OCTE 2012 – Elementary Conference Workshops

GRADE 8 | UNDERSTANDING EARTH AND SPACE SYSTEMS
WATER SYSTEMS

Design and Compare Irrigation Systems

OVERALL EXPECTATIONS

By the end of Grade 8, students will:
2. investigate factors that affect local water quality;

SPECIFIC EXPECTATIONS

2. Developing Investigation and Communication Skills

By the end of Grade 8, students will:

2.5 use technological problem-solving skills (see page 16) to design, build, and test a water system device that performs a practical function or meets a need
Sample problem: Design, build, and test a filtration device that makes unclean water clean; **build a working model of an irrigation system.**
2.6 use appropriate science and technology vocabulary, including water table, aquifer, polar ice-cap, and salinity, in oral and written communication
2.7 use a variety of forms (e.g., oral, written, graphic, multimedia) to communicate with different audiences and for a variety of purposes (e.g. using appropriate scientific conventions, draw a labelled diagram of a water treatment facility; create a brochure about the safe use of wells and septic tanks)

Learning Goals

1. Students will design and build working models of an in-ground drip irrigation system and an on-ground drip irrigation system.
2. Students will evaluate the personal, social, and/or environmental impacts of the two methods of irrigation, and will determine which method provides the most eco-friendly delivery of water to plants.
3. Students will use appropriate science and technology vocabulary to report on how they progressed through the technological problem solving process while completing the irrigation systems design challenge.
4. Students will use variety of forms to present their solutions to the design challenge, and report their findings their teacher and classmates. The students' presentations will include labelled diagrams of the two irrigation systems, as well as, charts and graphs to display data recorded during his/her observations.

Assessment and Evaluation

For Assessment and Evaluation support, please see Appendix G.

Success Criteria

- Check items you wish to evaluate during the completion of this unit. Skip items that do not apply to your current program needs.
- You may differentiate your assessment by offering your students a variety of these items as “choices”, while making other items mandatory.
- Please see Appendix B for this unit’s assessment rubric (assessment **of** learning).
- Please see Appendix C for this unit's Grade Sheet (assessment **of** learning).
- Please see Appendix D for the Continuum for Technological Problem Solving rubric (assessment **for/as** learning).
- Please see Appendix E for the Assessment As Learning, Student Self-Assessment Log” (assessment **as** learning).
- Please see Appendix F for the Teacher's Record, Assessment **For** Learning sheet.

Knowledge and Understanding (K&U), please see attached “Assessment Rubric” for corresponding evaluation items:

○ the student acquired a knowledge of facts and terminology related to water systems, and used tools and materials safely and appropriately in building and testing her/his irrigation systems (K&U, 1);

○ the student understands content (e.g., concepts, ideas, and processes) that addresses drip irrigation systems (K&U, 2);

Thinking and Investigation (T&I), please see attached “Assessment Rubric” for corresponding evaluation items:

○ the student identified and located relevant resources, developed hypotheses, regarding potential solutions to his/her design challenge, and developed a suitable set of plans - based on the research and hypotheses noted above (T&I, 3);

○ the student used processing skills and strategies (e.g., performing and recording, gathering evidence and data, observing, manipulating materials and using equipment safely, ... proving) to compare the efficiency of the two irrigation systems (T&I, 4);

○ the student used critical/creative thinking processes, skills, and strategies (e.g., analysing, interpreting, problem solving, evaluating, forming and justifying conclusions on the basis of evidence) to determine which irrigation system conserves the most water (T&I, 5).

Communication (Com.), please see attached “Assessment Rubric” for corresponding evaluation items:

○ the student completed an oral, visual, or written report that was organized in a clear, logical manner, and included diagrams and models where appropriate (Com., 6);

- ○ the student's report accurately described the steps taken to solve the design challenge, as well as, the learning that he/she acquired from the unit, and the student used an appropriate oral, visual (media), and/or written form for the selected audience e.g., teacher, or teacher and classmates (Com., 7);
- ○ the student included the correct use of scientific vocabulary and terminology in his/her report (Com., 8);

Application (App.), please see attached "Assessment Rubric" for corresponding evaluation items:

- ○ the student followed established safety practices for using an apparatus, tools, and materials (App., 9);
- ○ the student assessed the impact on individuals, society, and the environment of developing large scale versions of his/her chosen irrigation system to replace systems that are currently in place (e.g., municipal irrigation systems, agricultural applications etc.), and determined what some different points of view could be on this kind of change (App., 10);
- ○ the student proposed courses of practical action involving the installation of efficient watering systems that conserve water and reduce losses caused by evaporation, to deal with problems relating to science, technology, society, and the environment (App., 11).

Curriculum Connections and Additional Assessment Opportunities

Language:

- Oral Communication, Overall Expectations 2 and 3 (select from specific expectations 2.2 - 2.7, and 3.1);
- Writing, Overall Expectations 1, 2, 3, and 4 (select from specific expectations 1.3, 1.4, 1.5 1.6, 2.1, 2.4, 2.5, 2.6 - 2.8, 3.1 - 3.8, and 4.1);
- Media Literacy, Overall Expectations 3 and 4 (select from specific expectations 3.2 - 3.4, and 4.1).

The Arts:

- Drama, Overall Expectation B1 and B2 (select from specific expectations B1.1 - B1.3, B2.1, and B2.3);

Materials and Tools List

Materials:

- potting soil, one medium sized bag per class;
- soil containers, two matching containers per project (students supply these items, could be 2 L pop bottles, margarine or yogurt containers, etc.);
- 10 ml syringe, two per project (http://kidder.ca/);
- vinyl tubing, 3' (90 cm) per project (http://kidder.ca/);
- low heat glue sticks (one stick will be enough for at least four projects);
- newspaper, rags, paper towels, etc. (to absorb and/or clean up spills);
- 1 large tote box or cardboard box to contain the bag of soil and to catch spills that occur when the soil containers are being filled;

- water.

Tools:

- CSA approved safety glasses/goggles, one pair per person (parent volunteers included);
- an approved eyewash station; this can be two eyewash bottles containing approved eyewash fluid that has not reached its expiry time limit after decanting, or an installed system (an actual eyewash station, or approved faucet attachment);
- 1 first aid kit (consult your Board's health and safety policy for required size/ contents);
- work gloves, 1 pair per low heat glue gun;
- aprons, 1 per low heat glue gun;
- 1 bucket of cool water per glue gun station (place beyond the reach of a student who is still holding a glue gun that is plugged in);
- 1 low heat mini glue gun for every 7 projects;
- 1 ruler for every project;
- 1 pair of scissors for every five projects (they may use their own, if available);
- 1 digital soil moisture meter, to be shared by the class;
- 1 measuring cup for every 3 projects;
- 1 electric kitchen weigh scale (optional);
- 1 classroom sink, or a tub of water.

Electronic Resources to Get You Started

Electronic Resources **always stay on main page**:

- http://www4.agr.gc.ca/abstract-resume/abstract-resume.htm?lang=eng&id=16401000000511
- http://en.wikipedia.org/wiki/Drip_irrigation
- http://www.ext.colostate.edu/pubs/crops/04716.html
- http://www.northerngardensupply.ca/

Background Knowledge

Sprinkler systems cause more water loss than a drip irrigation system. With a sprinkler, moisture is lost primarily through evaporation, and runoff. Loss due to evaporation is greatest when water is sprayed through the air, and when it pools on top of the ground.

A soaker or drip system uses less water because there is less water loss. Smaller quantities of water are dispersed at a slower rate by a soaker hose that lies on the ground. This moisture is absorbed into the soil through capillary action and osmosis. Water, generally, will not pool or runoff using a drip irrigation system.

The measuring cup should be used to add equal amounts of soil to each container. If a weigh scale is available, and containers are matching, students can measure equal masses of soil to control this variable further.

The vinyl tubing should be divided so that the in-ground system has the extra length required to place it at the desired depth. The same number of equally spaced irrigation notches should be cut into each watering tube. The layout of the each tube should be similar, with one on top of the soil, and one buried at 1/2 to 1/3 of the soils depth. The same amount of water should be added to each sample. To moisten the soil well, the on ground drip system will require some time to avoid pooling on the surface.

See "Appendix H: Samples" for an example of student work.

Activity Description

Design Challenge:
Students will investigate the efficiencies of traditional sprinkler systems and drip irrigation systems. Using this knowledge, and the materials and tools provided, students will create an in-ground and an on ground drip irrigation system. They will use their systems to create a fair test to determine which drip system waters the soil in the most eco-friendly manner. Students will complete a report on the steps they took to solve the design challenge.

Minds On/Hands On

1. Discuss your city's watering bylaws, why they are needed, and why in some areas watering bans are needed to conserve water (hot temperatures, lack of precipitation, depleted reserves of municipal water).
2. Show pictures of traditional spray or sprinkler watering systems, and drip (soaker) watering systems. Have students record their observations and thoughts regarding the two systems.

Action

1. Teacher, introduces and distributes the design challenge (Appendix A) to individuals, partners, or small groups, discusses all items with the class, and ensures students understand what must be done.
2. Teacher, distributes the student self-assessment log (Appendix E), delivers instructions on what this resource is and how it is to be used. Discuss and clarify content items from the logs, prior to having your students address them.
3. Teacher and students, co-construct success criteria based on curriculum expectations and prior learning (recommended teacher suggestions are listed in this document).
4. Teacher, displays tools and materials that are available for the design challenge.
5. Teacher, teaches/reviews Learning Skills related to this type of task (e.g., safety [teacher follows his/her Board's protocol for instruction, regarding the safe use of tools and materials], research, problem solving, collaboration, and responsibility).
6. Teacher follows her/his Board's protocol for documenting student attendance during safety training.
7. Students, research the advantages and disadvantages of a variety of irrigation systems, and record information that addresses their designs.
8. Students form hypotheses (based on research) regarding potential solutions to their design challenge.
9. Students list their top ideas for solving the design challenge, sketch out the two that seem the most promising, record reasons for picking them (e.g. aesthetics, function, environmental impact) and submit these items for approval.
10. Teacher, reviews sketches for safety and feasibility; students with approved sketches move on to the next step.
11. Students, complete a set of plans for creating an in-ground irrigation system, and an on-ground irrigation system, and devise a plan that will allow them to compare the two systems fairly.
12. Teacher, reviews plans and tests for feasibility; students with approved plans and tests move on to the next step.
13. Students create their irrigation systems using the materials and tools provided, and carry out their test, to determine which system conserves water the best. Students record observations, data, and results as they carry out their comparison test.

14. Students, modify their designs (if necessary) based on observations, peer feedback and teacher feedback (test again if time permits).
15. Students, research and record social factors that have led to an interest in the development of irrigations that use water more efficiently.
16. Students, brainstorm, research, and record information and ideas about the impact their design and investigation could have on individuals, society, the economy, and the environment. Students should consider the benefits of adapting their chosen irrigation system for use in a large-scale project (e.g., irrigation systems in parks, municipal gardens, golf courses, agriculture etc.). Different points of view are to be considered during this exercise.
17. Students, record all final data, observations, research, and insights, then begin working on their reports.

Consolidation

1. In groups, students discuss what went well with their designs, what changes were made to their designs, why they were needed, and what they would do differently if given another opportunity. This material should be added to the students' reports.
2. In groups, students discuss/debate the findings and insights they have recorded for items 14-15; new insights are to be added to the students' reports.
3. Students, complete and hand in a written report, or present an oral and/or media report that addresses all the design challenge requirements selected by their teacher.

Appendix A: Student Design Challenge

Name:_______________________ Teacher:______________________ Class: ______

Your municipality has made conserving water a priority. They have enlisted the help of selected Grade 8 classes in your School Board to assist them. Your class has been chosen to carry out an investigation that will help determine which irrigation system should be installed in your community's municipal gardens. Research has shown that drip irrigation systems use the least water. There are two styles to choose from and your input will help to select the best option.

Your task is to design prototypes of an in-ground drip irrigation system and an on-ground drip irrigation system, as well as, a test that will provide a fair comparison of the two.

To address this design challenge, complete the following tasks:

- record and review the list of materials and tools provided for this challenge;
- research available information on in-ground and on-ground drip irrigation systems;
- use this knowledge and information to form hypotheses regarding potential solutions;
- list your top ideas for solving the design challenge, sketch out two sets that seem the most promising, record your reasons for picking them (e.g. aesthetics, function, environmental impact) and submit these items to your teacher for approval;
- when your sketches are approved, pick your best ideas and use them to develop a set of plans; include diagrams, dimensions, instructions, a list of materials, and a list of tools that are needed;
- submit your set of plans for approval;
- when your plans are approved, design a fair test that will accurately compare the two irrigation systems, submit your test design to your teacher for approval;
- when your plans and test are approved, construct your irrigation systems;
- carry out your test to determine which of the two systems conserves the most water; record all observations and data;
- if necessary, modify your prototypes and retest them.

Following this process, you will be required to complete further research and submit or present a report to your teacher. Your report must address all items checked off below.

○ Use vocabulary that includes the correct use of scientific terms used to discuss water systems.

○ List the components of your irrigation systems and describe how they function to provide better water conservation than traditional sprinkler systems.

○ Find and record social factors that have led to the evolution drip irrigation systems.

○ Brainstorm, research, and record ideas about how developing large-scale versions of your chosen irrigation system to replace systems that are currently in place (e.g., municipal irrigation systems, agricultural applications etc.) will effect individuals, society, and the environment; determine what some different points of view could be on this kind of change.

- ○ Propose practical action, involving your design challenge, that will help deal with problems relating to science, technology, society, and the environment.
- ○ Record what went well with your design, what changes were made (if any), why the changes were needed (if applicable), and what you would do differently if given another opportunity (if applicable).

Notes:

Appendix B: Assessment Rubric (Assessment **of** Learning)

This rubric was developed from the Ontario Curriculum Grades 1-8 Science and Technology, Revised 2007 document.				
	Level 1	Level 2	Level 3	Level 4
Knowledge and Understanding (K&U) – Subject-specific content acquired in each grade (knowledge), and the comprehension of its meaning and significance (understanding)				
	The Student:			
1. Knowledge of content (e.g., knows facts and terminology related to water systems and safe use of tools and materials)	demonstrates limited knowledge of content	demonstrates some knowledge of content	demonstrates considerable knowledge of content	demonstrates thorough knowledge of content
2. Understanding of content (e.g., concepts, ideas, and processes involving drip irrigation systems)	demonstrates limited understanding of content	demonstrates some understanding of content	demonstrates considerable understanding of content	demonstrates thorough understanding of content
Thinking and Investigation (T&I) – The use of critical and creative thinking skills and inquiry problem solving skills and/or processes				
	The Student:			
3. Use of initiating and planning skills and strategies (identify appropriate items to research, and locate resources that are relevant to the investigation and design challenge)	uses initiating and planning skills and strategies with limited effectiveness	uses initiating and planning skills and strategies with some effectiveness	uses initiating and planning skills and strategies with considerable effectiveness	uses initiating and planning skills and strategies with a high degree of effectiveness
4. Use of processing skills and strategies (e.g., performing and recording, gathering evidence and data, observing, manipulating materials and using equipment safely, ... proving) to compare the efficiency of the two irrigation systems	uses processing skills and strategies with limited effectiveness	uses processing skills and strategies with some effectiveness	uses processing skills and strategies with considerable effectiveness	uses processing skills and strategies with a high degree of effectiveness
5. Use of critical/creative thinking processes, skills, and strategies (e.g., analysing, interpreting, problem solving, evaluating, forming and justifying conclusions on the basis of evidence) to determine which irrigation system conserves the most water	uses critical/creative thinking processes, skills, and strategies with limited effectiveness	uses critical/creative thinking processes, skills, and strategies with some effectiveness	uses critical/creative thinking processes, skills, and strategies with considerable effectiveness	uses critical/creative thinking processes, skills, and strategies with a high degree of effectiveness
Communication (Com.) – The conveying of meaning through various forms				
	The student:			
6. Expression and organization of ideas and information in oral, visual, and/or written forms (complete a report that is organized in a clear, logical manner and include diagrams and models where appropriate)	expresses and organizes ideas and information with limited effectiveness	expresses and organizes ideas and information with some effectiveness	expresses and organizes ideas and information with considerable effectiveness	expresses and organizes ideas and information with a high degree of effectiveness

7. Communication for different audiences and purposes in oral, visual, and/or written forms (accurately describe the steps taken to solve the design challenge and the learning that he/she acquired from this unit and used an appropriate form for the selected audience, e.g., teacher, or teacher and classmates)	communicates for different audiences and purposes with limited effectiveness	communicates for different audiences and purposes with some effectiveness	communicates for different audiences and purposes with considerable effectiveness	communicates for different audiences and purposes with a high degree of effectiveness
8. Use of conventions, vocabulary, and terminology of the discipline in oral, visual, and/or written forms	uses conventions, vocabulary, and terminology with limited effectiveness	uses conventions, vocabulary, and terminology with some effectiveness	uses conventions, vocabulary, and terminology with considerable effectiveness	uses conventions, vocabulary, and terminology with a high degree of effectiveness
Application (App.) – The use of knowledge and skills to make connections within and between various contexts				
	The student:			
9. Application of knowledge and skills (e.g., concepts and processes, use of equipment and technology, investigation skills) in familiar contexts	applies knowledge and skills in familiar contexts with limited effectiveness	applies knowledge and skills in familiar contexts with some effectiveness	applies knowledge and skills in familiar contexts with considerable effectiveness	applies knowledge and skills in familiar contexts with a high degree of effectiveness
10. Making connections between science, technology, society, and the environment (assess the impact on individuals, society, and the environment of developing large scale versions of your chosen irrigation system to replace systems that are currently in place [e.g., municipal irrigation systems, agricultural applications etc.], and determine what some different points of view could be on this kind of change)	connects science, technology, society, and the environment with limited effectiveness	connects science, technology, society, and the environment with some effectiveness	connects science, technology, society, and the environment with considerable effectiveness	connects science, technology, society, and the environment with a high degree of effectiveness
11. Proposing courses of practical action to deal with problems relating to science, technology, society, and the environment (e.g., the installation of efficient watering systems that conserve water and reduce losses caused by evaporation)	proposes courses of practical action of limited effectiveness	proposes courses of practical action of some effectiveness	proposes courses of practical action of considerable effectiveness	proposes highly effective courses of practical action

Appendix C: Assessment of Learning, Grade Sheet.

Teacher's Record: Assessment **Of** Learning Use with the Assessment Rubric	Teacher: ____________________ Class: ______ Unit: __________________________ Date: ___/___/___										
	Knowledge and Understanding		Thinking and Investigation			Communication			Application		
Student's Name	1	2	3	4	5	6	7	8	9	10	11

Appendix D: Assessment For Learning
Continuum For Technological Problem Solving

Beginning > Exploring > Emerging > Competent > Proficient			
Initiating and Planning			
The student:			
(A) recognizes a practical problem in a given context	identifies practical problems to solve in the immediate environment	identifies practical problems to solve in the local community	identifies practical problems to solve
(B) with support (e.g., as a class or in small groups), brainstorms possible solutions to a practical problem	with support (e.g., as a class or in small groups), generates a list of possible solutions to a practical problem and determines which are realistic in the classroom and/or the real world	identifies possible solutions to a practical problem and explains how each might solve the problem	identifies possible solutions to a practical problem and prioritizes them with regard to their potential for solving the problem
(C) with support (e.g., as a class or in small groups), selects one possible solution to implement	selects a possible solution to implement	selects a possible solution to implement, and provides reasons for the choice	selects a possible solution, and provides reasons for the choice that take into account considerations such as function, aesthetics, environmental impact
(D) with support (e.g., as a class or in small groups), makes a simple plan to carry out the solution	makes a simple plan (individually or in small groups), including simple drawings and/or diagrams, to carry out the solution	outlines (individually or in small groups) the steps of a plan, including labeled drawings and/or diagrams, to solve the problem	outlines in detail, including technical drawings and/or diagrams, each step of a plan to solve the problem
(E) with support (e.g., as a class or in small groups), establishes a limited number of criteria for evaluating proposed solutions to the problem	with support (e.g., as a class or in small groups), establishes a limited number of criteria for evaluating proposed solutions to the problem	contributes to establishing general criteria for evaluating objects or devices designed to solve the problem	contributes to establishing general criteria for evaluating objects or devices designed to solve
Performing and Recording			
The student:			
(F) with support (e.g., as a class or in small groups), carries out the pre-determined plan	with support (e.g., as a class or in small groups), carries out the pre-determined plan	carries out the pre-determined plan (individually or in pairs or small groups)	carries out the pre-determined plan
(G) with support, designs, builds, and tests (on the basis of pre-determined criteria) a device or an object to solve the problem	with support, designs, builds, and tests (on the basis of pre-determined criteria) a device or an object to solve the problem	designs, builds, and tests (on the basis of pre-determined criteria) a device or an object to solve the problem	designs, builds, and tests (on the basis of pre-determined criteria) a device or an object to solve the problem

(H) records results using pictures and/or tally charts	records results in a variety of ways, such as sentences, simple drawings, diagrams, and/or charts, and/or charts	records results in a variety of ways, such as sentences, drawings, labelled diagrams, graphs	records results in a variety of ways, such as sentences, technical drawings, labeled diagrams, graphs, and/or charts
Analyzing and Interpreting			
The student:			
(I) with support, identifies how well the chosen solution solved the practical problem, using the pre-determined criteria	identifies how well the chosen solution solved the practical problem, using the pre-determined criteria	explains how well the chosen solution solved the practical problem, and suggests possible changes to the criteria and the solution	explains how well the chosen solution solved the practical problem, using qualitative and/or quantitative data, and suggests possible changes to the criteria and the solution
(J) with support, suggests something that might be changed about the solution to the problem identifies some things that could be done differently to improve the solution to the problem	identifies and explains what changes could be made to the plan and how to improve the solution to the problem, and gives reasons for the changes	identifies and explains what changes could be made to the plan and the testing process, and how to improve the solution to the problem, and gives reasons for the changes	identifies and explains what changes could be made to the plan and the testing process, and how to improve the solution to the problem, and gives reasons for the changes
(K)	identifies some possible beneficial and non-beneficial impacts of the chosen solution for himself/herself or others	identifies the effects of the chosen solution on himself/herself, others, and/or the environment, considering things such as cost, materials, time, and/or space	identifies the effects of the chosen solution on himself/herself, others, and/or the environment, considering things such as cost, materials, time, and/or space, and suggests ways in which undesirable effects could be lessened or eliminated
Communicating			
The student:			
(L) describes orally, and/or using drawings, pictures, and/or simple sentences, the problem and how he or she solved it	describes orally, and/or using drawings, pictures, and/or simple sentences, the problem and how he or she solved it	describes orally, and using labelled drawings and diagrams, charts, graphs, and/or written descriptions, the problem and how he or she solved it	describes orally, and using labelled drawings and diagrams, charts, graphs, and/or written descriptions, the problem and how he or she solved it
(M) uses grade-appropriate science and technology vocabulary correctly	uses grade-appropriate science and technology vocabulary correctly	uses grade-appropriate science and technology vocabulary correctly	uses grade-appropriate science and technology vocabulary correctly

Appendix E: Assessment As Learning, Student Self-Assessment Log

What Can I Do Well? What Can I Do Better? What is My Plan?

Name:_______________________ Teacher:______________________ Class: ______

Self-Assessment (SA):
1. I have reached this goal.
2. I am getting there.
3. Help! I am struggling with this.

Peer-Assessment (PA):
1. You have reached this goal.
2. You are getting there.
3. You have not reached this goal.

Responsibility For Learning (RFL).
1. No assistance is needed. I have achieved what this task requires.
2. I will reach this goal by asking for direct support from my teacher.
3. I will reach this goal by asking for support from my peers.
4. I will reach this goal by asking for support from my caregiver(s).
5. I will reach this goal by working on it independently.

A. I can identify a practical design problem that needs to be solved.

SA:_________ PA:________ RFL:_______ Date Achieved:__________

B. I can come up with some solutions to the design problem, and I can organize them from first choice to last.

SA:_________ PA:________ RFL:_______ Date Achieved:__________

C. I can pick my best idea and explain how it will work, look and impact the environment.

SA:_________ PA:________ RFL:_______ Date Achieved:__________

D. I can make a set of plans that describes, in detail, each step needed to build my project, and they include technical drawings and/or diagrams where needed.

SA:_________ PA:________ RFL:_______ Date Achieved:__________

E. I can contribute ideas on how solutions to this design problem should be graded.

SA:_________ PA:________ RFL:_______ Date Achieved:__________

F. I can carry out my plan independently.

SA:_________ PA:________ RFL:_______ Date Achieved:__________

G. I can design build and test a device that solves my design problem.

SA:_________ PA:________ RFL:_______ Date Achieved:__________

H. I can record my results in a variety of ways, such as sentences, technical drawings, labeled diagrams, graphs, and/or charts.

SA:_________ PA:________ RFL:_______ Date Achieved:__________

I. I can explain how well I solved the design problem, using what I observed (qualitative data), and/or what I measured (quantitative data). I can also suggest possible changes to the criteria and my solution to the design problem.

SA:_________ PA:________ RFL:_______ Date Achieved:__________

J. I can identify and explain what changes could be made to my plan and my testing process, how to improve my solution to the design problem, and can give reasons for the changes.

SA:_________ PA:________ RFL:_______ Date Achieved:__________

K. I can identify the effects of my solution on myself, others, and/or the environment (including cost, materials, time, and/or space), and I can suggest ways to lessen or eliminate any undesirable effects my solution may have.

SA:_________ PA:________ RFL:_______ Date Achieved:__________

L. I can give an oral presentation that describes what my design problem was and how I solved it. I can include labelled drawings and diagrams, charts, graphs, and/or written descriptions in my presentation.

SA:_________ PA:________ RFL:_______ Date Achieved:__________

M. I can use the science and technology vocabulary we have learned, correctly.

SA:_________ PA:________ RFL:_______ Date Achieved:__________

Notes:

Appendix F: Assessment For Learning, Tracking Sheet

Teacher's Record: Assessment **For** Learning, Technological Problem Solving Skills Continuum	Teacher: ______________________ Class: ___________ Unit: ___________________________ Date: ____/____/____ Suggested Assessment Codes: B - beginning, Ex - exploring, Em - emerging, C - competent, P - proficient												
	Initiating and Planning					Performing and Recording			Analysing and Interpreting			Communicating	
Student's Name	**(A)**	**(B)**	**(C)**	**(D)**	**(E)**	**(F)**	**(G)**	**(H)**	**(I)**	**(J)**	**(K)**	**(L)**	**(M)**

Appendix G: Support for Assessment and Evaluation

Assessment as/for/of Learning

It is the goal of the OCTE Elementary Committee to support their members in the development of these skills. This year the focus is on providing feedback (assessment for and as learning) using the Ministry's "Continuum for Technological Problem Solving Skills" (Science and Technology Grades 1-8, pp. 17-18) Please note that only the Ministry's "Achievement Chart -- Science and Technology, Grades 1-8" (Science and Technology Grades 1-8, pp. 26-27) is to be used for assessment of learning.

A summary of the three forms of assessment addressed in the Ministry of Education's Growing Success (2010) document is as follows:

- assessment for learning involves generating feedback about your students' progress that is shared with them before assessing for report card grades;
- assessment of learning is when you generate marks/levels for your report cards;
- assessment as learning, when developed fully, is when students provide their own feedback and assessment (peer and/or self) regarding their learning; students use this information to set learning goals, and to select appropriate learning strategies for their success.

Here are some suggestions to support the implementation of "Assessment as Learning" in your program; they are as follows:

1. Provide your students with a copy of "Appendix E: Assessment as Learning, Student Self-Assessment Log" and refer to applicable statements (see statements A-M) for discussion, before each of these items are addressed.
2. Ensure that the learning goal for each item is clearly understood by your students. Use student friendly language wherever possible.
3. Provide opportunities for self/peer assessment (move from structured to student directed as your students develop this skill).
4. Discuss or refer to successful and unsuccessful work (exemplars, or student generated materials) to provide benchmarks for your students' self/peer assessments.
5. Collect and review your students' "Assessment as Learning, Student Self Assessment Log." Make note of who needs additional support. Schedule time for these students into your next lesson (or provide opportunities for extra help, if possible).
6. Use your students' self/peer assessments to determine if a task requires modification to support successful learning.
7. Refer to pp. 27-36 in the Growing Success document for complete details. Reference: Ontario. Ministry of Education. (2010). *Growing Success: Assessment, Evaluation, and Reporting in Ontario Schools, First Edition, Covering Grades 1-12.* Toronto: Author. ISBN 978-1-4435-2284-7 (Print), ISBN 978-1-4435-2285-4 (PDF) (Rev.), ISBN 978-1-4435-2286-1 (TXT), © Queen's Printer for Ontario.

Appendix H: Samples

Photographs by: Darren Foy