed. (New York: Delmar, Thomsen Learning, 1997) (subsequently referred to as <i>Delmar Practical Problems in Series</i>)</p> <p>Ervin Dennis, LaVonne Vermeersch, and Charles Southwick, <i>Practical Problems in Mathematics for Graphic Communications</i>. 2nd Ed. (New York: Delmar, Thomsen Learning, 1998) (subsequently referred to as <i>Delmar Practical Problems in Series</i>)</p> <p>Louise Simmers, <i>Practical Problems in Mathematics for Health Occupations</i>, 2nd Ed. (New York: Delmar, Thomsen Learning, 1996) (subsequently referred to as <i>Delmar Practical Problems in Series</i>)</p> <p>Russell DeVore, <i>Practical Problems in Mathematics for Heating and Cooling Technicians</i>. 3rd Ed (New York: Delmar, Thomsen Learning, 1998) (subsequently referred to as <i>Delmar Practical Problems in Series</i>)</p> <p>Donna D. Boatwright, <i>Practical Problems in Mathematics for Industrial Technology</i>. (New York: Delmar, Thomsen Learning, 1996) (subsequently referred to as <i>Delmar Practical Problems in Series</i>)</p> <p>Frank Schell and Bill Jr. Matlock, <i>Practical Problems in Mathematics for Welders</i>. 4th Ed. (New York: Delmar, Thomsen Learning, 1996) (subsequently referred to as <i>Delmar Practical Problems in Series</i>)</p>

Number Concepts

Outcome 2 – Students will be expected to use whole numbers as a foundation for more advanced math concepts.

Demonstrations	Suggestions for Teaching and Learning
	<p>(cont'd.)</p> <ul style="list-style-type: none"> ▪ Use and define the terms: exponential notation, order of operations, parentheses, bracket, “BEDMAS” (see below), powers of ten, and square root. Have students add to their math learning logs ▪ Demonstrate that the product of $4 \bullet 4 \bullet 4 \bullet 4 \bullet 4$ can be expressed in exponential notation as 4^5 and that 4^5 can be read as “four to the fifth power” or as “four exponent five”. Many students make the mistake of saying $4^5 = 4 \times 5$ so make sure they know the correct method ▪ Have the students help you evaluate the powers of ten starting with 10^6 and going down to 10^{-6} using whole numbers for the power, including zero ▪ Demonstrate how large numbers can be expressed as a number between 1 and 10 and positive powers of ten and small numbers can be expressed as a number between 1 and 10 and negative powers of ten ▪ Demonstrate that parentheses or brackets are used to group numbers and those groupings are evaluated first ▪ Demonstrate and explain how to use brackets within brackets using different size boxes to hold other boxes within each box ▪ Have students practice order of operations ▪ Demonstrate how brackets can be entered on a calculator but stress that it is important to know and understand the long hand method first. Show various bracket symbols such as $\{, [, ($ <p><i>Note:</i> Use the acronym “BEDMAS” to get students to learn the sequence for the order of operations:</p> <p>e.g. B – do all calculations within <i>brackets</i> before operations outside</p> <p>E – evaluate all <i>exponential</i> expressions</p> <p>D – do all <i>divisions</i> in order from left to right</p> <p>M – do all <i>multiplication</i> in order from left to right</p> <p>A – do all <i>additions</i> in order from left to right</p> <p>S – do all <i>subtractions</i> in order from left to right</p>

Number Concepts

Outcome 2 – Students will be expected to use whole numbers as a foundation for more advanced math concepts.

Suggestions for Assessment	Notes and Resources
<p><i>Students can</i></p> <ul style="list-style-type: none"> ▪ Keep a learning log, including new vocabulary, new concepts, challenges, reflections, and completed activities. Sharing this learning log with the instructor can show progress and material learned to date (see <i>Math Level III Learning Log</i> in appendix) ▪ Use ‘think aloud’ activity to explore the students mathematical problem-solving processes (see <i>Think Aloud Activity</i> in appendix, outcome 1) ▪ Play BINGO/MATHO game (see <i>Matho</i> in appendix) 	<p>(cont’d.)</p> <p>L. Fownes, E. Thompson, and J. Evetts, eds., <i>Numeracy at Work</i>. (Burnaby BC: Skill Plan BC Construction Industry Skills Improvement Council. 2002) – examples of numeracy used in the workplace (subsequently referred to as Numeracy at Work)</p> <hr/> <p><i>Supplementary Resources</i></p> <p>J. Streeter, D. Hutchison, B. Bergman, and L. Hoelzle, <i>Basic Mathematical Skills with Geometry</i>. (New York, NY: McGraw-Hill Higher Education, 2001)</p> <p>See <i>Web Resources</i> in appendix</p>

Fractions, Decimals and Percent Notation

Outcome 3 – Students will be expected to use fractional notation as a foundation for more advanced math concepts.

Demonstrations	Suggestions for Teaching and Learning
<p><i>Students will be expected to</i></p> <ol style="list-style-type: none"> 3.1 multiply and divide fractions concretely, pictorially, and symbolically 3.2 estimate and mentally compute products and quotients involving fractions 3.3 add and subtract fractions mentally, when appropriate 3.4 apply the order of operations to fraction computations, using both paper and pencil and the calculator 3.5 create and solve problems involving fractions in meaningful contexts 3.6 determine the reasonableness of results in problem solving through estimation and mental math 	<p><i>Instructors can</i></p> <ul style="list-style-type: none"> ▪ Have students add new vocabulary and concepts to their math learning logs. Use and define the terms: fractional notation, reciprocal, mixed numeral (number), numerator, denominator, simplifying, equivalent fraction, lowest common denominator (LCD), lowest terms, proper fraction, improper fraction ▪ Explore the history of mathematical concepts in this outcome (based on examples given in the text) to reinforce the application, as needed ▪ Introduce students to the calculator and demonstrate that fractions are entered using the a b/c button ▪ Have students come up with fractions they have seen in real life, as in recipes, measurement of length, hours worked, weight loss, discounts for sales, etc. ▪ Demonstrate how a tape measure breaks down an inch into fractions by dividing each new section in two. This also shows the concept of equivalent fractions by showing the $\frac{1}{2}$" mark equal to $\frac{1}{4}$" ▪ Use examples, like the pieces of a pie, to demonstrate that the denominator represents the size of each piece of pie while the numerator represents the fraction. $\frac{5}{8}$ means 5 pieces of pie, each $\frac{1}{8}$ of a pie in size ▪ Demonstrate the need for common denominator, using the example of adding 3 apples and 5 oranges, which doesn't add up to 8 apple/oranges because they are not the same (refer back to LCM) ▪ Use a tape measure to demonstrate how to multiply fractions. Show that $\frac{1}{2}$ of $\frac{1}{2}$ an inch is $\frac{1}{4}$ of an inch on the tape measure. Demonstrate that $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$ by multiplying numerators by numerators and denominators by denominators ▪ Demonstrate all the mathematical operations on fractions and mixed numbers. Have students add to their math learning logs ▪ Provide practice and forum for discussion on fractional notation, conversion, and simplification. Have students add to their math learning logs

Fractions, Decimals and Percent Notation**Outcome 3 – Students will be expected to use fractional notation as a foundation for more advanced math concepts.**

Suggestions for Assessment	Notes and Resources

Fractions, Decimals and Percent Notation

Outcome 3 – Students will be expected to use fractional notation as a foundation for more advanced math concepts.

Demonstrations	Suggestions for Teaching and Learning
	<p>(cont'd.)</p> <ul style="list-style-type: none"> ▪ Demonstrate simplifying fractions to their lowest terms and finding equivalent fractions ▪ Demonstrate converting mixed numbers to improper fractions and vice versa ▪ Demonstrate how to find the reciprocal of a number and how it is used to perform a division with a fraction ▪ Demonstrate how to use the symbols $<$ (is less than) and $>$ (is greater than) to compare the value of fractions ▪ Demonstrate how fractions can be ranked in order of size ▪ Reinforce that problem solving with fractional notation uses the same five steps mentioned in Unit 1: Understand, Translate, Solve, Check, State

Fractions, Decimals and Percent Notation

Outcome 3 – Students will be expected to use fractional notation as a foundation for more advanced math concepts.

Suggestions for Assessment	Notes and Resources
<p><i>Students can</i></p> <ul style="list-style-type: none"> ▪ Play (even win!) <i>Multiplication Division Mixed Number Dominoes</i> ▪ Use ‘think aloud’ activity to explore the students’ mathematical problem-solving processes (see <i>Think Aloud Activity</i> in appendix, outcome 1) ▪ Keep a learning log, including new vocabulary, new concepts, challenges, reflections, and completed activities. Sharing this learning log with the instructor can show progress and material learned to date (see <i>Math Level III Learning Log</i> in appendix) 	<p><i>Key Resources</i></p> <p><i>Basic College Mathematics.</i> Chapters 2 and 3, videos and teachers guides</p> <p><i>Delmar Practical Problems in Math Series</i></p> <p><i>Numeracy at Work</i> - examples of numeracy used in the workplace</p> <hr/> <p><i>Supplementary Resources</i></p> <p>Jack LeSage, and Jim Mennie editors, <i>Nexus Mathematics.</i> (Calgary, AB: Rogue Media Inc., 2001) (subsequently referred to as <i>Nexus Mathematics</i>) – excellent section to introduce the concept of fractions</p> <p>J. Mennie, J. LeSage, E. Radomski, L. Wood, Editors, <i>Quantum Mathematics.</i> (Calgary, AB: Rogue Media Inc., 2003) (subsequently referred to as <i>Quantum Mathematics</i>) – “Tune Up” section offers a good review</p> <p>J. Streeter, D. Hutchison, B. Bergman, B., and L. Hoelzle, <i>Basic Mathematical Skills with Geometry.</i> (New York, NY: McGraw-Hill Higher Education, 2001) (subsequently referred to as <i>Basic Mathematical Skills with Geometry</i>)</p> <p><i>Content Area Blackline Masters</i></p> <p>See <i>Web Resources</i> in appendix</p>

Fractions, Decimals and Percent Notation

Outcome 4 – Students will be expected to use decimal notation as a foundation for more advanced math concepts.

Demonstrations	Suggestions for Teaching and Learning
<p><i>Students will be expected to</i></p> <p>4.1 add, subtract, multiply and divide positive decimal numbers with and without the calculator</p> <p>4.2 compare and order positive rational numbers in decimal and fractional forms</p> <p>4.3 create and solve problems involving addition, subtraction, multiplication, and division of positive decimal numbers in meaningful contexts</p> <p>4.4 determine the reasonableness of results in problem solving through estimation and mental math</p>	<p><i>Instructors can</i></p> <ul style="list-style-type: none"> ▪ Have students add new vocabulary and concepts to their math learning logs. Use and define the terms: decimal, decimal place, and repeating decimal ▪ Explore the history of mathematical concepts in this section (based on examples given in the text) to reinforce the application, as needed ▪ Demonstrate how to write word names for decimal numbers ▪ Show how to properly write an amount of money on a cheque (see <i>Blank Cheques</i> in appendix). Have students add to their math learning logs ▪ Demonstrate how to use division to convert a fraction or mixed number to a decimal ▪ Ensure students can perform the four operations with decimals using the long-hand method. Once they know how, have them use calculators to speed things up ▪ Demonstrate and practice how to round off decimal numbers to different place values. Round off money to the nearest cent ▪ Use grocery cash register receipts to practice rounding off decimals to the nearest whole number ▪ Use multiplication of decimals to calculate weekly pay ▪ Use division of decimals to calculate various rates. For example: if it costs \$47.94 for 60 litres of gas, what is the cost per litre? ▪ Have the student compare fraction notation and decimal notation and decide if either system makes it easier to compare values ▪ Have students do mental math with another. Have students add to their math learning logs ▪ Complete exercises on conversion of decimals and fractions, operations and problem solving. Have students add to their math learning logs

Fractions, Decimals and Percent Notation

Outcome 4 – Students will be expected to use decimal notation as a foundation for more advanced math concepts.

Suggestions for Assessment	Notes and Resources
<p>Please note: The following assessments may be used for any outcome</p> <p><i>Students can</i></p> <ul style="list-style-type: none"> ▪ Have students use addition and subtraction of decimals to balance a cheque-book, compare costs or prices, figure out change, and measure using the metric system ▪ Have students play <i>Hidden Message</i> (see appendix). Have students add to their math learning logs ▪ Use <i>Think Aloud Activity</i> to explore the students’ mathematical problem-solving processes (see appendix, outcome 1) ▪ Keep a learning log, including new vocabulary, new concepts, challenges, reflections, and completed activities. Sharing this learning log with the instructor can show progress and material learned to date (see <i>Math Level III Learning Log</i> in appendix) 	<p><i>Key Resources</i></p> <p><i>Basic College Mathematics</i> – Chapter 4, videos and teachers guides</p> <p><i>Delmar Practical Problems in Math Series</i></p> <p><i>Numeracy at Work</i> – examples of numeracy used in the workplace</p> <hr/> <p><i>Supplementary Resources</i></p> <p><i>Nexus Mathematics</i></p> <p><i>Basic Mathematical Skills with Geometry</i> – Chapters 4 and 6, videos and teachers guides</p> <p><i>Content Area Blackline Masters</i></p> <p>See <i>Web Resources</i> in appendix</p> <div style="border: 1px solid black; padding: 10px; margin: 20px auto; width: fit-content;"> <p style="text-align: center;">Links to ALP Level III Courses</p> <p>Social Studies: Unit 1: Introduction to Geography Outcome 1</p> </div>

Fractions, Decimals and Percent Notation

Outcome 5 – Students will be expected to use percent notation, rates and ratio and proportion to solve problems.

Demonstrations	Suggestions for Teaching and Learning
<p><i>Students will be expected to</i></p> <p>5.1 perform calculations using percent notation, rates and ratio and proportion</p> <p>5.2 create and solve real world problems involving percent notation, rates and ratio and proportion</p> <p>5.3 determine the reasonableness of results in problem solving through estimation and mental math</p>	<p><i>Instructors can</i></p> <ul style="list-style-type: none"> ▪ Have students add new vocabulary and concepts to their math learning logs. Use and define the terms: rate, ratio, proportion and percent ▪ Introduce ratios and proportions (see <i>Introduction of Ratio/Proportion</i> in appendix) ▪ Show students some everyday ratio situations, reinforcing that a ratio is a comparison of how much smaller or bigger a number is. For example, Person A makes \$15.00/hour and Person B makes \$5.00/hour. The ratio is 15 to 5 or if simplified, 3 to 1. Show students that it means person A is paid 3 times more than person B or person B is paid 3 times less than person A ▪ Use the scale on a map to show that the actual distance from point A to point B can be calculated by measuring the distance on the map, and using the ratio (or scale) to find the actual distance ▪ Demonstrate that in a true ratio, the comparison is always between <i>similar</i> items. For example, compare apples to apples, speed to speed, cost to cost ▪ Demonstrate that a rate is used to compare two <i>different</i> kinds of measure. For example, miles per hour, dollars per hour, ounces per square foot, gallons per minute. Also point out that the word “per” here means division ▪ Think about everyday examples of rates. Explain how rates are different from ratios ▪ Demonstrate that when two ratios are equal we have a proportion, and that we can solve for the unknown value. Use the scale on a map to set up a ratio and proportion problem and solve for the unknown. Have students add to their math learning logs ▪ Use a recipe to decide how much of each ingredient should be used for different numbers of servings (see <i>Recipe Exercise</i> in appendix). Have students add to their math learning logs ▪ Share appendix exercises and problems on Measurement and Ratio, Conversions, Solving percentages, Rates and Ratio, and Ratio and Proportion. Have students add to their math learning logs

Fractions, Decimals and Percent Notation**Outcome 5 – Students will be expected to use percent notation, rates and ratio and proportion to solve problems.**

Suggestions for Assessment	Notes and Resources

Fractions, Decimals and Percent Notation

Outcome 5 – Students will be expected to use percent notation, rates and ratio and proportion to solve problems.

Demonstrations	Suggestions for Teaching and Learning
	<p>(cont'd.)</p> <ul style="list-style-type: none"> ▪ Have the student come up with examples of where the word 'percent' and the symbol '%' are used ▪ Demonstrate how to convert among fractional, decimal and percent notation ▪ Explain the benefits of translating a problem into a math equation or a ratio and proportion problem, rather than learning or memorizing percent formulas for solving problems ▪ Demonstrate solving percent problems involving interest on loans, interest earned in a savings account, calculating marks on a test, commissions, discounts, sale prices, depreciation, percent increase or decrease, and a raise ▪ Demonstrate mental estimation. An example: calculate the tip of a bill of \$29.37 by rounding off the bill to \$30, and multiplying by 15%

Fractions, Decimals and Percent Notation

Outcome 5 – Students will be expected to use percent notation, rates and ratio and proportion to solve problems.

Suggestions for Assessment	Notes and Resources
<p><i>Students can</i></p> <ul style="list-style-type: none"> ▪ Calculate taxes (HST) on a number of items ▪ Calculate sale prices using a variety of % discounts ▪ Play <i>Ratio Dominoes</i>, demonstrating an understanding of rules and concepts (see appendix) ▪ Use <i>Think Aloud Activity</i> to explore the students’ mathematical problem-solving processes (see appendix, outcome 1) ▪ Keep a learning log, including new vocabulary, new concepts, challenges, reflections, and completed activities. Sharing this learning log with the instructor can show progress and material learned to date 	<p><i>Key Resources</i></p> <p><i>Basic College Mathematics. 2nd Ed.</i> – Chapters 5 and 6, videos and teachers guides</p> <p><i>Delmar Practical Problems in Math Series</i></p> <p><i>Numeracy at Work</i> – examples of numeracy used in the workplace</p> <hr/> <p><i>Supplementary Resources</i></p> <p><i>Nexus Mathematics</i></p> <p><i>Basic Mathematical Skills with Geometry</i> – Chapter 5, videos and teachers guides</p> <p><i>Content Area Blackline Masters</i></p> <p>See <i>Web Resources</i> in appendix</p> <div style="border: 1px solid black; padding: 10px; margin-top: 20px;"> <p align="center">Links to ALP Level III Courses</p> <p>Social Studies: Unit 1: Introduction to Geography Outcome 1</p> </div>

Unit 1: Problem Solving and Employment Explorations**Outcome 6 – Students will be expected to use systematic approaches to solve math problems.**

Demonstrations	Suggestions for Teaching and Learning
<p><i>Students will be expected to</i></p> <p>6.1 select and use appropriate systematic strategies to solve mathematical problems</p> <p>6.2 demonstrate logical multi-step processes to solve math problems including word problems</p> <p>6.3 determine the reasonableness of results in problem solving through estimation and mental math</p> <p>6.4 use mathematical language to communicate mathematical ideas, concepts and thought processes</p> <p>6.5 demonstrate accurate use of a calculator</p>	<p><i>Instructors can</i></p> <ul style="list-style-type: none"> ▪ Assign a text tour activity on reading the math text, particularly noting table of contents, text specific learning features and appendices. (see <i>Text Features Activity</i> in appendix, outcome 1) ▪ Discuss how students can find help and resources to help with their study of math (e.g., instructor help, videos, additional text material, etc.) ▪ Have students begin a math learning log where they can place new vocabulary and concepts (see <i>Math Level III Learning Log</i> in appendix, outcome 1) ▪ Explore the history of mathematical concepts in this outcome (based on examples given in the text) to reinforce the application, as needed ▪ Create a chart of math words and expressions used in problem solving and compare to chart in appendix ▪ Introduce problem-solving techniques (see <i>Problem-Solving Techniques Worksheet</i> in appendix) ▪ Have students work in groups to solve several word problems using the steps shown above. Use problems associated with real-life situations like money transactions. Have students add to their math learning logs ▪ Demonstrate and practice using the math words used previously, as well as diagrams, charts and graphs to help solve problems (see <i>Math Words Used in Expressions</i> in appendix) ▪ Have students compile a grocery list of items that they will need in the coming week. Have them go to the grocery store, price these items and come up with the total cost of the order ▪ Have students think about their own budget (or a fictional one). What do they spend every month on groceries, rent, heat, electricity, gasoline, insurance, car payments, and other items? Record in math learning logs ▪ Use addition and subtraction of whole numbers in real life situations, like looking at road maps to find distances from city to city, or to find the distance left to travel once part of the trip is completed ▪ Use examples of buying consumer goods to estimate the cost of goods or best buy items, by using multiplication and division ▪ Demonstrate the functions available on most calculators ▪ Demonstrate the conversion function available on graphic calculators

Unit 1: Problem Solving and Employment Explorations

Outcome 6 – Students will be expected to use systematic approaches to solve math problems.

Suggestions for Assessment	Notes and Resources
<p><i>Students can</i></p> <ul style="list-style-type: none"> ▪ Use <i>Think Aloud Activity</i> to explore the students’ mathematical problem-solving processes (see appendix, outcome 1) ▪ Share, in an interview with you, their strengths and weaknesses (see <i>Individual Interview: Supervised Math Work</i> in appendix, outcome 1) ▪ Respond, in discussions with you, to the <i>why</i> of concepts as well as the <i>how</i>. <i>Why</i> will probe their thinking processes and conceptual understanding. <i>How</i> looks at procedural skills only ▪ Complete a word problem, and record the experience in their learning logs ▪ Keep a learning log, including new vocabulary, new concepts, challenges, reflections, and completed activities. Sharing this learning log with the instructor can show progress and material learned to date (see <i>Math Level III Learning Log</i> in appendix) 	<p><i>Key Resources</i></p> <p><i>Basic College Mathematics</i> – the preface describes the features of the text designed to assist students with problem solving</p> <p><i>Numeracy at Work</i> – examples of numeracy used in the workplace</p> <hr/> <p><i>Supplementary Resources</i></p> <p><i>Nexus Mathematics</i> – excellent explanations of problem solving steps, visually presented</p> <p><i>Content Area Blackline Masters</i></p> <p>See <i>Web Resources</i> in appendix</p> <div style="border: 1px solid black; padding: 10px; margin-top: 20px;"> <p style="text-align: center;">Links to ALP Level III Courses</p> <p>Communications: Learning Strategies Unit Outcome 3</p> <p>Comprehension Unit 1: Reading Strategies Outcomes 6 & 7</p> </div>

Unit 1: Problem Solving and Employment Explorations

Outcome 7 – Students will be expected to investigate and communicate information and data about the integration of math concepts and applications in the current workplace.

Demonstrations	Suggestions for Teaching and Learning
<p><i>Students will be expected to</i></p> <p>7.1 research and communicate the applications of math concepts in the workplace</p>	<p><i>Instructors can</i></p> <ul style="list-style-type: none"> ▪ Use as a review workplace-specific mathematics problems using one of the Practical Problems in Mathematics publications, or sources at your school, Union Local, Association or Internet ▪ Have students write a short report, given a number of workplace charts or reports (FMEA, Near Miss Reports, etc.) for use in a report for a departmental management meeting ▪ Work with students to develop an interview questionnaire that explores the mathematical skills and knowledge required at a workplace of interest to them. This could include types of measurement tools, number skills, and computational tools. Then, have students interview someone at the workplace and develop a poster or PowerPoint presentation (whichever is most appropriate to the workplace visited) with examples of the results. They could also collect samples of applied math at the workplace (see <i>Job Research Interview Master</i> in appendix) ▪ In groups, have students share feedback to refine their questionnaires before going to the workplace ▪ Have students complete a workplace project involving authentic workplace mathematical problems ▪ Construct various data displays (both manually and electronically) and ask students which work best ▪ Have students select a <i>Practical Problems in Mathematics</i> text and report on the mathematical concepts required for work in this field ▪ Have students use a company's annual report (available in libraries or on most company web sites) to determine the yearly revenues and expenses, net income or loss, and results compared to the previous year. Have them read the reports to determine what factors may have contributed to the differences between years ▪ Use the National Occupational Code information to research and compare the requirements and potential income for specific occupations (see <i>Job Research Master</i> and see <i>Web Resources</i> for employability Web links in appendix)

Unit 1: Problem Solving and Employment Explorations

Outcome 7 – Students will be expected to investigate and communicate information and data about the integration of math concepts and applications in the current workplace.

Suggestions for Assessment	Notes and Resources
<p>Please note: The following assessments may be used for any outcome</p> <p><i>Students can</i></p> <ul style="list-style-type: none"> ▪ Use <i>Think Aloud Activity</i> to explore the students’ mathematical problem-solving processes (see appendix, outcome 1) ▪ Share, in an interview with you, their strengths and weaknesses (see <i>Individual Interview: Supervised Math Work</i> in appendix, outcome 1) ▪ Respond, in discussions with you, to the <i>why</i> of concepts as well as the <i>how</i>. <i>Why</i> will probe their thinking processes and conceptual understanding. <i>How</i> looks at procedural skills only ▪ Complete a word problem, and record the experience in their learning logs ▪ Keep a learning log, including new vocabulary, new concepts, challenges, reflections, and completed activities. Sharing this learning log with the instructor can show progress and material learned to date 	<p><i>Key Resources</i></p> <p><i>Basic College Mathematics</i> – Applications index at front of book. Can use with activities to find real-life problems.</p> <p><i>Delmar Practical Problems in Math Series</i></p> <p><i>Career Options, A Guide to Nova Scotia’s Changing Labour Market.</i> (Halifax, NS: Crown Copyright, Province of Nova Scotia, Department of Education, 2003) (subsequently referred to as <i>Career Options</i>) – reference guide, searchable online database</p> <p><i>Government of Canada. Top 100 Internet Sites for Learning and Employment.</i> (Human Resources and Skills Development Canada, Youth Path) – complete PDF document available to download from Web site listed in the appendix (subsequently referred to as <i>Top 100 Internet Sites for Learning and Employment</i>)</p> <p><i>Numeracy at Work</i> – examples of numeracy used in the workplace</p> <hr/> <p><i>Supplementary Resources</i></p> <p><i>Content Area Blackline Masters</i></p> <p>See <i>Web Resources</i> in appendix</p> <div style="border: 1px solid black; padding: 10px; margin-top: 20px;"> <p style="text-align: center;">Links to ALP Level III Courses</p> <p>Communications: Unit 2: Writing Strategies and Skills Outcome 10</p> <p>Science: Unit 1: Introduction to Science Outcome 1 Unit 2: What is Biology? Outcome 7 Unit 3: What is Chemistry? Outcome 10 Unit 4: What is Physics? Outcome 13</p> <p>Social Studies: Unit 5: Citizenship Outcome 12</p> </div>

Unit 2: Introduction to Algebra

Outcome 8 – Students will be expected to demonstrate an understanding of number meanings with respect to integers and rational and irrational numbers, and explore their use in meaningful situations.

Demonstrations	Suggestions for Teaching and Learning
<p><i>Students will be expected to</i></p> <p>8.1 understand the meanings and notations of positive and negative integers and rational and irrational numbers</p> <p>8.2 use the computational rules of addition, subtraction, multiplication, division of positive and negative integers and rational and irrational numbers, including number line graphing</p> <p>8.3 apply properties of integers and rational numbers in simplifying expressions</p> <p>8.4 apply computational procedures in a wide variety of problem situations involving fractions, decimals, ratios, percents, proportions and exponents</p>	<p><i>Instructors can</i></p> <ul style="list-style-type: none"> ▪ Have students add new vocabulary and concepts to their math learning logs. Use and define the terms: natural numbers, whole numbers, rational numbers, irrational numbers, real numbers, absolute value, negative and positive integers, and number line ▪ Give examples of how negative and positive numbers are used in real life situations. For example: $+8^{\circ}$ or -20° to show temperature, $-\\$250.00$ to indicate a bank account in the red, $+15$ yards to indicate a gain of 15 yards in a football game ▪ Demonstrate and practice using the four mathematical operations on real numbers. Use real situations to help students understand how operations work, rather than memorizing rules ▪ Demonstrate the difference between operational signs and signs used to show value of numbers ▪ Demonstrate and practice the graphing of rational numbers on a number line (see <i>Reproducible Number Lines</i> in appendix for and practice exercise) ▪ Demonstrate and practice finding the “absolute value” of a real number. Show the symbol for absolute value, for example -7 ▪ Demonstrate and practice finding the opposite of a real number ▪ Demonstrate and practice finding the reciprocal of a real number ▪ Demonstrate that “<i>looking for patterns</i>” makes it easier to understand operations with signed numbers. Use temperature, money, and number lines to reinforce (see <i>Looking for Patterns</i> in appendix) ▪ Demonstrate and practice simplifying equations by removing brackets and collecting like terms ▪ Have students, in their math learning logs, create a problem in their own words and share it with each other ▪ Use concrete examples to teach negative integers. Examples could be: <ul style="list-style-type: none"> - The population of Clare County decreased by 5,000 in 2001 and 4,000 in 2002. Over the past two years how much did the population decrease? - A submarine travelling at 200 feet below sea level dives a further 150 feet to avoid a passing whale. How far below sea level is it now?

Unit 2: Introduction to Algebra

Outcome 8 – Students will be expected to demonstrate an understanding of number meanings with respect to integers and rational and irrational numbers, and explore their use in meaningful situations.

Suggestions for Assessment	Notes and Resources
<p><i>Students can</i></p> <ul style="list-style-type: none"> ▪ Complete a number of case study activities on such topics as: revenue vs. expenses, profit and loss, temperature (emphasizing positive and negative values), and surface water compared to water at a depth. They can then record their results and experiences in their math learning logs ▪ Use <i>Think Aloud Activity</i> to explore the students’ mathematical problem-solving processes (see appendix, outcome 1) ▪ Keep a learning log, including new vocabulary, new concepts, challenges, reflections, and completed activities. Sharing this learning log with the instructor can show progress and material learned to date (see <i>Math Level III Learning Log</i> in appendix) 	<p><i>Key Resources</i></p> <p><i>Basic College Mathematics</i> – Chapter 10 good for patterns re integers, Focus on History of “Magic Squares”, investigation on revenue, net income profiles</p> <p>J. Scully, B. Scully, and J. LeSage. <i>Alge-Tiles</i>. (Barrie, ON: Exclusive Educational Products, 1991) (subsequently referred to as <i>Alge-Tiles</i>) – manipulatives to provide hands-on learning opportunities, teachers’ resource binder includes many ready-to-use activities</p> <p><i>Numeracy at Work</i> – examples of numeracy used in the workplace</p> <p><i>Career Options</i></p> <p><i>Top 100 Internet Sites for Learning and Employment</i></p> <hr/> <p><i>Supplementary Resources</i></p> <p><i>Basic Mathematical Skills with Geometry</i></p> <p><i>Nexus Mathematics</i> – excellent explanations of problem solving steps, visually presented, good explanation on p. 113</p> <p><i>Content Area Blackline Masters</i></p> <p>See <i>Web Resources</i> in appendix</p>

Unit 2: Introduction to Algebra

Outcome 9 – Students will be expected to perform computation procedures on algebraic expressions, including simplification.

Demonstrations	Suggestions for Teaching and Learning
<p><i>Students will be expected to</i></p> <p>9.1 write algebraic expressions</p> <p>9.2 evaluate algebraic expressions</p> <p>9.3 understand properties of algebraic expressions</p> <p>9.4 translate word problems into algebraic expressions</p>	<p><i>Instructors can</i></p> <ul style="list-style-type: none"> ▪ Have students add new vocabulary and concepts to their math learning log. Use and define the terms: algebraic expression, variable, constant, exponent, factors, like terms, unlike terms, substitution ▪ Introduce the <i>Basic Laws of Algebra</i> (see appendix) ▪ Demonstrate and practice re-writing word statements as algebraic expressions. Have students add to their math learning logs ▪ Demonstrate and practice evaluating algebraic expressions by substitution. Have students add to their math learning log ▪ Demonstrate and practice simplifying algebraic expressions by combining like terms and removing parentheses. Be sure to follow the rules for “order of operations” (review in Number Concepts Unit) ▪ Have students compare their math learning log entries about solving algebraic problems. ▪ Have students practice concepts on ‘real-life’ scenarios (see <i>Cal’s Computer</i> and <i>Brities Bargain Barn</i> in appendix). Have students add to their math learning logs

Unit 2: Introduction to Algebra

Outcome 9 – Students will be expected to perform computation procedures on algebraic expressions, including simplification.

Suggestions for Assessment	Notes and Resources
<p><i>Students can</i></p> <ul style="list-style-type: none"> ▪ Use Alge-Tiles to solve algebraic expressions ▪ Complete the verbalizing measurement activity (see <i>Verbalizing Measurement</i> in appendix) ▪ Use <i>Think Aloud Activity</i> to explore the students mathematical problem-solving processes (see appendix, outcome 1) ▪ Keep a learning log, including new vocabulary, new concepts, challenges, reflections, and completed activities. Sharing this learning log with the instructor can show progress and material learned to date (see <i>Math Level III Learning Log</i> in appendix, outcome 1) <div style="border: 1px solid black; padding: 10px; margin-top: 20px;"> <p style="text-align: center;">Links to ALP Level III Courses</p> <p>Communications: Unit 2: Writing Strategies and Skills Outcome 9</p> </div>	<p><i>Key Resources</i></p> <p><i>Basic College Mathematics</i> – Chapters 10 and 11</p> <p><i>Alge-Tiles</i> – manipulatives to provide hands on learning opportunities; teachers resource binder includes many ready-to-use activities</p> <p><i>Numeracy at Work</i> – examples of numeracy used in the workplace</p> <p><i>Career Options</i></p> <p><i>Top 100 Internet Sites for Learning and Employment</i></p> <hr/> <p><i>Supplementary Resources</i></p> <p><i>Basic Mathematical Skills with Geometry</i></p> <p><i>Nexus Mathematics</i> – excellent explanations of problem solving steps, visually presented and matching the format of Alge-Tiles, good section on Polynomials</p> <p>J. Mennie, E. Radomski, M. Strasser, Editors, <i>Continuum Mathematics</i> (Calgary, AB: Rogue Media Inc., 2002) (subsequently referred to as <i>Continuum Mathematics</i>) – “Solving Two Step Equations” section</p> <p><i>Content Area Blackline Masters</i></p> <p>See <i>Web Resources</i> in appendix</p>

Unit 3: Measurement and Equations**Outcome 10 – Students will be expected to measure in a variety of contexts.**

Demonstrations	Suggestions for Teaching and Learning
<p><i>Students will be expected to</i></p> <p>10.1 solve measurement problems involving conversion between SI and Imperial units in one, two and three dimensional problems</p> <p>10.2 represent any number written in scientific notation in standard form, and vice versa</p> <p>10.3 measure with accuracy and confidence in a variety of contexts</p>	<p><i>Instructors can</i></p> <ul style="list-style-type: none"> ▪ Have students add new vocabulary and concepts to their math learning logs. Use and define terms such as: approximate number ▪ Explain the difference between the use of the terms accuracy, precision and significant digits in trades or science applications ▪ Explore the history of mathematical concepts in this outcome (based on examples given in the text) to reinforce the application, as needed ▪ Demonstrate and practice the concepts of approximate numbers and accuracy, emphasizing that only counting numbers are exact; all measures are approximations ▪ Explore how these skills may be applied to everyday life or a variety of workplaces ▪ Compare results obtained from a variety of workplace measurement instruments, e.g., gauges, micrometers, calipers, tape measures and stopwatches ▪ Have students practice reading digital measurements from a variety of sources, including an odometer (distance), digital thermometer (temperature) and digital scale (weight) ▪ Demonstrate and practice reading the outside, inside, and depth measurements on a vernier caliper in both metric and Imperial ▪ Have students practice reading the scales on various objects available in the classroom (e.g., tape measure, stop watch, volume measures). Record measurement, and precision ▪ Demonstrate and practice adding and subtracting measurements through determining the least precise, least accurate measure and rounding off accordingly ▪ Demonstrate and practice adding and subtracting measurements through determining the least accurate measure and rounding off accordingly ▪ Discuss, visualize and then create concept cards for students to use as reference. Students can also make their own concept cards with their own descriptions ▪ Have students describe verbally how they measure and what the results are and then make a record on their concept cards. Have students add to their math learning logs

Unit 3: Measurement and Equations

Outcome 10 – Students will be expected to measure in a variety of contexts.

Suggestions for Assessment	Notes and Resources

Unit 3: Measurement and Equations**Outcome 10 – Students will be expected to measure in a variety of contexts.**

Demonstrations	Suggestions for Teaching and Learning
	<p>(cont'd.)</p> <ul style="list-style-type: none"> ▪ Have students offer their own description of a metre (see <i>Remembering Metric Units</i> in appendix) and add to their math learning logs ▪ Use mnemonic to learn order (e.g., “King Henry Doesn’t Mind Drinking Captain Morgan” and “When He Drinks Captain Morgan He Loses His Mind”) (see <i>Remembering Metric Units</i> in appendix) ▪ Demonstrate and practice using the Metric System (SI) units: metre (for length), gram (for mass), square metre (for area), litre (for capacity) and cubic metre (for volume) ▪ Demonstrate how the metric prefixes are based on increasing or decreasing in increments of ten ▪ Develop a system for converting from one metric unit to another (see <i>Conversion Sheet</i> and metric exercises in appendix) ▪ Demonstrate that some units or prefixes are used more than others are. For example, the mL, ℓ and kℓ are commonly used for capacity, while the mg, g, and kg are commonly used for mass. ▪ Demonstrate that when comparing volume to capacity, $1\text{ cm}^3 = 1\text{ mL}$, $1\text{ dm}^3 = 1\text{ L}$ and $1\text{ m}^3 = 1\text{ kℓ}$. ▪ Explain the difference between mass and weight ▪ Explain the difference between volume and capacity ▪ Work with students in “hands on” measuring of length, comparing a mm to a cm, etc. ▪ Demonstrate and practice using the Imperial system units: inch, foot, and mile for length; ounces, pounds and ton for weight; square inch, square foot, square yard and square mile for areas; fluid ounces, pints, quarts, and gallons for capacity; and cubic inches, cubic feet, cubic yards for volume

Unit 3: Measurement and Equations

Outcome 10 – Students will be expected to measure in a variety of contexts.

Suggestions for Assessment	Notes and Resources
<p><i>Students can</i></p> <ul style="list-style-type: none"> ▪ Verbalize the problem solving process required to measure common composite figures, e.g., a hockey rink or football field (see <i>Verbalizing Measurement</i> in appendix, outcome 9) ▪ Measure and compare height, weight, etc. for class ▪ Predict the dimensions of a variety of items and then confirm by measuring ▪ Measure using rulers, scales, graduated cylinders, thermometers, etc. ▪ Measure using hydro power meters, tire pressure gauges, kitchen measuring cups, odometers (both km and miles), tachometers, etc. ▪ Use measurement devices that have different scales (e.g., thermometers, odometers, measuring cups, etc.) ▪ Compare sizes of food product bags (e.g., juice, milk) ▪ Compare tire pressures of cars, trucks, bicycles, motorcycles ▪ Check tire pressure of all 4 tires of a vehicle and compare what will be needed to be added or taken out to make all of them conform to recommended inflation ▪ Use <i>Think Aloud Activity</i> to explore the students’ mathematical problem-solving processes (see appendix, outcome 1) ▪ Keep a learning log, including new vocabulary, new concepts, challenges, reflections, and completed activities. Sharing this learning log with the instructor can show progress and material learned to date (see <i>Math Level III Learning Log</i> in appendix, outcome one) 	<p><i>Key Resources</i></p> <p><i>Basic College Mathematics – Chapter 7</i></p> <p><i>Delmar Practical Problems in Math Series</i></p> <p><i>Numeracy at Work – examples of numeracy used in the workplace</i></p> <p><i>Career Options</i></p> <p><i>Top 100 Internet Sites for Learning and Employment</i></p> <hr/> <p><i>Supplementary Resources</i></p> <p><i>Basic Mathematical Skills with Geometry</i></p> <p><i>Continuum Mathematics – measurement section</i></p> <p><i>Content Area Blackline Masters</i></p> <p>See <i>Web Resources</i> in appendix</p> <div style="border: 1px solid black; padding: 10px; margin-top: 20px;"> <p style="text-align: center;">Links to ALP Level III Courses</p> <p>Science:</p> <p style="padding-left: 40px;">Unit 1: Intro to Science Outcome 2</p> <p style="padding-left: 40px;">Unit 2: What is Biology? Outcome 5</p> </div>

Unit 3: Measurement and Equations**Outcome 11 – Students will be expected to isolate variables using a wide range of formulas.**

Demonstrations	Suggestions for Teaching and Learning
<p><i>Students will be expected to</i></p> <p>11.1 describe the relationship between opposite operations</p> <p>11.2 use concepts of opposite operations to describe properties of equality</p> <p>11.3 solve for variables retaining units</p> <p>11.4 rearrange formulas</p>	<p><i>Instructors can</i></p> <ul style="list-style-type: none"> ▪ Have students add new vocabulary and concepts to their math learning logs. Use and define the words: equation, variable, solution, substitution, equality, formulas, units, and solve ▪ Demonstrate that simple equations can be solved by simply guessing an answer and substituting to verify if it is correct ▪ Demonstrate that the answer or solution to the previous problem can be found by using the opposite operation as long as you perform the same operation to both sides of the balance ▪ Review basic concepts that are helpful in solving equations: <ul style="list-style-type: none"> - adding the opposite to any number equals zero - the same rule applies to an equation where a number is subtracted from an unknown - any number divided by itself is equal to 1 - any number multiplied by its reciprocal is equal to 1 ▪ Demonstrate and practice this method of solving equations by reinforcing these 3 basic steps: <ol style="list-style-type: none"> 1. Look at what operation is used with the unknown 2. Perform the opposite operation on both sides of the equation 3. Solve for the unknown ▪ Demonstrate and practice checking the solution to an equation by substituting the answer in the original equation ▪ Have students complete a number of real life problems <ul style="list-style-type: none"> - Commission = rate x sales - Pay check and number of hours worked, gross income and income tax - Conversion of Celsius to Fahrenheit - Break-even point (e.g., for a charity event – when have you covered the expenses?) <p>Have students include the results and experiences in their math learning logs</p> ▪ Have students practice expressing words as formulas and manipulating formulas (see <i>Manipulating Formulas</i> in appendix)

Unit 3: Measurement and Equations

Outcome 11 – Students will be expected to isolate variables using a wide range of formulas.

Suggestions for Assessment	Notes and Resources
<p><i>Students can</i></p> <ul style="list-style-type: none"> ▪ Demonstrate and practice isolating any variable in a formula by performing opposite operations ▪ Rearrange variables in the equations found in their science texts (see appendix for formulas) ▪ Use <i>Think Aloud Activity</i> to explore the students’ mathematical problem-solving processes (see appendix, outcome 1) ▪ Keep a learning log, including new vocabulary, new concepts, challenges, reflections, and completed activities. Sharing this learning log with the instructor can show progress and material learned to date (see <i>Math Level III Learning Log</i> in appendix, outcome 1) <div style="border: 1px solid black; padding: 10px; margin-top: 20px;"> <p style="text-align: center;">Links to ALP Level III Courses</p> <p>Science:</p> <ul style="list-style-type: none"> Unit 4: What is Physics? Outcome 12 Unit 6: Enhanced Biology Outcome 18 </div>	<p><i>Key Resources</i></p> <p><i>Basic College Mathematics</i> – Chapter 10 good for patterns re integers; Magic Squares activity is useful</p> <p>Et al., <i>science.connect 2</i>. (Toronto, ON: McGraw-Hill Ryerson Limited, 2003) (subsequently referred to as <i>science.connect.2</i>) – chapter “Types of Chemical Reactions” has math link section including balancing simple and complex chemical equations</p> <p><i>Alge-Tiles</i> – manipulatives to provide hands on learning opportunities; teachers resource binder includes many ready to use activities</p> <p><i>Numeracy at Work</i> – examples of numeracy used in the workplace</p> <p><i>Career Options</i></p> <p><i>Top 100 Internet Sites for Learning and Employment</i></p> <hr/> <p><i>Supplementary Resources</i></p> <p><i>Basic Mathematical Skills with Geometry</i></p> <p><i>Nexus Mathematics</i> – excellent explanations of problem solving steps, visually presented and matching the format of Alge-Tiles</p> <p><i>Content Area Blackline Masters</i></p> <p>See <i>Web Resources</i> in appendix</p>

Unit 4: Geometry**Outcome 12 – Students will be expected to understand the relationships among basic geometric figures and angles.**

Demonstrations	Suggestions for Teaching and Learning
<p><i>Students will be expected to</i></p> <p>12.1 classify geometric angles</p> <p>12.2 compare and classify geometric figures and polygons</p> <p>12.3 find the measure of unknown angles</p> <p>12.4 demonstrate an understanding of the relationships of angles, triangles and parallelograms</p>	<p><i>Instructors can</i></p> <ul style="list-style-type: none"> ▪ Make a chart of the math that will be learned in this unit where these skills could be used. Review the chart at the end of the unit as well ▪ Have students add new vocabulary and concepts to their math learning log. Use and define the terms: point, segment, line, ray, angle, parallel, perpendicular, intersecting, vertex, right angle, straight angle, acute angle, obtuse angle, degree, polygon, transversal ▪ Explore the history of mathematical concepts in this outcome (based on examples given in the text) to reinforce the application, as needed ▪ Demonstrate and practice how to properly name segments, lines, rays and angles ▪ Given a selection of angles classify them as: acute, right, obtuse, straight, complementary, supplementary ▪ Identify and classify triangles as equilateral, isosceles, scalene, right, obtuse and acute ▪ Identify and measure perpendiculars, parallels, transversals and polygons ▪ Classify polygons as quadrilaterals, pentagons, hexagons, heptagons, octagons, nonagons, etc. ▪ Determine how to find the sum of the angle measures of any polygon using the formula $(n - 2) \bullet 180^\circ$ (see <i>Angle Measurement of Polygons</i> in appendix) ▪ Use a protractor as a verification tool for determining angles ▪ Use and define the terms: complementary angle, supplementary angle, vertical (opposite) angle, corresponding angle, interior angle, alternate interior angle, alternate exterior angle, congruent, similar ▪ Demonstrate and practice finding pairs of complementary and supplementary angles and finding the measure of a complement or a supplement of a given angle and other relationships ▪ Draw intersecting lines and prove that adjacent angles add up to 180° and therefore are supplementary ▪ Demonstrate and practice finding the measures of the vertical (opposite) angles with intersecting lines

Unit 4: Geometry**Outcome 12 – Students will be expected to understand the relationship among basic geometric figures and angles.**

Suggestions for Assessment	Notes and Resources

Unit 4: Geometry

Outcome 12 – Students will be expected to understand the relationships among basic geometric figures and angles.

Demonstrations	Suggestions for Teaching and Learning
	<p>(cont'd.)</p> <ul style="list-style-type: none"> ▪ Draw parallel lines, cut them with a transversal and show pairs of corresponding angles, vertical angles, alternate interior angles, alternate exterior angles, and supplementary angles ▪ Demonstrate and practice determining measures of angles formed when a transversal line cuts two parallel lines ▪ Apply the properties of congruency and similarity in geometric figures to: <ol style="list-style-type: none"> 1. Prove congruency (SAS, ASA, SSS) or similarity in triangles 2. Identify the equivalent angles and sides of congruent triangles 3. Identify the equivalent angles and proportional sides of similar triangles ▪ Demonstrate and practice using ratio and proportion calculations to determine the unknown sides of similar triangles ▪ Given two congruent triangles, match up only congruent sides to form new polygons. Name the polygons. Play game to create different shapes. Talk about the shapes created ▪ Demonstrate and practice using the properties of parallelograms to find the lengths of sides and measures of angles of parallelograms

Unit 4: Geometry

Outcome 12 – Students will be expected to understand the relationships among basic geometric figures and angles.

Suggestions for Assessment	Notes and Resources
<p><i>Students can</i></p> <ul style="list-style-type: none"> ▪ Use <i>Think Aloud Activity</i> to explore the students’ mathematical problem-solving processes (see appendix, outcome 1) ▪ Keep a learning log, including new vocabulary, new concepts, challenges, reflections, and completed activities. Sharing this learning log with the instructor can show progress and material learned to date (see <i>Math Level III Learning Log</i> in appendix, outcome 1) ▪ Complete the <i>Angle Measurement of Polygons</i> activity (see appendix) <div style="border: 1px solid black; padding: 10px; margin: 20px auto; width: fit-content;"> <p style="text-align: center;">Links to ALP Level III Courses</p> <p>Social Studies: Unit 1: Geography Outcome 1</p> </div>	<p><i>Key Resources</i></p> <p><i>Basic College Mathematics</i> – Chapter 8, videos and teachers guides</p> <p><i>Delmar Practical Problems in Math Series</i></p> <p><i>Numeracy at Work</i> - examples of numeracy used in the workplace</p> <p><i>Career Options</i></p> <p><i>Top 100 Internet Sites for Learning and Employment</i></p> <hr/> <p><i>Supplementary Resources</i></p> <p><i>Continuum Mathematics</i> – measurement section</p> <p><i>Nexus Mathematics</i> – visual and practical explanations</p> <p><i>Quantum Mathematics</i> – Design and Construction Unit has excellent practical application project</p> <p><i>Basic Mathematical Skills with Geometry</i></p> <p><i>Content Area Blackline Masters</i></p> <p>See <i>Web Resources</i> in appendix</p>

Unit 4: Geometry**Outcome 13 – Students will be expected to apply geometric formulas and procedures in a wide variety of contexts.**

Demonstrations	Suggestions for Teaching and Learning
<p><i>Students will be expected to</i></p> <p>13.1 describe patterns and generalize the relationships between areas and perimeters of quadrilaterals and circles</p> <p>13.2 calculate the areas of composite figures</p> <p>13.3 measure and calculate volumes and surface areas of composite 3-D shapes</p> <p>13.4 solve applied problems using geometry including an introduction to Pythagorean Theorem</p>	<p><i>Instructors can</i></p> <ul style="list-style-type: none"> ▪ Have students add new vocabulary and concepts to their math learning logs. Use and define the terms: perimeter, area, volume, surface area, linear measurement, square measurement, and cubic measurement ▪ Explore the history of mathematical concepts in this outcome (based on examples given in the text) to reinforce the application, as needed (see <i>The 3, 4, 5 Rule</i> in appendix) ▪ Demonstrate and practice finding the perimeter of any polygon by adding up the length of all the sides. Show how formulas can be developed for various polygons. ▪ Introduce the “3, 4, 5 rule” (see <i>The 3, 4, 5 Rule</i> in appendix) ▪ Measure the circumference and diameter of circular objects and calculate pi (π) (see <i>Pi</i> in appendix for facts and exercises) ▪ Calculate the perimeter of various polygons ▪ Measure the perimeter of a room to calculate the amount of moulding, or wallpaper border needed to remodel the room. Do an estimate on the cost ▪ Discuss the relationship of perimeter, area, and volume, to linear, square and cubic measurement ▪ Demonstrate and practice using the formula for radius, circumference, and diameter of a circle ▪ Demonstrate using the formulas for area of a square, a rectangle, a triangle, a parallelogram, a trapezoid, a circle. ▪ Introduce “area formulas” for squares, circles, triangles and rectangles (see <i>Area</i> in appendix) ▪ Newspaper ads are sold based on the area of paper they take up. Find a number of different size ads in newspapers and magazines. Determine the cost of ads using the following guide <ul style="list-style-type: none"> - Newspaper ads run at \$40 per 1/8th page - Magazine ads are \$50 for each square cm ▪ Street signs are also sold by area. Measure a number of street signs of various shapes and determine the cost of each using the knowledge that it costs \$20 a square foot ▪ Measure 2D and 3D shapes

Unit 4: Geometry**Outcome 13 – Students will be expected to apply geometric formulas and procedures in a wide variety of contexts.**

Suggestions for Assessment	Notes and Resources

Unit 4: Geometry

Outcome 13 – Students will be expected to apply geometric formulas and procedures in a wide variety of contexts.

Demonstrations	Suggestions for Teaching and Learning
	<p>(cont'd.)</p> <ul style="list-style-type: none"> ▪ Demonstrate and practice using the formula for surface area of a rectangular solid, a cube, a cylinder (see <i>Area</i> in appendix) ▪ Demonstrate and practice using the formulas for volume of a cube, a rectangular solid, a cylinder, a sphere, a cone ▪ Demonstrate solving word problems involving perimeter, area and volume. Use everyday examples and situations so it becomes relevant to the student ▪ Research the work of Archimedes on the web. He died in 212 B.C. and considered the 1:2:3 ratio between the cone, sphere and cylinder his greatest achievement; so much so that they put a figure of a sphere inscribed inside of a cylinder on his tombstone

Unit 4: Geometry

Outcome 13 – Students will be expected to apply geometric formulas and procedures in a wide variety of contexts.

Suggestions for Assessment	Notes and Resources
<p><i>Students can</i></p> <ul style="list-style-type: none"> ▪ Measure the area of the floor or the walls of a room to calculate the amount of flooring needed or the amount of paint or wallpaper needed. Do a cost estimate. See the “Room Design Project” in <i>Continuum Mathematics</i>. To provide an assessment for all of the demonstrations in this outcome, the students can complete the activity in <i>Continuum Mathematics</i> ▪ Complete the “Animal Care” project in <i>Quantum Mathematics</i> ▪ Measure a cardboard box, and imagine it to be a fuel tank. Calculate the volume, then its capacity in litres and/or gallons and estimate the cost of filling the tank with gasoline ▪ Design a product and box for packaging. Calculate the area and volume. VARIATION: Use one sheet of cardboard to design a package for a small object ▪ Use two pieces of different-sized string to determine the length of the third piece needed to construct a right angle triangle. Explain the answer ▪ Complete the “3, 4, 5 rule” challenge using the Pythagorean Theorem (see <i>The 3, 4, 5 Rule</i> in appendix) ▪ Determine the distance from home plate to second base on a standard-sized baseball diamond. Explain the answer ▪ Complete the home building project (see <i>Area</i> in appendix) ▪ Use <i>Think Aloud Activity</i> to explore the students’ mathematical problem-solving processes (see appendix, outcome 1) ▪ Keep a learning log, including new vocabulary, new concepts, challenges, reflections, and completed activities. Sharing this learning log with the instructor can show progress and material learned to date (see <i>Math Level III Learning Log</i> in appendix) 	<p><i>Key Resources</i></p> <p><i>Basic College Mathematics</i> – Chapter 8, videos and teachers guides, Focus on History section</p> <p><i>Delmar Practical Problems in Math Series</i></p> <p><i>Numeracy at Work</i> – examples of numeracy used in the workplace</p> <p><i>Career Options</i></p> <p><i>Top 100 Internet Sites for Learning and Employment</i></p> <hr/> <p><i>Supplementary Resources</i></p> <p><i>Continuum Mathematics</i> – “Room Design” project at the end of measurement section and classroom problem on page 359</p> <p><i>Nexus Mathematics</i> – visual and practical explanations</p> <p>Quantum Mathematics – Unit Three: Animal Care</p> <p><i>Basic Mathematical Skills with Geometry</i></p> <p><i>Content Area Blackline Masters</i></p> <p>See <i>Web Resources</i> in appendix</p> <div style="border: 1px solid black; padding: 10px; margin-top: 20px;"> <p style="text-align: center;">Links to ALP Level III Courses</p> <p>Science: Unit 3: Chemistry Outcome 8</p> <p>Social Studies: Unit 3: Introduction to History Outcome 5</p> </div>

Unit 5: Consumer Math and Statistics**Outcome 14 – Students will be expected to create and solve problems related to consumer spending and money management.**

Demonstrations	Suggestions for Teaching and Learning
<p><i>Students will be expected to</i></p> <p>14.1 solve real-world problems related to consumer spending and money management</p> <p>14.2 solve problems related to income and deductions from income</p> <p>14.3 select and use appropriate computational techniques to solve a variety of problems and explain the choices</p>	<p><i>Instructors can</i></p> <ul style="list-style-type: none"> ▪ Have students add new vocabulary and concepts to their math learning logs. Use and define the terms: harmonized sales tax (HST), simple interest, compound interest, loans, and investments ▪ Explore the history of mathematical concepts in this outcome (based on examples given in the text) to reinforce the application, as needed ▪ Demonstrate ‘math and money’ uses: how to write a cheque, calculate sales tax, and calculate discount and sales prices ▪ Demonstrate the calculations of simple and compound interest on investments and loans using compound interest table (see <i>Compound Interest Table</i> in appendix) ▪ Use and define the terms: gross income, net income, deductions, Employment Insurance (EI), Canada Pension Plan (CPP), Income Tax, hourly wage, salary, weekly salary, commission, and piecework ▪ Calculate gross income for an hourly wage position, a job on commission and when piecework is paid (see appendix) ▪ Have students find out the rates used for calculating CPP, EI and Income Tax deductions, then calculate net income by deducting CPP, EI, and Income Tax from gross income ▪ Help students determine the pay for chosen occupations, including salary and benefits. Have them convert annual incomes into monthly, semimonthly, weekly and hourly incomes ▪ Have students calculate and compare the total cost involved in making a purchase with varying credit vehicles (credit card, layaway, lease, rent, etc.) ▪ Have students create a table of the advantages and disadvantages of borrowing

Unit 5: Consumer Math and Statistics

Outcome 14 – Students will be expected to create and solve problems related to consumer spending and money management.

Suggestions for Assessment	Notes and Resources
<p><i>Students can</i></p> <ul style="list-style-type: none"> ▪ Write a short report comparing features and conditions of various short-term loan options (varying length of loan, type of instalments, etc.) for the purchase of an automobile ▪ Using Career Options, record the salary of a selected career. Then, calculate a monthly budget, deducting income tax and CPP, EI, etc. (see <i>Monthly Budget Worksheet</i> in appendix) ▪ Use <i>Think Aloud Activity</i> to explore the students’ mathematical problem-solving processes (see appendix, outcome 1) ▪ Complete a word problem, and record the experience in their learning logs ▪ Keep a learning log, including new vocabulary, new concepts, challenges, reflections, and completed activities. Sharing this learning log with the instructor can show progress and material learned to date (see <i>Math Level III Learning Log</i> in appendix) ▪ Complete the “On My Own” unit in <i>Quantum Mathematics</i> 	<p><i>Key Resources</i></p> <p><i>Basic College Mathematics</i>– Chapter 6, videos and teachers guides</p> <p><i>Delmar Practical Problems in Math Series</i></p> <p><i>Numeracy at Work</i> – examples of numeracy used in the workplace</p> <p><i>Career Options</i></p> <p><i>Top 100 Internet Sites for Learning and Employment</i></p> <hr/> <p><i>Supplementary Resources</i></p> <p><i>Quantum Mathematics</i> – The “On My Own” unit provides practical real world problems and projects applying consumer math</p> <p><i>Continuum Mathematics</i> – practical real world problems involving consumer math</p> <p><i>Basic Mathematical Skills with Geometry</i></p> <p><i>Content Area Blackline Masters</i></p> <p>See <i>Web Resources</i> in appendix</p> <div style="border: 1px solid black; padding: 10px; margin-top: 20px;"> <p style="text-align: center;">Links to ALP Level III Courses</p> <p>Science: Unit 6: Enhanced Biology Outcome 15</p> <p>Social Studies: Unit 3: Introduction to Economics Outcome 7</p> </div>

Unit 5: Consumer Math and Statistics

Outcome 15 – Students will be expected to solve problems involving the collection, display and analysis of data.

Demonstrations	Suggestions for Teaching and Learning
<p><i>Students will be expected to</i></p> <p>15.1 construct and analyze tables and graphs and identify trends</p> <p>15.2 explore types of graphical and tabular representations of statistics in newspapers, magazines and texts</p> <p>15.3 describe real-world relationships depicted by graphs and tables of values</p>	<p><i>Instructors can</i></p> <ul style="list-style-type: none"> ▪ Have students add new vocabulary and concepts to their math learning logs. Use and define the terms: line graphs, pie graphs, bar pictographs, histograms, interpolation, and extrapolation ▪ Explore the history of mathematical concepts in this outcome (based on examples given in the text) to reinforce the application, as needed ▪ Demonstrate and practice reading information from tables, pictographs, line graphs, bar graphs and circle graphs. Try to gather examples from advertisements, junk mail, informational pamphlets, flyers, etc. ▪ Demonstrate how important it is to choose the best type of graph to better display the type of information given ▪ Explain what is meant by the horizontal-axis (x-axis), the vertical axis (y-axis), the scale and the label on a line or bar graph ▪ Explain and practice how to draw a circle graph: measuring the number of degrees with a protractor and converting the fractional or percent portion of a circle to a number of degrees ▪ Demonstrate and practice constructing line and bar graphs. Follow these 5 steps: <ol style="list-style-type: none"> 1. Determine the proper scale 2. Draw and label the axes 3. Plot the data 4. Draw and label the lines or bars 5. Name the graph ▪ Demonstrate and practice using problem solving techniques learned in earlier units and statistical methods learned in this unit to solve problems in pairs, groups and individually ▪ Explain what is meant by interpolation and extrapolation (see <i>Interpolation and Extrapolation</i> in appendix) ▪ Use graphs to make predictions by interpolation and extrapolation (see <i>Make Predictions by Interpolation and Extrapolation</i> in appendix)

Unit 5: Consumer Math and Statistics

Outcome 15 – Students will be expected to solve problems involving the collection, display and analysis of data.

Suggestions for Assessment	Notes and Resources
<p><i>Students can</i></p> <ul style="list-style-type: none"> ▪ Conduct a simple survey, such as what kind of soft drink the student population prefers. Create line, bar and circle graphs based on the survey information. Comment on how this information might be useful. Put the results into a short report explaining the significant findings (this can take the form of a poster or can be an oral presentation) ▪ Use the budget created for Outcome 13 assessment and create charts and graphs to compare percentages of budget items ▪ Use <i>Think Aloud Activity</i> to explore the students’ mathematical problem-solving processes (see appendix, outcome 1) ▪ Complete a word problem, and record the experience in their learning logs ▪ Keep a learning log, including new vocabulary, new concepts, challenges, reflections, and completed activities. Sharing this learning log with the instructor can show progress and material learned to date (see <i>Math Level III Learning Log</i> in appendix) <div style="border: 1px solid black; padding: 10px; margin-top: 20px;"> <p style="text-align: center;">Links to ALP Level III Courses</p> <p>Science:</p> <p style="padding-left: 20px;">Unit 4: What is Physics? Outcome 12</p> <p style="padding-left: 20px;">Unit 5: Science Connections Outcome 14</p> </div>	<p><i>Key Resources</i></p> <p><i>Basic College Mathematics</i> – Chapter 6, videos and teachers guides</p> <p><i>Delmar Practical Problems in Math Series</i></p> <p><i>Numeracy at Work</i> – examples of numeracy used in the workplace</p> <p><i>Career Options</i></p> <p><i>Top 100 Internet Sites for Learning and Employment Career Options</i></p> <p><i>Top 100 Internet Sites for Learning and Employment</i></p> <hr/> <p><i>Supplementary Resources</i></p> <p><i>Quantum Mathematics</i> – practical real world problems involving consumer math; “O Canada” section has good section on statistics and interpretation of graphics, good example of bias in data</p> <p><i>Continuum Mathematics</i> – practical, real world problems</p> <p><i>Basic Mathematical Skills with Geometry</i></p> <p><i>Content Area Blackline Masters</i></p> <p>See <i>Web Resources</i> in appendix</p>

Unit 5: Consumer Math and Statistics**Outcome 16 – Students will be expected to apply basic concepts of statistics and representations in everyday contexts.**

Demonstrations	Suggestions for Teaching and Learning
<p><i>Students will be expected to</i></p> <p>16.1 solve problems involving mean, medians, modes and range</p> <p>16.2 explore and discuss sampling issues and understand procedures with respect to collecting data</p> <p>16.3 evaluate the validity of statistical information presented in the media</p>	<p><i>Instructors can</i></p> <ul style="list-style-type: none"> ▪ Have students add new vocabulary and concepts to their math learning logs. Use and define the terms: mean, median, mode, range, data, random sampling, statistics, bias ▪ Explore the history of mathematical concepts in this outcome (based on examples given in the text) to reinforce the application, as needed ▪ Explain how to calculate the mean, median, mode and range in a group of data ▪ Demonstrate problems that easily distort information, such as unusually low or high sample numbers or not using a random sampling technique ▪ Collect information about the class such as height, number of children, time spent studying each evening, amount of time spent sleeping, distance away from school, work etc. Use this data to determine the mean, median, mode and range (see <i>Height Exercise for Statistics/Measurement</i> in appendix) ▪ Have students construct a variety of graphs used to display data ▪ Select a math-based article, graphic or narrative from a textbook they are using and have the students write a report asking what the main argument is. In groups have students share their reports and comment on each others'. Allow students to redraft their reports before handing them in ▪ Find a Web site (e.g., a pharmaceutical company) that claims a math-based result (e.g., works 20% better than the competition). Have the student search the data portion of the site and answer the question: can the company back this claim? ▪ Have students complete exercises on interpretation of data

Unit 5: Consumer Math and Statistics

Outcome 16 – Students will be expected to apply basic concepts of statistics and representations in everyday contexts.

Suggestions for Assessment	Notes and Resources
<p><i>Students can</i></p> <ul style="list-style-type: none"> ▪ Select a math-based article from the newspaper or other media and write a report on what the article says and how it will affect them. In groups have students share their reports and comment on each others’. Allow the students to redraft their reports before handing them in (see <i>Mathematics in the Newspaper</i> and <i>Mathematics in the Media</i> in appendix) ▪ Use statistically based case stories from magazines, newspapers, and texts to show how statistics are used in the media. Relate this to what questions are asked, how data is collected and what conclusions have been drawn ▪ Solve applied statistical problems (see <i>Solve Applied Problems in Statistics</i> in appendix) ▪ Use <i>Think Aloud Activity</i> to explore the students’ mathematical problem-solving processes (see appendix, outcome 1) ▪ Complete a word problem, and record the experience in their learning logs ▪ Keep a learning log, including new vocabulary, new concepts, challenges, reflections, and completed activities. Sharing this learning log with the instructor can show progress and material learned to date (see <i>Math Level III Learning Log</i> in appendix) ▪ Complete the “Health and Fitness” section in <i>Quantum Mathematics</i> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p style="text-align: center;">Links to ALP Level III Courses</p> <p>Communications: Unit 3: Responding to Text and Media Outcome 11</p> <p>Science: Unit 4: What is Physics? Outcomes 11 &12 Unit 5: Science Connections Outcome 14 Unit 6: Enhanced Biology Outcomes 15 & 16</p> <p>Social Studies: Unit 1: Geography Outcome 2 Unit 2: Introduction to History Outcome 6 Unit 4: Diversity and Culture Outcomes 9 & 10</p> </div>	<p><i>Key Resources</i></p> <p><i>Basic College Mathematics</i> – Chapter 9, videos and teachers guides</p> <p><i>Delmar Practical Problems in Math Series</i></p> <p><i>Numeracy at Work</i> – examples of numeracy used in the workplace</p> <p><i>Career Options</i></p> <p><i>Top 100 Internet Sites for Learning and Employment</i></p> <hr/> <p><i>Supplementary Resources</i></p> <p><i>Quantum Mathematics</i> – real world problems involving consumer math; example of math based article in “Health and Fitness” section</p> <p><i>Continuum Mathematics</i> – Entertainment Industry section, real world problems</p> <p><i>Basic Mathematical Skills with Geometry</i></p> <p>Print media: newspapers and magazines, available at libraries, on line, or from local circulation offices</p> <p><i>Content Area Blackline Masters</i></p> <p>See <i>Web Resources</i> in appendix</p>

Unit 6: Further Explorations in Algebra and Intro to Trigonometry**Outcome 17 – Students will be expected to demonstrate operations principles in algebraic expressions.**

Demonstrations	Suggestions for Teaching and Learning
<p><i>Students will be expected to</i></p> <p>17.1 graph and solve basic linear equations (e.g., $Y=mx+b$)</p> <p>17.2 solve inequalities</p> <p>17.3 solve problems using properties of exponents</p> <p>17.4 perform operations using basic polynomials (add, subtract, multiply, divide)</p> <p>17.5 factor polynomials when the terms have a common factor</p> <p>17.6 factor polynomials of the type $x^2 + bx + c$</p>	<p><i>Instructors can</i></p> <ul style="list-style-type: none"> ▪ Have students add new vocabulary and concepts to their math learning logs ▪ Demonstrate and practice how to change a word problem into an equation ▪ Review and practice finding solutions to equations using opposite operations and isolating variables ▪ Solve word problems in science and business. Remember the steps to solving problems: <ul style="list-style-type: none"> - <i>Familiarize</i>: Familiarize yourself with the situation. What is the problem asking you to find? If it helps, draw a picture to help clarify the situation - <i>Translate</i>: Translate the word problem into mathematical operations or an equation. There are key words to help you decide which operation to use. They are often found in the sentence with the question mark - <i>Solve</i>: Set up the method you are going to use to solve the equation. Do the math - <i>Check</i>: Check your answer by looking at the original wording to see if it makes sense. You can also check by estimating and by doing the opposite operation you performed in the “solve” step - <i>State</i>: State the answer to the problem clearly with the appropriate units

Unit 6: Further Explorations in Algebra and Intro to Trigonometry

Outcome 17 – Students will be expected to demonstrate operations principles in algebraic expressions.

Suggestions for Assessment	Notes and Resources
<p><i>Students can</i></p> <ul style="list-style-type: none"> ▪ Use <i>Think Aloud Activity</i> to explore the students’ mathematical problem-solving processes (see appendix, outcome 1) ▪ Keep a learning log, including new vocabulary, new concepts, challenges, reflections, and completed activities. Sharing this learning log with the instructor can show progress and material learned to date (see <i>Math Level III Learning Log</i> in appendix) 	<p><i>Key Resources</i></p> <p>Bittinger, M.L., Beecher, J.A., (2000). <i>Developmental Mathematics</i>. 5th Ed. Reading, MA: Addison-Wesley (2000) (subsequently referred to as <i>Developmental Mathematics</i>) – chapters 9, 10, 11, 12, 13, 15</p> <p>See <i>Web Resources</i> in appendix</p> <div data-bbox="956 1129 1442 1287" style="border: 1px solid black; padding: 10px; margin: 20px auto; width: fit-content;"> <p style="text-align: center;">Links to ALP Level III Courses</p> <p>Science: Unit 17: Enhanced Chemistry Outcome 17</p> </div>

Unit 6: Further Explorations in Algebra and Intro to Trigonometry**Outcome 18 – Students will be expected to understand applications of and solve applied trigonometric problems involving right triangles.**

Demonstrations	Suggestions for Teaching and Learning
<p><i>Students will be expected to</i></p> <p>18.1 demonstrate an understanding of the Pythagorean relationship using models</p> <p>18.2 apply the Pythagorean relationship in problem situations</p> <p>18.3 use trigonometry to solve right angle triangles</p> <p>18.4 use the law of sines and cosines to solve oblique triangles</p>	<p><i>Instructors can</i></p> <ul style="list-style-type: none"> ▪ Have students add new vocabulary and concepts to their math learning logs. Use and define the words: Pythagorean theorem, sine, cosine, tangent, oblique triangle, law of sines, law of cosines ▪ Explain the conventions for naming a right triangle ▪ Define the Pythagorean theorem (see <i>Pythagorean Theorem</i> in appendix, outcome 13) ▪ Use a tape measure to show the student how the Pythagorean Theorem works by using the one-foot square tiles on a floor. Use two edges of the tiles that are perpendicular and measure off 3 feet and 4 feet at 90° (see diagram below). Then measure the diagonal from point A to point B. The measure should be 5^1. Then prove $a^2 + b^2 = c^2$ by using $3^2 + 4^2 = 5^2$. Point out this only works for right triangles ▪ Measure 2 sides of several right triangles. Verify the length of the third side by calculation and measurement. What do you notice about the results? ▪ Introduce the relationship of sides and angles in right triangles (see <i>Right Angle Trigonometry</i> in appendix) ▪ Define and determine sine and relate it to angles in a right triangle ▪ Use knowledge of sine to solve for angle measure and side length in applications ▪ Define and determine cosine and relate it to angles in a right triangle ▪ Use knowledge of cosine to solve for angle measure and side length in applications ▪ Define and determine tangent and relate it to angles in a right triangle ▪ Use knowledge of tangent to solve for angle measure and side length in applications ▪ Use knowledge of sine, cosine and tangent to solve for angle measure and side length in word problems ▪ Explore the <i>Trigonometric Values</i> of angles greater than 90 degrees (see appendix)

Unit 6: Further Explorations in Algebra and Intro to Trigonometry

Outcome 18 – Students will be expected to understand applications of and solve applied trigonometric problems involving right triangles.

Suggestions for Assessment	Notes and Resources
<p><i>Students can</i></p> <ul style="list-style-type: none"> ▪ Use ‘think aloud’ activity to explore the students’ mathematical problem-solving processes (see appendix, outcome 1) ▪ Complete activities in Bittinger, <i>Developmental Mathematics</i> 	<p><i>Key Resources</i></p> <p><i>Developmental Mathematics</i> – chapters 9, 10, 11, 12, 13, 15</p> <p>See <i>Web Resources</i> in appendix</p>

Neurodevelopmental Information

This appendix is intended to be used three ways: as an introduction to the world of neurodevelopmental constructs, a reference to the overall relationship between the neurodevelopmental constructs and mathematics, and a collection of construct specific strategies for supporting neurodevelopmental weaknesses.

All of these materials have been taken from the All Kinds of Minds website which is accessible to anyone with the internet (www.allkindsofminds.org). They have been re-organized to fit with this specific document so as to be more user friendly.

What Are Neurodevelopmental Constructs?

According to Dr. Mel Levine in *A Mind at a Time* (Simon & Schuster, 2002) a neurodevelopmental function is the most basic instrument for learning. It is likened to a delicate tool found in a carpenter's tool chest. Our minds are said to make use of different clusters of neurodevelopmental functions to learn specific skills and to create particular products (Simon & Schuster, 2002, page 28). These functions may be one component or memory allowing a student to remember where something has been seen in the past or the capacity to store and retrieve chains of information. Given the metaphor of the brain as a toolbox, the total number of neurodevelopmental functions are inestimable. It should not be surprising then to consider that breakdowns or weaknesses are commonplace. Everyone has weaknesses of some sort; for some people they become a permanent roadblock to learning. In order to use the concept of neurodevelopmental constructs to assist struggling students, it is important to identify the eight systems which are the foundation of the concept:

- (a) Attention;
- (b) Memory;
- (c) Language;
- (d) Spatial Ordering;
- (e) Sequential Ordering;
- (f) Neuromotor Function;
- (g) Higher Order Cognition; and
- (h) Social Cognition.

Attention (Simon & Schuster, 2002, p. 31)

Attention is the administrative bureau of the brain, the headquarters for mental regulators that patrol and control learning and behaviour. The attention controls direct the distribution of mental energy within our brains, so that we have the wherewithal to finish what we start and stay alert throughout the day. Other controls of attention slow down our thinking so we can plan and complete tasks competently and efficiently.

Memory

Memory works in three ways: short term, long term and active working. Most people think they know what short term memory is. In fact it is the ability to store information in the brain for 2-3 seconds. The memory that most people think is short term is actually active working memory. This portion of memory allows a person to hold several pieces of information and procedures at the core of operations - holding a pen and writing an idea down coherently takes a large active working memory until the task becomes habitual. Long term memory is the storage of information and procedures for use over days, weeks, months, or even years. It is the filing cabinet of the brain.

Language (Simon & Schuster, 2002, p. 32)

The language ingredients of learning include, among other things, the ease with which a brain detects differences between the forty-four or so different English language sounds, the ability to understand, remember, and start using new vocabulary, the capacity to express thoughts while speaking and on paper, and the speed of comprehension needed to keep pace with the flow of verbal explanations and instructions. Language is divided into receptive and expressive functions.

Spatial Ordering (Simon & Schuster, 2002, p. 33)

The spatial ordering system is designed to enable us to deal with or create information arranged in a gestalt, a visual pattern, or a configuration. Through spatial ordering we perceive how parts of things fit together. It also helps us organize the various material necessities of the day, such as pencils, notebooks, keys and other props needed for academic efficiency and proficiency.

Sequential Ordering (Simon & Schuster, 2002, p. 33)

This system, a working partner of spatial ordering, helps us deal with the chains of information that come into or depart from our minds coded in a particular serial order or sequence. Sequential ordering forms the basis for time management, understanding time, estimating time, allocating time, and being aware of time's passage.

Neuromotor Function

Neuromotor functions are divided into three categories: fine motor, gross motor and graphomotor. Most people recognize fine motor as the ability to draw, repair fine machinery and build model toys. Gross motor involves the larger muscles and is often connected to athletic ability – the ability to throw a ball, run efficiently and jump well. Graphomotor is the key to school work - the ability to handwrite or print letters on a page. An excellent description of the graphomotor skills used in writing can be found in *The Myth of Laziness* (Simon & Schuster, 2003, p. 28).

Higher Order Cognition (Simon & Schuster, 2002, p. 34)

Higher order cognition includes the ability to problem-solve and reason logically, to form and make use of concepts, to understand how and when rules apply, and to get the point of a complicated idea. Higher order cognition also takes in critical and creative thinking.

Social Cognition

Social cognition includes the ability to communicate and interpret feelings (one's own and others'), using appropriate vocabulary, tone and intonation in different social settings, selecting appropriate topics for the audience, regulating the use and appropriateness of humour, engaging in proper conversational techniques, presenting oneself well, processing body language, tone and voice of other participants in a social setting, getting along with other people, resolving conflicts in non-violent ways and working with people to achieve a desired goal. In short, social cognition is how we get along with others.

The Relationship Between the Neurodevelopmental Constructs and Mathematics

Mathematics is among the most cumulative of academic areas. The learner must constantly integrate new and more sophisticated skills and concepts into a network of math knowledge. In order for learners to progress to more complex mathematical tasks, a portion of math knowledge must become automatized. As basic abilities become automatic, the learner is able to operate more effectively on higher mathematical levels. Such levels include the use of math procedures (such as the steps for long division and the rules for multiplying fractions), the building of math concepts (such as ratio and proportion), and the process of problem solving (as in math word problems).

The Fundamentals of Math

The mastery of math facts is an essential ingredient in a learner's math development. Math facts are those addition, subtraction, multiplication and division computations which are the basis for math operations. These basic facts must become increasingly effortless and automatic, so learners can use them quickly and accurately when working with math procedures, learning new math concepts, and performing math problem-solving.

A learner's number sense includes the ability to understand both number meanings (as in the association of the digit 7 with seven items) and quantitative concepts (for example, that the symbol '+' signifies 'add' which means 'combine'). Such understanding is promoted by a learner's ability to relate a concrete symbol to a concept or abstract idea. The awareness of basic math patterns is closely related to number sense. Pattern awareness involves an appreciation of basic rules and patterns that exist in math, knowing, for example, that multiplying a number by zero yields zero, while multiplying by 1 yields the original number.

Both number sense and the ability to make simple generalizations from patterns are aided by a learner's higher order thinking skills, including the ability to think on an abstract level.

The Impact of Attention

The mental energy controls of attention get the 'fuel' to the brain that the learner needs. By maintaining concentration and sustaining a high level of mental energy, a learner is able to "tune in" to the learning of math facts. Then, using the processing controls of attention to effectively think about the new mathematical information (in this case, attending to details of number and sign), a learner can build a repertoire of mastered facts. Finally, the production controls of attention help the learner recall and use math facts efficiently, for example, enabling a learner not only to remember math facts, but to self-monitor for careless errors in the process.

As learners develop their mathematical awareness, they begin to discover the rules that guide computation and problem solving. Attention skills play an important role in the learning and recognition of these rules. For example, recognizing basic rules depends in part upon a learner's ability to concentrate consistently, attend to detail, and connect new information to what is already known.

For learners to use algorithms (a set of specific steps used to compute a problem), they must rely on many attention skills including the ability to sustain attention to detail, to plan a solution, and to self-monitor progress.

In addition, learners must be able to call up algorithms from long-term memory and to hold a number of steps in their minds while working through multi-step solutions.

Active problem solving skills are strongly tied to a learner's attention abilities. Learners must closely attend to problem details to determine what the question is, what kind of answer to look for, and what information will be salient or important when solving the problem. Learners must analyze the problem, possibly breaking it down into a logical sequence of smaller steps (instead of reacting impulsively or 'jumping' to a conclusion). In addition, the ability to preview, or estimate likely outcomes within a problem, enables the learner to make quantitative and strategic predictions, such as what amounts will likely be involved or what strategies are likely to be used.

The Impact of Memory

Long-term memory also plays an important role in the mastery and automatization of math facts. Often math facts are memorized and later called to mind as paired associations. For example, a learner might learn the equation, "two times four" and the answer, "eight" as an associated pair. Thus, when he hears "two times four," he automatically associates and recalls the number "eight" as the missing half of the pair.

Through short-term memory, information is first registered into the mind. The details of math facts within a problem must be registered and processed quickly, with the sequence and visual attributes of the facts preserved correctly. Active working memory plays an important role as well, since learners must instantaneously recall facts while holding in mind the operations and steps of the larger problem. Finally, efficient organization of math facts in long-term memory aids the learner's quick and easy access of those facts contained in the problem. Thus the demands upon memory are numerous.

Rules in math are based upon patterns. Learners must learn to recognize the patterns in different math situations and the rules associated with each pattern. Once a rule pattern has been learned, the learner can then store it in long-term memory, and access the rule when the pattern occurs in a new situation. For example, once a learner learns the rules for regrouping in subtraction problems, when faced with a new subtraction problem requiring regrouping, he/she can recognize the pattern and call up the proper rules to mind.

Learners use their long-term memory to help determine whether a word problem reflects a familiar pattern. They search in memory for prior knowledge, learned rules, or relevant skills that have worked in the past for that type of problem, and then, apply that knowledge in the new situation.

The Impact of Sequential Ordering

Math is built upon a logical structure of patterns, rules, and procedures. The use of basic rules and sequences of steps (algorithms) helps learners compute math more effectively. Algorithms provide us with a blueprint, or set of guidelines, for working with math problems. Moreover, many rules and algorithms are based upon numerical relationships and important math concepts. An understanding of rules and procedures in math fosters an understanding of mathematical concepts and the ability to solve problems with computation. For some learners, learning and applying algorithms can be a challenge.

Learners must also keep in mind the fact that algorithms are sequential in nature, having an order in which steps must be completed. The order of operations algorithm, for example, states that rather than moving from left to right to solve an equation like $3 + 6 \times 4$, the equation must be solved in a specific order based on the operation involved (in this case, first the multiplication: 6×4 , then the addition: $3+24$). Learners must remember and follow the correct sequence to solve the problem correctly.

The Impact of Spatial Ordering

In addition to attending to the sequential aspect of algorithms, learners must use spatial abilities to apply many procedures. When working with column addition and subtraction, or multiple-digit multiplication, for example, learners must keep numbers aligned and spaced correctly on the page to do the calculations effectively.

In developing an awareness of mathematical concepts, learners must engage their nonverbal thinking skills. Nonverbal thinking involves the use of spatial and visual processes to learn or think about a problem or concept. Nonverbal thinking may involve the use of symbols. The numerals 6 and 26, for example, are symbols that represent quantities. Learners use and manipulate symbols when doing operations ranging from basic addition to algebraic equations.

Nonverbal thinking also may involve visual or spatial representations of math processes and relationships. Learners must be able to interpret visual and spatial information (as when looking at a map, graph, or geometric shape), and to form and understand visual and spatial concepts (as when translating graph images into usable mathematical information, or describing attributes of shapes).

Some concepts lend themselves to ‘visualization’, creating a mental image to represent a mathematical relationship. The concept of proportion is a good example. A learner may have a difficult time interpreting proportion through words and verbal explanation, but being able to visualize the relationship (e.g., the number of boys to girls in the class, the ratio of eaten slices in a pizza) may greatly enhance his/her understanding of proportion as a concept.

In math, learners can use mental imagery (the process of picturing an event, concept, or procedure in your mind) to reinforce their understanding of new concepts. By translating a verbal description of a new concept into a visual picture, a learner can better “see” the mathematical relationships, and create an association that improves comprehension. A learner’s ability to effectively move between verbal instruction and visual representations in math depends upon skills in attention and spatial abilities. Learners must be able to sustain focus on details, shift between words and pictures, and interpret and organize spatial relationships by linking new instruction to existing knowledge.

Learners also use mental images when solving mathematical problems. During problem solving, learners must actively create visual images in their minds to represent the components of the problem. This process of visualization involves the ability to preview; that is, to form an image of an event or outcome before it occurs, e.g., to imagine what will happen when two cups of water are combined into a larger cup, etc.

The Impact of Language

Mastering the language of mathematics is much like mastering a foreign language. The content is both new and cumulative, as new learning enhances abilities by complementing and expanding upon what a learner already knows. As learners progress in math, they must grapple with many complex verbal explanations and a growing vocabulary of terms that are rarely used outside math situations, e.g., trapezoid and dividend. For this reason, a learner's language skills and comfort with new vocabulary can have a great impact on mathematical development. The ongoing acquisition and use of math language is also aided by a learner's ability to read and listen carefully, to organize terms in memory and recall those terms as needed, to follow sequences of rules and procedures, and to use language abilities to enhance understanding of math concepts.

Reading a complex math problem is akin to problem solving itself, placing demands on a learner's language, attention, and sequential ordering skills. A learner's ability to understand the language found in math word problems greatly influences his proficiency at solving problems. Learners must incorporate semantic abilities (the knowledge of specific words and their meanings), an understanding of syntax (the effects of word order and meaning of sentences), and discourse skills (understanding language beyond the sentence level, as in textbook explanations, teacher instructions, or word problems). Once a learner understands the language of a problem, he must pull out the important details, disregard extraneous information, place the crucial information in the proper sequence, or order, etc. Only when a learner is able to understand the situation to be solved will he be able to complete the problem solving process.

The Impact of Social Cognition

An important goal of math instruction is for learners see the relevance of math concepts to everyday life. A learner's progression from a basic understanding of a concept to a particular level of competency in applying that concept in real-life situations is strongly influenced by abilities in attention, memory and higher order thinking. Another key element in mathematics is the ability to communicate the solution to a problem using language protocols that the audience will understand. If you are preparing a budget for a CEO you use different language than preparing a budget for a housewife. Selecting the appropriate language is a function of social cognition. If inappropriate language choices are made, then the mathematical information is lost.

The Impact of Higher Order Cognition

Throughout the process of mathematical development, learners are expected to operate on an increasingly abstract symbolic level. Areas of higher math, such as probability, statistics, geometry and algebra, require learners to apply logical reasoning skills which are both sequential (as in multi-step equations) and spatial (as in geometric relationships). The application of higher order thinking skills assists students in finding the appropriate or best solution to increasingly difficult problems.

A large portion of higher order cognition in math revolves around rule use. Rules provide a consistent structure for calculating and problem solving. As learners are required to apply more and more rules in math, their abilities

in memory and higher order cognition are called into play. When working through a math problem, learners must remember which rules apply to the problem and which do not. In addition, they must hold aspects of the problem in mind while accessing and applying rules. It is common for someone to overuse a rule when they first begin to learn it. Through further practice, learners learn when the rule does and does not apply, and are able to apply the rule more appropriately. This conditional knowledge of rules is a function of higher order thinking.

Virtually all levels of mathematics depend on problem solving skills. Learning to solve problems involves: actively investigating and exploring math concepts within a word problem or math activity; applying previously learned information to new and different problems; forming pictures in one's mind to represent math concepts and visualize word problems; applying the process of estimation to solving math problems; and establishing the reasonableness of a math solution. Systematic problem solving often involves 'step-wisdom', knowing that the best way to solve a particular problem may be to break it up into a series of logical steps, rather than to try to solve it all at once. Effective math problem solving requires learners to be both systematic in their approach to problems and flexible in their use of strategies. Successful problem solvers are methodical, or systematic, in their problem solving. They are as concerned with the techniques they are using as they are with obtaining the right answer. These techniques may involve reorganizing a problem into simpler terms, breaking a problem into steps, making a plan about how to proceed, determining the best way to solve a problem, pulling out key ideas, etc.

Being systematic in problem solving requires learners to: be alert to details; preview or predict the outcomes of their actions; sustain their effort and be goal directed; look at the problem in different ways before choosing the best way to solve it (inhibiting first responses when necessary); and pace themselves and self-monitor their answers at each step.

A systematic approach to problem solving also involves higher order thinking skills, including thinking strategically, recognizing when a problem calls for a well-thought out solution rather than an automatic response, determining the appropriate steps when breaking down a problem, ordering the steps correctly, and monitoring progress during and after problem solving.

Effective problem solving also requires flexible thinking. Learners may need to use, evaluate or change strategies; at times, they may need to consider several alternative strategies. And, finally, throughout the problem solving process, learners must be able to monitor the outcomes of their calculations, and refine their solutions when necessary.

Strategies to Support Learner Problems with Math

Weakness	Strategies
Learner has difficulty forming the numbers on the page or keeping numbers spaced and aligned legibly and accurately.	<p>Give learners the opportunity to write with different writing utensils - pens, markers, chalk, computers. It is important that every learner have a comfortable writing implement to work with.</p> <p>Act as a scribe for your learners until they feel comfortable with a writing utensil.</p> <p>Have learners work in pairs with only one person writing at a time. Alternate the responsibility for writing in the activity.</p> <p>Use grid paper for all math work to help keep the numbers aligned correctly.</p>

Weakness	Strategies
Learner does not have a strong sense of numbers. Learner does not understand that there are basic patterns in numbers.	<p>Encourage learners to use a strategic approach for practicing and recalling math facts.</p> <p>Assess and review learners' understanding of the commutative property of addition and multiplication to build awareness of number patterns. Grasping the commutative property not only enhances learners' conceptual understanding in math, but provides them with the thrilling notion that such patterns or "tricks" make it easier to learn math, for if they know 3×5, they also know 5×3, etc., essentially cutting the number of math facts to 'memorize' in half!</p> <p>When teaching math facts, move learners through a sequence of understanding: Concrete, Semi-abstract, Abstract.</p> <p>The concrete level of understanding involves using concrete objects or manipulatives to learn a symbolic process. The semi-abstract level of understanding involves the use of pictures or drawings to represent numbers in the symbolic process. The abstract level of understanding involves the use of numerals as representatives of the symbolic process, that is, using numbers only to solve the computational problem $3 \times 2 = 6$. In order to master the abundance of addition, subtraction, multiplication and division facts, learners must progress to this abstract level.</p> <p>Build learners' abilities with math facts through the use of number families. Number families are clusters of related math facts. Encourage learners to write problems horizontally and vertically, as well as to say them aloud.</p>

Weakness	Strategies
<p>Learner is inconsistent, remembering some math facts while forgetting others.</p>	<p>Incorporate multi-sensory activities into the teaching and memorizing of math facts, i.e. have learners write it, say or sing it, show it, do it, etc.</p> <p>Use group rehearsal. For example, “Softly repeat each fact as I give it to you before writing it down.”</p> <p>Keep learners’ optimal attention spans in mind. Plan short breaks when teaching and practicing math facts.</p> <p>Give learners who are inconsistent in their performance of math facts an advanced warning before calling on them (e.g., “In three minutes I am going to ask you to run through the multiplication tables for the number 5.”).</p> <p>Encourage learners to use mid-task self-questioning during math computation activities, e.g., stopping to check calculations after each line.</p> <p>Take advantage of learners’ strengths when teaching math facts, e.g., use sounds, rhythm, and musical instruments to teach learners with musical talents, use manipulatives for those with strong spatial skills, etc.</p> <p>Use multiple methods (e.g., flashcards, rhyming, rapping) to help learners "over-learn" critical fact pairs. Have learners work in teams, drilling each other on facts.</p> <p>Provide jump-starts to help learners get going, e.g., start one or more math problems, provide the first fact in a sequence, etc.</p> <p>Let learners use accommodations for facts that are not already automatic. For example, math fact tables may be kept on hand for reference during math activities. As math facts are mastered, remove the supportive prompts.</p> <p>Use math fact tables as a learning and assessment tool. Have learners fill in a partially completed table as a practice activity, and complete a blank table in order to identify which facts are automatic, which are known but not yet automatic, and which are still to be learned.</p> <p>Give learners plenty of positive reinforcement as their mastery of math facts improves and their recall becomes automatic.</p> <p>Teach learners to self-monitor their daily use of math facts. Provide checklists that list steps for self-checking, etc. to serve as a self-monitoring guide until the learner internalizes the process and is able to self-check on his/her own.</p>

Weakness	Strategies
<p>Learner has difficulty remembering multiplication, division, and/or other facts while solving problems.</p>	<p>Teach strategies for developing accuracy with math facts before building speed in recall. Make sure learners have mastered math facts (can recall them accurately and with ease) before testing or drilling them under timed conditions.</p> <p>Provide learners with techniques for working through facts that are not consistently recalled.</p> <p>For example, many learners use their fingers as a concrete counting mechanism. This requires them to stop, put down their pencils, etc., and often interferes with the learners' ability to fluently work through a problem. An alternative is the "touch math" technique, where the learner touches points on each number with his/her pencil while counting. This technique provides a concrete reinforcement for the learner, while also helping to preserve the fluency of the problem.</p> <p>Integrate drill and practice activities into a fun format, such as a game with a deck of playing cards that learners can play in pairs, or software that offers well-designed math activities.</p> <p>Encourage the use of calculators to check accuracy and to do computation when appropriate (e.g., when facts are embedded in longer computations). It may be helpful for some learners to write down numbers before entering them, or to use a calculator with a paper printout to reinforce the facts.</p>

Weakness	Strategies
<p>Learner has trouble knowing if a rule or procedure is required to solve a problem.</p>	<p>Help learners see how patterns and rules reflect mathematical concepts. For example, first explain that the rules for regrouping rise from the concept of place value, then show the role regrouping plays in addition, subtraction, multiplication and division. This allows learners to focus on the reasoning behind the rules. Moreover, instead of memorizing eight different sets of rules, learners memorize two processes (borrowing and carrying) with variations.</p> <p>As learners learn and practice rules, use written cues to remind them how the rules work (for example, printing the phrase: "big number goes on top" next to subtraction problems serves as a reminder about the number relationships in subtraction).</p> <p>Use concrete objects, drawings, check marks, etc. to illustrate mathematic rules whenever possible, so learners can associate the abstract process with a visual image.</p> <p>Use color-coding to help learners become aware of how and when rules are in play (e.g. making the bigger numbers in a group of subtraction problems green, the smaller numbers in each problem blue, using highlighting or underlining to identify plus or minus signs, etc.)</p> <p>When focusing on specific rules or procedures, separate different types of problems on the page. As learners become more comfortable with the rules, gradually combine problems of different types.</p> <p>Have learners practice identifying rules in problems without actually doing the related computations. For example, a learner given the problem '4 + 0' might respond that the '+' sign means to add, and that adding zero to any number results in the original number. Or, given the problem '3/4 X 1/3,' a learner might respond that the 'X' sign means multiply, and the rule for multiplying fractions is to multiply the top numbers together and the bottom numbers together.</p> <p>Have learners categorize related math problems together as variations of a larger rule. (e.g., the steps for $4/5 = \underline{\quad}\%$, and the steps for $80\% = \underline{\quad}/\underline{\quad}$ are different, but the steps fall within the larger rule for converting fractions to percentages).</p> <p>Have learners practice identifying math problems that are examples of specific rules (e.g., by operation), then have them create their own math problems where the rules apply.</p>

Weakness	Strategies
<p>Learner has trouble applying rules to solve a problem, such as the rules for borrowing or carrying.</p>	<p>Promote learners' recognition of math patterns to guide them in the use of rules. For example, teach learners to ask themselves, "Have I seen this type of problem before? What rule did I use? Do I apply the same rule for this problem?" etc.</p> <p>Encourage learners to monitor their own progress as they use rules, for example, stopping after completing each problem, or each line of problems, to ask themselves, "How am I doing so far? Am I using the rule I need to?" etc.</p> <p>Build learners' knowledge of when to apply rules and how rules are relevant using real life situations. For example, to teach the rules for rounding numbers, use items from a restaurant menu, "for sale" notices from classified ads, mileage on a map, etc. Have learners talk about when it would be appropriate to use rounded numbers, and when the exact figure would be needed.</p>

Weakness	Strategies
<p>Learner gets confused when working with algorithms that involve several steps, for example, when doing long division.</p>	<p>Teach learners to break multi-step problems (including equations with several computations, word problems, etc.) into smaller parts. For example, ask learners to first look over the entire problem, then to break the problem into parts and identify which parts require the use of algorithm(s). Next, have them choose the algorithm to be applied for each part, and finally, ask them to solve the problem, reflecting on their answers at each step. Note: A checklist may come in handy for learners to use to break down problems into stages.</p> <p>Encourage learners to practice using a calculator and the computer, math tools that will be useful in their school and work careers. As learners progress in their mathematical development, they can continue to explore the many capabilities of these tools.</p> <p>Incorporate mnemonics. Mnemonics are memory techniques, like making up words or rhymes, to help us remember things such as the steps in a process. Use mnemonics to help learners remember steps to math algorithms. For example, Daddy, Mama, Sister, Brother can be used for the long division algorithm (Divide, Multiply, Subtract, Bring down). For those learners who find a picture helpful, a face can be drawn to illustrate the four long division steps (adapted from Mercer & Mercer, 1998).</p> <p>Provide 'scaffolding' for learners. Scaffolding is the structure necessary for a learner to successfully complete a task. For example, when solving multi-step algorithms, the scaffold structure may be a checklist of the steps in the algorithm that a learner can use to complete or double-check his computations.</p>

Weakness	Strategies
<p>Learner has difficulty visualizing patterns or the parts of a math problem in his head. Learner has difficulty associating math symbols with the concepts they represent.</p>	<p>Integrate hands-on activities and verbal explanations into the learning of spatially based concepts. For example, have learners use pattern blocks or geoboards to make geometric shapes, then discuss and write down the characteristics of the shapes, such as number of sides, types of angles, etc.</p> <p>Use examples of familiar situations, or analogies, to talk and think about math concepts. This helps learners link the concepts to a visual image. For example, the concept of ratio may be illustrated by asking learners to imagine two brothers sharing a pizza, and the amount of pizza left over after the big brother takes his portion.</p> <p>Guide learners in visualizing patterns. For example, talk learners through 'seeing' a geometric shape in their minds, 'picturing' a math process taking place, such as 1/3 of a pizza being taken away, and 2/3 of the pizza remaining, etc.</p>

Weakness	Strategies
<p>Learner is not comfortable using mathematical language, or has difficulty with math vocabulary words.</p>	<p>Make reading about math an activity you and your class can do together. Math vocabulary can be reinforced by reading biographies of mathematicians and inventors, books about the history of math, fictional stories with characters that work with math, news and sports stories involving math, etc.</p> <p>Have learners use their new math vocabulary words to teach family members or peers about the concepts they have learned.</p> <p>Have learners keep a personal math vocabulary book in which they record new math terms. Have them actively link the new terms to their existing knowledge by drawing pictures next to terms to have a visual representation, by showing examples that match and don't match the concept, by creating a flowchart of terms or diagram of pictures to show how a concept fits in with other math concepts, etc.</p>

Weakness	Strategies
<p>Learner has difficulty seeing how concepts (such as addition and subtraction, or ratio and proportion) are related to each other.</p>	<p>Provide plenty of hands-on practice with concepts that are typically confused, such as weight and mass, capacity and volume, area and perimeter, etc.</p> <p>Use manipulatives to help learners explore mathematical relationships. For example, Connecting People (available from the Cuisenaire Company), are small, connectable figurines of different colors, sexes, and sizes. Activities can be built around the Connecting People figurines in which learners build patterns, use math concepts in stories, organize and classify, use estimation, collect data, and explore units of measurement. (Welchman-Tischler, 1995).</p> <p>In addition to using manipulatives and hands-on activities, have learners develop charts and diagrams, or create note cards to define terms, show examples, etc. to explore how math terms are related.</p> <p>Have learners use different representations to describe the same situation. For example, demonstrate how something can be shown using a table, a graph, written description, etc.</p> <p>Give learners access to a dynamic or interactive computer software program that allows them to manipulate symbols, compare concepts, etc.</p>

Weakness	Strategies
<p>Learner has problems transferring concepts learned in the math classroom to real life situations.</p>	<p>When teaching basic concepts, let learners work with concrete objects in the classroom.</p> <p>When introducing broad concepts, give learners opportunities to connect these concepts to prior experience and relevant situations. For example, reinforce measurement concepts by having learners compare the height of classmates, or the weight of their book bags when empty and full. Have learners first estimate measurements (e.g., how many books the bag can hold, how much taller John is than Matt); then solve exact measurements.</p> <p>Identify topics that would be of interest to your learners, such as building a deck, being a sales person, etc., and explore the mathematical relationships or concepts related to these topics.</p> <p>Help learners learn to apply math concepts to new situations. Provide specific instructions (and ongoing prompting) that describe what to look for, and the steps to follow when applying each concept. For example, teach learners to use the concept of percent to examine the amount of water in the human body, the price of a jacket on sale at the mall, the portion of learners who have children, the percentage of monthly budget spent on entertainment, food or rent etc.</p> <p>Have learners identify daily situations where they use math skills, for example, when reading bus schedules, filling out catalog order forms, etc.</p> <p>Integrate historical information and events into your discussions to connect math concepts to everyday life. Have learners explore how the needs of the times prompted people to create or define math concepts and ideas, e.g., the need to build the pyramids. Have learners write a biographical portrait about a person to whom math was important, e.g., Pythagoras.</p>

Weakness	Strategies
<p>Learner has difficulty using mental pictures (such as patterns or shapes) to represent math concepts, or has difficulty 'seeing' the math problem in his/her mind.</p>	<p>Have learners draw pictures to represent what is going on in a word problem. Learners may draw actual objects from the problem (e.g., 3 shirts, a 6' by 12' garden plot, etc.), or they may represent objects with check marks or dots.</p> <p>Engage learners' imaginations by proposing a number sentence, e.g., $6 + 4$ or $5(12 \times 5)$, and having them come up with a story problem for that number sentence.</p> <p>Incorporate problem-solving activities using maps, diagrams, graphs, and tables to strengthen learners' use of visual/spatial materials. For example, have learners calculate the distances of trips taken by learners in the class, then display this information in a graph or table format.</p> <p>Involve learners in making predictions in situations where visualization can aid problem solving. For example, "If I place three green marbles and one red marble in a bag then pull one out, what color marble am I most likely to get?"</p> <p>Help learners practice manipulating images in their minds in order to solve a problem. For example, provide learners with a variety of shapes made from connected squares, some of which can be folded to form an open box. Ask learners to find the shapes which will make an open box. Learners will need to visualize the anticipated results in order to solve the problem. Many may need to develop their ability to visualize by making cut-out models and actually doing the folding. (Adapted from Brumbaugh, Ashe, Ashe & Rock, 1997).</p>

Weakness	Strategies
<p>Learner is confused by the language of word problems, such as when irrelevant information is included or when information is given out of sequence.</p>	<p>Be sure learners are comfortable with one-step word problems (problems requiring only one operation) before working with multi-step word problems (problems with multiple components and operations).</p> <p>Focus specifically on the information provided in word problems. Have learners separate the necessary information (numbers, labels, etc. needed to solve the problem) from the extra information (numbers, labels, and other details not needed for the solution).</p> <p>Teach learners to read for meaning, rather than searching for key words, when trying to identify the operation to use for a math word problem. For example, a learner who can read a problem and restate it in his own words to help him realize that he's been asked to combine amounts or add, will have a deeper understanding than a learner who looks only for a key word or phrase in the sentence (e.g., 'total', 'how many', etc.) to indicate what operation to use.</p> <p>Have learners create new story problems, and reword existing problems in such a way that essential information remains the same, but is worded differently. Also, have learners alter important information in a problem and talk about how the problem has been changed.</p> <p>Ask learners to help you come up with topic ideas for word problems, e.g., situations related to sports, popular music groups or performers, your own school, etc. Learners are more likely to be interested in topics that have relevance to their lives.</p> <p>Have learners paraphrase word problems for each other. Create partner pairs where one learner reads a word problem silently, then provides the necessary information to his partner so the partner can do the solution.</p> <p>Have learners compare textbook word problems to real life situations. For example, a textbook math problem may read "Jill bought three CDs at \$14.99 each. How much did she spend?" In a real life situation, learners would want to consider other factors, such as sales tax, customer discounts, etc.</p>

Weakness	Strategies
<p>Learner doesn't know how to get started on word problems, or how to break problems down into simpler subproblems</p>	<p>Help learners develop 'step-wisdom', the ability to know when math problems need to be broken into steps to be solved, rather than done all at once. Work with the entire class to break down sample problems. First, model a step-wise approach. Let learners observe how you approach problems (verbalize your steps, explain how you think through each step, etc.) Then, have learners do the step breakdown, identifying what needs to be done first, what action or operation should follow next, etc.</p> <p>When assigning math activities and projects, give these assignments one step at a time to encourage learners to work in stages.</p> <p>Provide learners with a set of questions they can ask themselves to 'jump start' their problem solving, e.g. "What does this question remind me of?", "What am I being asked to do or find?", "What are the important facts or numbers?", etc.</p> <p>Provide learners with a general strategy which can be used in many problem solving situations, for example, present the following four problem solving steps (Poyla, 1945): (1) Understand the problem, (2) Make a plan for solving the problem based on the information given, (3) Carry out the plan (4) Look back at the solution.</p> <p>Teach learners about strategies they can use for organizing a word problem before attempting calculations, for example, making a graphic chart that shows the important information, using a personalized checklist of steps, etc.</p> <p>Isolate specific steps in problem solving, and have learners focus on one step at a time. For example, provide word problem activities in which learners identify only what the question is asking them to find, which information is necessary to answer the question, which operations should be used in the problem, or whether or not the answer provided to a word problem makes sense.</p> <p>Explain to learners that good problem solvers rarely skip steps when problem solving, although it might seem that they do. Instead, problem solvers learn to do steps mentally (in their heads) instead of writing them down or talking about them. Suggest that with experience, learners may learn to do this, too.</p>

Weakness	Strategies
<p>Learner has difficulty in grade level areas of higher math, such as algebra, geometry, or statistics.</p>	<p>Establish that learners have the necessary background skills to move ahead to formal instruction in areas of higher math. For example, learners who have not mastered factoring will have great difficulty simplifying rational expressions.</p> <p>Utilize computer software programs to help learners explore areas of higher math. Programs exist for all levels and areas. Incorporate tutorial programs that are interactive and dynamic.</p> <p>Investigate people in the community who use math in his/her work, e.g., a surveyor, an architect, a research scientist, an accountant, etc.</p> <p>Use real life problem solving to help learners connect concepts in higher math. For example, when learners are exploring the question of how a spacecraft stays in orbit around the earth they will use formulas for gravity, geometric concepts, proportion formulas, etc.</p>

Weakness	Strategies
<p>Learner has difficulty reasoning through a problem, or difficulty using strategies effectively during problem solving.</p>	<p>Model problems for the class and explain each step when teaching learners how to be active problem solvers. Think out loud for learners as you reason through a problem, choose a strategy to use, decide if the strategy is working, etc. Have learners talk through problems with each other as well.</p> <p>To promote strategy use and adjustment, ask learners guiding questions as they solve problems, e.g., "Is there an easier way to do that?", "Will that strategy always work?", etc.</p> <p>Have learners communicate their understanding of a problem through both oral discussion and written explanation.</p> <p>Have a brainstorming session with learners to discuss the types of behavior or steps are involved in problem solving, characteristics of 'good problem solvers', etc. Some ideas may include reasoning, looking for patterns, patience, persistence, hypothesizing, stating the obvious, creativity, etc.</p> <p>Encourage learners to explore multiple strategies that could be used for solving a math problem. For example, ask learners to find the length of the diagonal of a 12" x 16" rectangle. Learners will likely recognize that the rectangle is made up of two right triangles, and apply the Pythagorean theorem. One approach might be to calculate by hand or to use a calculator for the computation ($12^2 + 16^2 = ?$) to eventually come up with the answer of 20 inches. However, an alternate view of the problem makes it even easier to solve. A learner might notice that the 12" and 16" sides are both divided evenly by 4, resulting in a triangle with sides of 3" x 4", respectively. The learner will likely recognize the missing diagonal length to be 5", making the standard 3" x 4" x 5" triangle. Then, simply multiplying the 5" back by 4 would give the answer to the diagonal: 20 inches. No lengthy computations would be needed. (Adapted from Brumbaugh, Ashe, Ashe & Rock, 1997).</p> <p>Have learners practice selecting what strategies might be appropriate for solving a given problem. For example, in each case, would it be helpful to act out the problem, make a model, draw a picture, make a chart or graph, use logic, guess and check, break it into parts, etc.?</p> <p>Promote learners' flexible thinking by presenting situations in which there is more than just one right answer. For example, have learners take out a piece of paper, fold the paper in half, then fold the paper in half again. Ask learners to count how many rectangles have been formed. Answers will vary depending upon how the second fold was made in the paper, if learners count the whole piece of paper as one of the rectangles, etc. Have learners discuss how different folding approaches resulted in different 'answers'. (Adapted from Brumbaugh, Ashe, Ashe & Rock, 1997).</p> <p>Give learners practice estimating the answers to problems. Have them move from estimation to calculation, then back again to estimation. Help learners develop their sense, before starting calculations, of what a general solution to the problem might be, and also to take time to examine their answers, after calculation, to see if they seem credible. Learners may require guidance in useful strategies for estimation, e.g., rounding numbers, creating a visual image, etc.</p>