Public District School Board Writing Partnership

Course Profile

Integrated Technologies

Grade 9
Open

• *for teachers by teachers*

Acknowledgments

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Unit #1: Transportation/Manufacturing Technologies

Time: 22 hours

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Simcoe County District School Board: Lead Board

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Unit Description

In this unit, students investigate four different activities covering many aspects of transportation and manufacturing technologies, as well as the integration of computers into various activities. These activities may be conducted in any order, but it is suggested that activity 2 and 3 be done sequentially as the principles of flight apply to both. During this unit, students have the opportunity to become aware of career opportunities, educational programs, and opportunities for cooperative education in the fields of transportation and manufacturing.

Strands and Expectations

Strands: Theory and Foundations, Skills and Processes, Impact and Consequences.

Overall Expectations: TFV.01X, TFV.02X, TFV.03X, SPV. 01X, SPV. 03X, SPV. 05X, ICV. 01X, ICV. 04X

Specific Expectations: TFS.01X, TFS.02X, TFS.03X, TFS.04X, SPS.01X, SPS.02X, SPS.03X, SPS.05X, SPS.07X, SPS.08X, SPS.09X, ICS.01X, ICS.03X, ICS.05X, ICS.06X

Activity Titles

Activity One	Mousetrap Car	360 minutes
Activity Two	Styrofoam Glider	300 minutes
Activity Three	Compressed Air Powered Water Rocket	330 minutes

Unit Planning Note

This unit requires teachers to ensure all necessary references, equipment, and resources listed in each activity are available for students' use. Materials for review, activities, and research may be obtained from a variety of sources including web site addresses (where provided), school libraries, and public libraries. Students and teachers benefit from contacting local businesses in the manufacturing and transportation sectors for support in conducting the various activities. These members of the community may also provide students with insight into career opportunities, educational requirements and potentially offer students cooperative education learning opportunities in grades 11 or 12. Teachers need to perform the activity before implementation to familiarize themselves with all necessary safety considerations and to ensure that all facility, equipment, and material requirements are available.

Prior Knowledge Required

Students must demonstrate an understanding of the following: general safety techniques when using hand tools and powered equipment, measurement techniques, properties of air and mass, the design process, design features of products and structures, methods used to alter drag; design principles used to minimize the force of the earth's gravity, Bernoulli's principles of flight, effect of force on structures; evaluation of design of systems and identification of modifications; transformation of energy based on the mechanism used, factors to be considered in the design and making of products, and factors that contribute to the efficient operation of machinery.

Teaching/Learning Strategies

This unit incorporates a variety of teaching and learning strategies, including: teacher-directed activities, individual learning activities, group work, and co-operative learning strategies. The teacher should provide students with the information, resources, and guidance necessary to complete each task safely with maximum opportunity for success. Students should be provided with opportunities to work independently and in groups to perform the following tasks: problem solving, brainstorming, safely using hand and power tools, following various design procedures, collecting information, report writing, assessing and evaluating projects, and making classroom presentations. Activities should be modified to meet the needs of all learners by applying various accommodations, such as: allowing increased time for activities, enhancing or compacting content, assisting during evaluation processes, and facilitating peer – tutor assistance where possible. Teachers must supervise students' operation of only those hand and power tools that they (the teachers) themselves are skilled at using safely. If a teacher is uncertain about the correct use of equipment, then an alternate activity should be selected for students.

Assessment/Evaluation

Methods of assessment and evaluation must include a wide variety of approaches to enhance the learning environment. Assessment methods may include: student-designed assessment criteria, performance assessments such as projects and skills demonstrations, personal communication assessment processes such as instructional questions and answers, conferences, classroom discussions, journals or log books, and standardized tests such as classroom tests or examinations. Each activity contains a sample rubric for assessment, which may be used by the teacher and/or students.

Resources

Resources required for this unit include: solid aluminum bar stock (if a metal lathe is available) or tire valves, basic hand tools, drill press, two-litre plastic bottle with cap, hot glue guns/sticks, Bristol board, paper tubes, paper, tape, low-density Styrofoam, thin wood for template, toothpicks, elastic bands, mousetraps (new), hanger wire, string, wheels, popsicle sticks, computers/computer software for research, problem-solving strategies, documentation, and presentations. Furthermore, each activity contains references to additional sources of information such as researched web site addresses.

Activity #1: Mousetrap Car

Time: 360 minutes

Description

By developing a mousetrap car, students will gain an understanding of the design process and the importance of safe and thoughtful construction techniques in successfully completing their vehicle. This project facilitates the practical exploration of forces, conservation of energy, and rotational motion. Students will better understand aspects of real-life vehicles using the concepts explored in building a mousetrap car.

Strands and Expectations

Strands: Theory and Foundations, Skills and Processes, Impact and Consequences

Expectations: TFV.01X, TFV.O2X, TFS.01X, TFS.02X, TFS.03X, SPV.01X, SPV.04X, SPS.01X, SPS.02X, SPS.07X, SPS.08X, ICV.02X, ICV.05X, ICS.01X, ICS.03X, ICS.05X, ICS.06X

Planning Notes

The following materials are required to complete this activity: a mousetrap, 70 centimetres of hanger wire, one piece of Bristol board (approximately 22 cm × 28 cm), two metres of string, four wheels, five hot glue sticks, ten popsicle sticks, and one individual ingredient (teacher approval required). Where possible, teachers should encourage students to search the Internet for web sites that will help them to develop designs (see Resources). Teachers should distribute to each student a concise, written description of the design challenge, including the problem statement, criteria/rules, assessment criteria, and the method of evaluation.
See Resources for a Sample Design Problem/Challenge Statement and Sample Criteria/Rules for the challenge.

Prior Knowledge Required

Students should have knowledge of structures and mechanisms, specifically in the following areas:

Grade 5 - Forces acting on structures and mechanisms
- demonstrate an understanding of the effect of forces acting on different structures and mechanisms
- evaluate the design of systems that include structures and mechanisms and identify modifications to improve their effectiveness

Grade 6 - Motion
- design and make mechanical devices and investigate how mechanisms change one type of motion into another and transform energy from one form to another
- identify modifications to improve the design and method of production of systems that have mechanisms that move in different ways

Grade 7 - Structural Strength and Stability
- demonstrate an understanding of the factors that must be considered in the designing and making of products that meet a specific need

Grade 8 - Mechanical Efficiency

- demonstrate an understanding of the factors that contribute to the efficient operation of mechanisms and systems

Teaching/Learning Strategies

Students participate in a class demonstration and discussion of the mousetrap car challenge. The class will be asked to research different types of vehicles and submit reports that include sketches and drawings as well as technical design details. Where possible, teachers should reinforce the mathematical concepts/calculations and scientific principles students are applying while designing and analyzing their vehicles. Students will be required to work in small groups of two or three. Teachers must ensure that all group members make an important contribution to the final project by reinforcing co-operative group learning skills. Teachers must review all appropriate safety precautions before allowing students to use hand and power tools. For example:

1. Mousetraps can be held open with tape or string while being worked on.
2. Safety glasses must be worn while operating tools or equipment and while in the vicinity of operating equipment.
3. The use of hot glue guns must be carefully supervised and they must never be used by students in a seated position.
4. Horseplay is not acceptable in a technology lab at any time.

Activity Instructions

Running the Contest

1. The racetrack may be on any smooth level floor, including a gymnasium or non-carpeted hallway.
2. Each vehicle will be allowed three attempts. The vehicle that obtains the greatest distance on any one of the three attempts is the winner. Ties are decided by a single run-off between the tied vehicles.
3. Prior to the operation of the vehicle, each group of students should develop the "race day" assessment criteria and then apply their criteria to determine the overall success of their vehicle. Each group’s individual criteria should align with the overall criteria for the challenge (see sample challenge in resources).

Assessment/Evaluation

	Level 1	Level 2	Level 3	Level 4
Understanding of concepts ICV 05X	• demonstrates limited understanding of concepts such as: exploration of force, conservation of energy, rotational motion	• demonstrates some understanding of concepts such as: exploration of force, conservation of energy, rotational motion	• demonstrates considerable understanding of concepts such as: exploration of force, conservation of energy, rotational motion	• demonstrates thorough and insightful understanding of concepts such as: exploration of force, conservation of energy, rotational motion
Thinking Skills TFV 01X TFS 02X SPS 01X	• uses thinking skills with limited effectiveness in the design process	• uses thinking skills with moderate effectiveness in the design process	• uses thinking skills with considerable effectiveness in the design process	• uses thinking skills with a high degree of effectiveness in the design process
Communi-cation of information TFS 03X TFV 02X	• communicates information, such as the technical drawing with limited clarity	• communicates information, such as the technical drawing with moderate clarity	• communicates information, such as the technical drawing with considerable clarity	• communicates information, such as the technical drawing with a high degree of clarity and confidence
Applications of procedure, equipment and technology SPV 01X ICS 01X ICS 03X	• uses technical equipment safely and correctly only with supervision	• uses technical equipment safely and correctly with some supervision	• uses technical equipment safely and correctly	• demonstrates and promotes safe and correct use of technical equipment
Making Connections ICS 05X ICS 06X	• makes connections between a mousetrap–powered car and a real–life vehicle with limited effectiveness	• makes connections between a mousetrap–powered car and a real–life vehicle with moderate effectiveness	• makes connections between a mousetrap–powered car and a real–life vehicle with considerable effectiveness	• makes connections between a mousetrap–powered car and a real–life vehicle with a high degree of effectiveness

Accommodations

As an extension activity, students could redesign the challenge statement and the rules for the challenge by allowing the use of multiple mousetraps or by including an inclined ramp in the race course. Alternatively, students experiencing difficulty with an open-ended, problem-solving challenge could be provided with one or more prescribed vehicle specifications, (e.g., the closing action of the trap must pull a string wrapped around the axle of the vehicle.) In this case, the problem then becomes one of selecting the optimum pulley diameter to make the vehicle move the greatest distance.

Resources

The following web sites on the Internet contain useful information for students and teachers engaged in this activity: http://www.mae.carleton.ca/course_info/39097.html

http://www.docfizzix.com/
http://www.blainehs.anoka.k12.mn.us/BlaineHS/students/projects/mousetrap/default.html
http://www.geocities.com/CapeCanaveral/5080/
http://quark.angelo.edu/sps/mouse.htm

Sample Design Problem/Challenge Statement:

Students will build a vehicle powered solely by the energy of one standard-sized ($1\frac{3}{4}" \times 3\frac{7}{8}"$) mousetrap that will travel the greatest distance in a straight line. For this challenge a vehicle is defined as a device with wheels used to carry something. Therefore, launching a ball from the mousetrap is inappropriate.

Sample Criteria/Rules:

1. A single Victor brand mousetrap must power the device. Other devices may be used if permitted.
2. The mousetrap cannot be physically altered except in the following ways: four holes may be drilled only to mount the mousetrap to the frame; the mousetrap spring can be removed only to adjust the length of its lever arm.
3. The device cannot have any additional potential or kinetic energy at the start other than what can be stored in the mousetrap spring itself (this also means students cannot push start their vehicles).
4. The spring from the mousetrap cannot be altered or heat-treated.
5. The spring cannot be wound more than its normal travel distance of 180 degrees
6. Vehicles must be self-starting. Students may not push vehicles in a forward or side direction.
7. The vehicle must steer itself. Measurements of distance will not measure the total distance travelled, only the displacement distance.
8. Distance will be measured from the front of the tape at the starting line to the point of the vehicle closest to the start line at the time of release.
9. The teacher makes the final decision relating to the appropriateness of any additional item that students may use to construct the vehicle.

Activity #2: Styrofoam Glider

Time: 300 minutes

Description

Students acquire knowledge about the principles of flight. They apply this knowledge to create a glider using Styrofoam, and they use the design process to document the development of the glider. They learn and develop practical skills by using hot glue guns, scroll saws, and wire foam cutters, and computer skills by working with airfoil design software.

Strands and Expectations

Strands: Theory and Foundations, Skills and Processes, Impact and Consequences

Expectations: SPV.01X, SPV.03X, SPS.01X, SPS.02X, SPS.04X, SPS.08X, TFS.04X

Planning Notes

Teachers will need to gather the following materials for this activity: a minimum of one standard 1219 mm × 2438 mm sheet of low-density Styrofoam per class of 24 students (If budget allows, the use of high-density foam and/or more Styrofoam to create larger scale gliders may be possible), thin wood for templates (scraps of panelling or plywood work well and are readily available at no cost), glue sticks, sandpaper, toothpicks, and elastic bands.
The following pieces of assembly equipment are required: foam cutters (easily constructed with 0.3 mm to 0.6 mm nichrome wire, a low-voltage, variable direct-current power supply, and bow for supporting the foam cutting wire a smaller hand-held version is useful for cutting the original pieces), scroll saw(s), a roll of two-inch wide clear packing tape, and hot glue guns. See the resources section for information on setting up a hot-wire cutting system. However, if it is not possible to set up and use a foam cutting hot wire, alternative materials can be used for the aircraft – from "new" foam meat trays to paper (e.g., White Wings). These alternate materials allow students to learn many of the principles in this unit but they provide a limited opportunity to investigate the effects of different airfoil shapes on the performance of an aircraft.
Teachers will need to ensure a computer and printer is available. An airfoil software program (see References) must be installed on the computer. The school gymnasium will need to be booked for half an hour on the expected end-of-project date to accommodate a flight test.

Prior Knowledge Required

The following Grade 6 expectations will provide a basis of knowledge as student's progress through this activity.
- Demonstrate and explain how the shape of a surface over which air flows affects the role of lift (Bernoulli's principle) in overcoming gravity (e.g., changing the shape of airplane wings affects the air flow around them).
- Demonstrate an understanding of the properties of air (e.g., air and other gases have mass) and explain how these can be applied to the principles of flight.
- Investigate the principles of flight and determine the effect of the properties of air on materials when designing and constructing flying devices.
- Identify design features (of products or structures) that make use of the properties of air, and give examples of technological innovations that have helped inventors to create or improve flying devices.
- Demonstrate and describe methods used to alter drag in flying devices (e.g., flaps on a jet aircraft's wings).
- Explain the importance of minimizing the mass of an object when designing devices to overcome the force of the earth's gravity.

Teaching/Learning Strategies

This activity incorporates a variety of teaching and learning strategies, including: open-ended learning, teacher directed activities, individual learning activities and group work. These strategies are demonstrated while students problem solve in the area of aircraft design, test the effect of different airfoil shapes, safely use hand and power tools, collect information, write reports, and assess and evaluate aircraft performance. Teachers must review all appropriate safety precautions before allowing students use of hand and power tools. For example:

1. A hot wire cutter requires good ventilation (if any odour or smoking is present, reduce the current/wire heat).
2. Ensure the hot wire is on top of a solid wood table/work bench so no one can walk into the hot wire.
3. Ensure the power source is CSA approved, such as a low-current battery charger or model train power transformer.

4. Safety glasses must be worn while operating tools or equipment such as the scroll saw.
5. The use of hot glue guns must be carefully supervised and hot glue guns must never be used by students who are in a seated position.
6. Horseplay is not acceptable in a technology lab at any time.

Sequence of Activity

1. Review the Principles of Flight.

Teachers summarize the four forces involved in flight: thrust, drag, gravity, and lift. The main design considerations deal with decreasing drag and increasing lift. Thus, teachers should emphasize aerodynamics and Bernoulli's Principle.

To explain Bernoulli's Principle, teachers provide a variety of brief hands-on demonstrations such as blowing with a straw between two playing cards or suspending table tennis balls to observe the counter-intuitive result of movement toward the faster flow of air. Another activity could involve the following kinesthetic exercise: two groups of five students start at one side of the classroom and move in pairs to the other side. Students from the first group move directly across the front of the classroom, while students from the other group must go the long way around the back of the classroom. Pairs must arrive at the finish at the same time. This exercise gives a visual and kinesthetic understanding of why air must move faster across the curved section of an asymmetrical airfoil than across the flat section. Relating the spacing between students (and, by analogy, air particles) to the concept of density helps students understand why the faster moving air, which is less dense, provides lift. Students will develop a vocabulary list of necessary airplane parts and airfoil terms in their notebooks. Students will practise their understanding of the principles of flight and airplane parts by designing paper airplanes.

2. Plan material use.

Working in assigned groups of two, students cut a piece of Styrofoam 15 cm × 120 cm. The teacher will provide design parameters relating the dimensions of the glider components (wing, tail, and fuselage) to the chord length of 15 cm. A review of the concept of scale drawing may be necessary. As an enrichment activity, students may be provided the following criteria for aircraft design and allowed to experiment with different designs, if time permits, and report on the results.

Note: The following parameters will create a glider that flies quite well:

- aspect ratio for wing (chord length: span) 1:3 to 1:20 (e.g. span = 70 cm)
- horizontal stabilizer 20% to 50% of wing area (e.g. area = 30 × 10 square cm)
- vertical stabilizer 30% to 60% of horizontal stabilizer area (e.g. area = 10 × 10 square cm)
- fuselage mid-length (from centre of wing to centre of horizontal stabilizer) 30% to 60% of wing span (i.e. if the wing span takes 70 cm, 50 cm remain from the original length for the entire fuselage, allowing a mid-length of 28 cm and a nose of 10 cm.)

Students will create a scale drawing of their cutting layout, clearly showing the dimensions of the three components.

3. Airfoil for the rear wing (tail) component.

The teacher reviews the characteristics of asymmetrical and symmetrical airfoils and facilitate a class discussion focusing on the purpose of the two parts of the rear wing, namely the horizontal stabilizer (elevator) and vertical stabilizer (rudder). Students use the airfoil computer program to select and print out an appropriate (symmetrical) airfoil to be used for the rear wing (tail) pieces.

Note: Starting with the tail is helpful because it is the smallest of the components. This gives students the opportunity to practise cutting with wire cutters and templates. If unsuccessful the first time, students still have sufficient foam in their original piece to allow for another attempt, although their fuselage design may need modifying due to the fact that less material is available. Students will record their airfoil number and trace the airfoil shape. These items are added to their portfolio and will form part of their design report.

4. Create templates for cutting rear wing shape.
Students glue together two pieces of template material (the thin wood) that are 1 cm longer and wider than the paper airfoil pattern printed using the computer airfoil program.
Note: Students must use only two small drops of hot glue under the centre of the pattern so that the two pieces remain glued during cutting but can be easily separated later using the hot wire cutter to slice through the hot glue.
Students glue the paper airfoil pattern to the two joined pieces of wood. The entire "sandwich" of wood and paper is cut out around the paper airfoil pattern using the scroll saw. The joined templates should be sanded until all outer edges are smooth. With a pencil, students draw wire-cutting guide marks every centimetre around the outside of the joined templates. These marks may be numbered to assist in the hot-wire cutting process by acting as guide lines to ensure the cutting of the templates is at the same rate by the hot wire (see step 5).

5. Cut the rear wing.
Students carefully separate the templates. Each template is lightly glued to one end of the rear wing foam piece. Care must be taken to ensure the template and piece is aligned the same way. Students work with their partner to guide the hot wire around the templates.
Note: A well cut wing is key to the success of the glider. Cutting is best performed as a two-person operation. Each person needs to make sure the wire is moving smoothly around the template at his or her end of the foam. The wire must also move at a constant speed across the foam, therefore one student should announce which mark he or she is currently passing and the other student should try to follow the pace.

6. Assemble the rear wing.
Note: The rear wing already cut will be further cut into two pieces, the vertical and horizontal stabilizers. Students then join these in the shape of an upside-down "T". Since the horizontal stabilizer has a curved upper surface, the vertical stabilizer must have a corresponding curve to its lower surface to sit flush on top. Students accomplish this by placing the template over the division mark and guiding the hot wire around to make the cut.
Students design the tail, referring to the parameters for vertical and horizontal stabilizers and cut the rear wing into two pieces. The smaller piece (the vertical stabilizer or rudder) is glued to the centre of the larger piece (the horizontal stabilizer or elevator).

7. Create the main wing.
Students repeat steps 3 to 5, substituting an asymmetrical airfoil shape.

8. Design the fuselage.
Students create a minimum of four thumbnail sketches of their fuselage design, taking into account the amount of foam remaining from their original piece. Students choose a design from their thumbnail sketches to create a scale pattern for their fuselage. Choice should be based on their understanding of aerodynamics (reduced drag), the need for the glider to be nose-heavy, and the fact that longer fuselages generally produce a more "level" glide. Students transfer their pattern to the remaining foam piece and cut it with the hot wire cutter.
Note: Proper design of the fuselage can reduce or eliminate the need for adding a lot of weight to the nose later. Some students have been very successful in gluing foam pieces together for a multi-layer nose section.

9. Assemble the glider.
Students attach the main and rear wings to the fuselage, using elastic bands anchored to toothpicks pushed horizontally through the fuselage. The main and rear wing should initially be set at the same angle relative to the fuselage. Students add weights to the nose if necessary to ensure proper weighting. Students test fly their gliders, adjusting weights and wing angles as necessary.
When students locate the centre of gravity of the glider, one-third of the main wing chord length in from the leading edge of the wing, the weighting should not need further adjustment. The elastic band

attachment system is very useful for allowing wing angle adjustments, using small pieces of foam to raise the leading or trailing edge. The elastic band also helps to absorb shock when the glider hits other objects (such as walls and floor) and thereby helps to lessen damage to the foam wings. Students provide a finish to their glider using markers or other media.

Assessment/Evaluation Techniques

	Level 1	**Level 2**	**Level 3**	**Level 4**
Knowledge of facts TFS 04X	demonstrates limited knowledge of the principle of flight	demonstrates some knowledge of the principle of flight	demonstrates considerable knowledge of the principle of flight	demonstrates thorough knowledge of the principle of flight
Thinking skills SPS02X	evaluates peer and self work with limited effectiveness	evaluates peer and self work with moderate effectiveness	evaluates peer and self work with considerable effectiveness	evaluates peer and self work with a high degree of effectiveness
Communica-tion of information SPV 03X SPS 01X SPS 04X	documents the development of the glider with limited clarity	documents the development of the glider with moderated clarity	documents the development of the glider with considerable clarity	documents the development of the glider with a high degree of clarity and with confidence
Application of procedures, equipment and technology SPV 01X SPS 08X	uses procedures, equipment and technology safely and correctly only with supervision	uses procedures, equipment and technology safely and correctly with some supervision	uses procedures, equipment and technology safely and correctly	demonstrates and promotes the safe use of procedures, equipment and technology

Students peer– and self-evaluate the quality and amount of work done in the design process and on their aircraft by reflecting on the checklist of design and construction steps listed above. The teacher will provide quizzes about vocabulary and principles of flight. Students may also present the rationale for their design to the class, to a guest from a local flying club, or to an aircraft service/manufacturing facility. To assist students in evaluating their aircraft, each student will prepare a list of assessment criteria for evaluating the quality of construction (static test) and the aircraft’s performance on flight day, such as distance flown. Teachers should collect and comment on the submitted student design reports.

Accommodations

Activities should be modified to meet the needs of all learners by applying various accommodations, such as: increasing time allowed for activities, enhancing or compacting content, assisting during evaluation processes, and providing peer tutor assistance where possible. Groups can be chosen to balance different abilities within each pair. Teachers ensure all equipment is easily accessible. Enrichment opportunities may include extensions such as having students plot their own airfoils from printed coordinates

Resources

Instructions for constructing hot wire foam cutters are available at http://www.epicrc.com/ep00007.htm.

Sample airfoil coordinates and profiles, diagrams to assist with template construction, etc. are available using ModelCAD, a CAD system specifically designed for PC and scale modelers, or Wingmaster model wing designer software, available at hobby stores or via the Internet.
Additional information on model aircraft is available at:
http://www.maac.ca/
http://www.modelaircraft.org/.
http://www.aviation.nmstc.ca/e-home.htm
Guest speakers and videos on flight are available from local flying schools.

Activity #3: Compressed Air Bottle Rocket Activity

Time: 330 minutes

Description

Students are challenged to create a compressed the air powered water rocket that flies the highest and straightest. Student controlled variables affecting rocket performance include rocket nozzle diameter, volume of water, and aerodynamic shape. Nozzles are machined on an engine lathe. Students measure the launched rockets' angles of elevation and deviation from vertical. This activity incorporates manufacturing, transportation, and design components.

Strands and Expectations

Strands: Theory and Foundations, Skills and Processes, Impact and Consequences

Expectations: TFV.02X, TFV.03X, TFS.03X, SPV.01X, SPV.04X, SPV.05X, SPS.01X, SPS.02X, SPS.08X, ICV.02X, ICS.01X, ICS.03X

Planning Notes

Teachers and students must pay particular attention to safety procedures when working with compressed air and high-pressure water. Participants and observers should remain at least five metres clear of the rocket launch area. If the body of the rocket (outside of plastic pop bottle) is scratched, kinked, permanently dented, or in any way damaged, it should not be used as it could rupture on pressurization.
The valve for the rocket can be manufactured or purchased – this depends on the equipment available. In manufacturing the rocket valve the following equipment is required: engine lathe with 3-jaw chuck, knurling tool, lathe turning tool bit, drill chuck for tailstock and drills, M14x1.5 metric tap and die or Imperial equivalent, hot glue gun, and hand shears. The following material is required: two-litre PET (plastic) pop bottle with cap; hot glue sticks; Bristol board (one sheet per four rockets); cardboard tubes (from toilet paper, wax paper, or plastic wrap); paper; tape; aluminum rods (20mm diameter by 40mm long per rocket) to manufacture nozzle assembly. Alternately, a tire valve stem can be provided for students requiring a modified activity without lathe operation.
A number of setup safety procedures must be followed. Teachers and students may design nozzle test stands and rocket launch platforms or this may be done in advance by teachers during training or in-service sessions. The launch platform must allow the person launching the rocket to remotely release the rocket from a minimum distance of five metres. Preferably, the rockets are contained in a protective shield (e.g. large plastic pail or plastic pipe) while being pressurized.
Rockets should be pressured to a maximum of 90 pounds per square inch, air over water. Teachers and students need to design a rocket clamp and release mechanism, a source of compressed air and air

pressure regulator, a rubber stopper drilled with a 1/16 in. diameter hole, an air line with needle valve fitting, a needle fill valve, and two elevation and two deviation angle measurement tools made from large chalk board protractors.

Prior Knowledge Required

Students require some knowledge of techniques for measuring pressure, force, volume, angles, lengths, and diameters, as well as experience with a variety of measuring tools, including a pressure gauge, spring scale, tape measure, vernier and steel rule. Students should be familiar with engine lathe operation, specifically with respect to general safety precautions. Some experience with the design process and knowledge of drafting, including scale drawings, is recommended. Students should know how to operate a hot glue gun. Awareness of safe practices relating to compressed air and tool operation is a necessity. As well, students require an understanding of technology laboratory routines.

Teaching/Learning Strategies

This activity challenges students to achieve the highest altitude rocket flight they can. Team building, pride in achievements, and responsibility for assigned roles are emphasized as students form rocket teams and assume positions such as Chief Design Engineer, Chief Tool and Die Maker, and Chief Testing and Evaluation Technologist. Each team member is assigned a job description and specific tasks. Teachers use whole-class lessons to provide safety instruction, introduce the challenge, and present activity phases and specific expectations (who does what and what is produced). Detail tasking is facilitated through small group instruction and demonstrations relevant to specific job descriptions. Everybody works – all team members' use their team designs to manufacture and integrate their own complete rocket. Teachers must review all appropriate safety precautions before allowing students to use hand and power tools. For example:

1. If the body of the rocket (outside of plastic pop bottle) is scratched, kinked, permanently dented, or in any way damaged, it should not be used as it could rupture on pressurization.
2. Rockets should be pressured to a maximum of 90 psi air over water (therefore only used a regulated air source).
3. The rockets must be contained in a protective shield (e.g. large plastic pail or plastic pipe) while being pressurized.
4. The rockets must never be pressurized indoors.
5. The operator of a rocket requires safety goggles and may only release the rocket remotely from a distance no less than five metres.
6. Students must never attempt to operate any equipment without detailed and thorough safety instruction from the teacher, especially power tools such as the drill press or lathe.
7. Horseplay is not acceptable in a technology lab at any time.

Activity Instructions

1. Introduction (Conception Phase): The teacher begins the rocket activity by introducing the two-litre pop bottle rocket challenge activity. The teacher also provides a non-flying demonstration of the rocket launch and the clamp, and also demonstrate the release mechanism and the tools used to measure rocket performance.

Note: The following activity instructions are not intended to be a sequential set of formal lessons. The rocket challenge is a group activity for teams of two to four students, with an optimum number of three students to a group. The teacher provides demonstrations and small group lessons to students with specific job functions. For example: a lathe setup demonstration is provided to students acting as Chief Tool and Die Makers. Safety aspects such as the correct handling of compressed air and correct tool operation must be taught to all students and reinforced in smaller student groupings.

To ensure the rocket is built in a timely and successful manner, the teacher helps students understand and practise project management. Students learn how to schedule and complete several overlapping sub-tasks within the overall project schedule. The rocket creation follows a multi-path engineering design and manufacturing development cycle in which all students will be involved. The overall project creation and completion of this manufacture, transportation, and design activity is provided to students in the following chart form to help track project phase activities and list responsibilities.

Project Phase/ Activities/ Responsibility/ Due Date

Conception	– challenge overview, team formation, charting project overlapping phases, introductory video.
Design	– planning, prototype scale model, sketch, nozzle detail drawings, aerodynamics.
Manufacture	– full-scale bottle rocket fins and nose cone, nozzle, and nozzle nut.
Integration	– aerodynamic fins, nose and body, nozzle assembly and sealing.
Test	– prototype aerodynamic scale model drop test, nozzle thrust test, rocket launch.
Completion	– elevation calculation, technical drawings and final report, individual and group evaluations.

2. Rocket Design (Design Phase): Students will use the experimental method to design the rocket by constructing a free-fall scale model rocket and machining three or four test nozzles. Each student is expected to build for homework a free-fall scale model rocket or at least gather material to construct one. Each student machines, with the assistance of student Chief Tool and Die Makers, one test nozzle and knurled nut for evaluation by the teams' Chief Testing and Evaluation Technologists.

3. Rocket Nozzle Manufacture (Manufacture Phase): Students will manufacture a simple nozzle and nut on the engine lathe (caution - prior safety and machine instruction is required). The nozzle starts with a 20mm diameter aluminum rod that students have end-faced and drill- and counter-sunk on one end. About 30mm is turned down to 14mm diameter and threaded for a M14x1.5 nut. Students will drill a nozzle hole 2mm to 8mm in diameter. Parting the machined end to a 35mm finished length completes the nozzle. The finished nozzle is left with a 20mm diameter by 5mm wide shoulder.

Students will machine the nozzle nut from a length of knurled 20mm diameter aluminum rod. They will drill the knurled rod to 12.5mm diameter, then thread it to M14x1.5. By parting the threaded end, students will produce a knurled nut of 10mm. Several knurled nuts may be produced from one length of 20mm diameter aluminum rod.

4. Rocket Assembly (Integration Phase): Students will put a 15mm hole into the two-litre bottle cap by drilling in a fixture made from a cut-off bottleneck. The nozzle is fitted into the two-litre bottle cap and secured with the knurled nut. Students will then screw the nozzle assembly on the bottle. Students will cut full-scale fins and nose cone from Bristol board. The nose cone is formed and glued to the previously designed and tested nose cone shape. Students will complete the rocket by gluing the fins and nose cone to the bottle.

5. (a) Rocket Aerodynamic Shape and Control – Free-Fall Scale Model (Test Phase): Students will build an approximate one-third-scale paper tube rocket with nose cone and fins. Dropping the scale model rockets from a safe platform to a one-meter diameter target will test designs. The best aerodynamic design will hit target centre.

(b) Rocket Nozzle Hole Diameter versus Thrust and Mass Flow Rate (Test Phase): Students will mount their nozzles in the test stand (review instructions regarding safety with high-pressure water and compressed air). The air is turned on and the force – the water rocket thrust generated – is measured directly in kilograms with a spring mass scale. Students will conduct a second nozzle test relating to the time to expel a given mass. Using a known volume of water (two litres/two kilograms), students will measure the time to eject, or empty, the water. Students will use both mass and time to determine the rate of mass ejection per second (kilograms per second). Students will calculate the mass flow rated, or the rate water is ejected in kilograms per second, by dividing the total mass of water ejected by the total time taken to expel the water.

(c) Deviation and Elevation Angle Measurements and Altitude Calculation: The design and manufacture of the necessary angle measurement tools should be a bonus student activity. All rocket launch measurements are done simultaneously at 50m from the launch point. Four measurement sites are located at 90 degrees from each other around the launch site.
Students will measure the angle of deviation by first aligning a horizontal protractor to point 90 degrees at the rocket launch site. When the rocket is launched, students should slide the perpendicular deviation sight about the deviation protractor to align the sight with the maximum rocket off vertical deviation.
Students will measure the angle of elevation by first aligning a vertical protractor to point along the 0-180 degree line at the rocket launch site. When the rocket is launched, students should slide the elevation sight about the elevation protractor to align the sight with the maximum rocket altitude. Students can then calculate the elevation using simple trigonometry: Height = 50m * cotangent (angle of elevation).

6. Final Report and Assessment (Completion Phase): Students will complete their final project report and hand in their personal project notes and logs. They will also perform group and self-assessments. The class may organize a celebration party during which the teacher will present rocket awards.

Assessment/Evaluation Techniques

	Level 1	Level 2	Level 3	Level 4
Understanding of concepts SPV 04X	demonstrates limited understanding between relationship of production methods and, material	demonstrates some understanding between relationship of production methods and material	demonstrates considerable understanding between relationship of production methods and material	demonstrates thorough and insightful understanding between relationship of production methods and material
Thinking skills TFV 03X SPV 05X SPS 01X	understands project with relation to identified specifications with limited effectiveness	understands project with relation to identified specifications with moderate effectiveness	understands project with relation to identified specifications with considerable effectiveness	understands project with relation to identified specifications with a high degree of effectiveness
Communication of information TFV 02X TFS 03X SPS 02X	communicates design and research ideas with limited clarity	communicates design and research ideas with moderate clarity	communicates design and research ideas with considerable clarity	communicates design and research ideas with a high degree of clarity and with confidence
Use of language symbols and visuals SPS 01X	produces technical drawing with limited accuracy and effectiveness	produces technical drawing with some accuracy and effectiveness	produces technical drawing with considerable accuracy and effectiveness	produces technical drawing with a high degree of accuracy and effectiveness
Application of procedures, equipment and technology SPV 01X SPS 08X	uses equipment and technology safely and correctly only with supervision	uses equipment and technology safely and correctly with some supervision	uses equipment and technology safely and correctly	demonstrates and promotes safe and correct use of equipment and technology

Teachers will evaluate students on initiative, work ethic, and finished quality of the rockets and design reports. As well, teachers will assess the students' presentation of finished projects. Daily work ethics marks are determined by student demonstrations of safe work habits, initiative in research and production, and teamwork. This may be tracked by means of a journal or logbook. Each student design team will establish and apply a set of assessment criteria to determine how well the rocket was designed for the flight and how well it performed on "launch day".

Accommodations

Accommodations for alternate and enrichment activities are noted in the Activity Appendix. Special Education and ESL, ELD students will build a simplified rocket omitting lathe manufacture and detailed testing of the nozzle. Exceptional student enrichment is provided by having students use rocket formulas and design measurement tools to achieve higher levels of understanding.

Resources

Information on rockets and limited information on bottle rockets is available through multiple web sites in the Internet, including the following sample listing.
http://www.physics.umanitoba.ca/CAP/aop/96c2n07.html
http://teacherlink.ed.usu.edu/nasa/rockets/index.html
http://www.lerc.nasa.gov/WWW/K-12/TRC/Rockets/RocketActivitiesHome.html
http://members.aol.com/StanDCmr/rocket.html

Rocket Theory and Hints and Teachers Notes

Principles of Rocket Flight
The three main principles of rocket flight are: (a) thrust (b) aerodynamics, and (c) control. The principles of rocket flight may be taught in various ways to address different student capabilities. For example, some students will find formulas difficult while others require further formula challenges through enrichment activities. Activities such as viewing a short video on rockets and visiting several pre-selected web sites may be used to introduce the principles of rocket flight. Students should make notes of these principles during these activities.

Principles of Rocket Flight - Thrust
By examining what occurs with the rocket nozzle, students will gain an understanding of the rocket thrust principle. Mass (water in this activity's bottle rocket or burning hot gas in most rockets) is ejected at high velocity (meters per second). The faster (or higher rate) that the mass (water) is ejected, the greater the thrust. Together the velocity of the expelled material (water velocity relative to the rocket) and the rate at which the mass is expelled (big or little stream of water) imparts momentum (mass × velocity) on the rocket. The magnitude of the rocket thrust in newtons is the relative velocity of the ejected mass times the rate that the mass is expelled. Simply stated, the higher the velocity of the ejected water stream, the higher the bottle rocket's thrust, and the higher the rate of expelled water in the stream, the higher the bottle rocket's thrust.
The following physics description of rocket thrust is provided as a mathematically based explanation for the university-bound student. The physics of rocket thrust (or push) is described by Classical Newtonian mechanics. The thrust of a rocket engine is also called a reaction force. Reaction force is the rate at which momentum (mass × velocity) is transferred out of (or into) a system (rocket) by the mass that the system has ejected (or collected). The physics equation for rocket thrust is:
F = vrel * dM/dt
Where;
* = multiply
/ = divide
d = change in
M = mass (kilograms)
t = time (seconds)
Thrust = F [newtons]
Velocity ejected mass relative to rocket = vrel [meters per second]
Rate mass is ejected = mass expelled per unit time = dM/dt [kilograms per second]
The rocket engine designers' challenge is to obtain the largest thrust for the longest period of time with a given amount of propellant (two litres of water and 90 psi compressed air). A very small and very fast stream of water could last for minutes but would not have enough thrust to lift the bottle rocket off the ground. Alternately, a very large stream of water would lift off in a blast but empty the propellant in a fraction of second, thus giving very little momentum to the bottle rocket and hence very little altitude. The best design will be one that gives a thrust high enough to lift the rocket up and provides a maximum period of thrust to yield the greatest altitude.

Students may view a short two-minute video clip of a real rocket launch to observe the slow start and the rapid final velocity of the rocket. The teacher will also explain the rocket engine designers' challenge of optimizing thrust versus time to students in Chief Design Engineer positions.

Principles of Rocket Flight – Aerodynamics

Students will quickly discern several obvious points of rocket aerodynamic design by accessing related information in books, CD encyclopedias, and pictures or videos of modern rockets. The rockets are round long cylinders (tubes) with blunt rounded forward ends and fins on the tail end. The teacher will ask student groups to formulate their thoughts on the best bottle rocket design to reduce air resistance. The teacher will tabulate suggested design parameters and assist students in understanding minimum air resistance. Teams will test their thoughts by building scale models, keeping in mind the following observations: round and long objects slide easily through air like a javelin, pointed yet blunt nose cones spread the flowing air gently around the rocket, tail fins keep the nose pointed in the correct direction (control) and help the body to fly in a straight line like an arrow, and the rocket motor at the tail end (which provides control) provides push in exactly the opposite direction that the rocket is to go.

Principles of Rocket Flight - Control

The bottle rocket has three means of control. An aerodynamic control is created as tail fins direct the rocket's flight through air. A second type of control is provided a through rocket motor, as the rocket will go in a direction opposite to the thrust (expelled stream of water). A third form of control is the direction in which the rocket motor is pointed. All three of these control factors determine whether the rocket flies in a straight line or along a curved path.

Calculation of Rocket Propellant Velocity from Test Measurements

The teacher may provide an enrichment activity by asking students to calculate relative water velocity with two measurements: water rocket thrust and the time to eject or empty the water. Students calculate the relative velocity of the ejected water using the formula – relative velocity is equal to measured thrust multiplied by time divided by the total mass of water expelled, or
$v_{rel} = F * t / M$

Rocket Launch Setup

For the rocket launch setup, teacher/students must conduct a thorough safety inspection of rockets. High pressure can explode damaged bottles so all rocket bottles must be inspected for cracks, scratches, or other signs of damage, and any damaged bottles must be rejected.
The water-charged rocket is clamped to the launch platform with a quick release mechanism. The nozzle is forced securely onto a rubber stopper. A small diameter air-fill tube protrudes through the stopper. The bottle is filled to the maximum launch pressure of 90 psi. The bottle is released when the area is safe.

Launch Field Duties

Duties are arranged to keep everyone involved. The teacher organizes four measuring stations with two students each or eight students in total. Flight timers record flight times during three flights and then average the times. A rocket filling station is the responsibility of two students. At the launch site, one student assumes responsibility for compressed air charging, one student assumes clamp and release duty, one student is launch site controller, and one student is assigned to be range safety officer. The teacher can provide at least 16 designated launch duties. Students are assessed and evaluated on the basis of how well they perform assigned launch site tasks including safety precautions such as wearing safety glasses.

Unit #2: Communications/Computer Technologies

Time: 1560 minutes

Unit Developers: John Rampelt, Don Cook, Margaret Ritchie, Michael A. Scott.
Simcoe County District School Board: Lead Board

Development Date: 1999

Unit Description

In this unit, students explore the various applications of computers and communications technologies. Activities are listed sequentially from introductory to more challenging. Although activities may be independent of each other, skills developed throughout the unit continue to build one upon the another.
Students apply various problem-solving strategies throughout this unit, and produce five products by the end of the unit, including drawings, 3D models, posters, videos, and games. During this unit students will have the opportunity to become aware of career opportunities, educational programs or opportunities for cooperative education in the field of communications technology.

Strands and Expectations

Strands: Theory and Foundations, Skills and Processes, Impact and Consequences.

Overall Expectations: TFV 01X, TFV 02X, TFV 03X, SPV 01X, SPV 03X, SPV 04X, ICV 01X, ICV 02X, ICV 03X, ICV 04X

Specific Expectations: TFS.01X, TFS.03X, TFS.04X, TFS.06X, SPS.01X, SPS.02X, SPS.03X, SPS.04X, SPS.05X, SPS.06X, SPS.07X, SPS.08X, ICS.01X, ICS.02X, ICS.04X, ICS.07X.

Activity Titles

Activity One	Simple Stop Action Animation	180
Activity Two	Electronic Poster	300
Activity Three	Memo Pad and Holder	270
Activity Four	Auto Cad – Habitat 2000	270
Activity Five	Computer Game	300

Unit Planning Notes

Before initiating each of these units, teachers should secure the appropriate resources and work through each activity prior to implementation. These preparations will ensure that all facility, equipment, and material requirements are met. Some activities require the teacher to research new information. For example, the electronic poster activity requires some knowledge of electronics. Students and teachers would benefit from contacting local businesses in the communications technology sector for support in conducting the various activities. These members of the community may also provide students with insight into career opportunities, educational requirements and potentially offer students cooperative education learning opportunities in grades 11 or 12 in the communications sector of the economy.

The Simple Stop Action Animation activity requires a camcorder capable of stop-motion or single-frame recording – or a digital camera, computer software which can generate an animation from individual still frames (ranging from shareware GIF animators to commercial packages such as Adobe Premiere), a camera tripod, objects or materials to model, and a paint program (for example, Corel Photo-Paint).

The Electronic Poster activity requires basic knowledge of electricity and introductory knowledge of an electronic circuit consisting of resistors, diodes, and a switch to enable an electrical current to flow from a nine-volt battery.

The Memo Pad and Holder activity requires knowledge of CorelDraw features, such as extrude, blend, and fit text to path. These features are used in the instruction for this activity. Teachers will develop ideas for potential uses for a memo pad and expand the related design criteria stated in the activity. Materials and equipment required for the activity include: coloured letter size paper, padding glue, weights for pressing the memo pad while gluing, thin cardboard/card stock, acrylic plastic up to 3 mm thick, computers with CorelDraw software, printer (colour capabilities offer more design options), paper cutter or guillotine, band saw or scroll saw, plastic cutting knife, strip heater or oven to heat plastic, buffer, and plastic adhesive – a scanner is useful, but not essential.

The AutoCad - Habitat 2000 activity requires that teachers be comfortable with a CAD program such as AutoCad LT and the principles of architectural design. Some resources required include photocopies of modular rooms drawn to a modular design, tracing paper, tape, pencils, coloured pencils, metric scale, Styrofoam or similar material, and glue to build the 3-dimensional model.

The Computer Game activity requires teachers to possess a knowledge of how data is stored in Random Access Memory (RAM) or magnetic media, how digital gates such as "AND", "OR", or "NOT" control data flow, and the role of the CPU in retrieving, decoding, and executing instructions. Required resources include old computers and a limited fabrication facility to construct the games.

Prior Knowledge Required

In each of the activities in this unit, students will be drawing upon a variety of knowledge and skills. They will have to connect the results of investigations with specific purposes and utilize a variety of communication procedures. In particular, students will need to communicate with specific audiences using media works, written notes and descriptions, drawings, and oral presentations. They will be required to produce drawings, evaluate their own designs against the original need, and propose modifications to improve the quality of product. Students will need to determine factors that contribute to the efficient operation of mechanisms, as well as systems and factors that can affect the manufacturing process of products, such as the driving force of consumer need. Students must also demonstrate a basic knowledge of safety concerns, as they will be exposed to a variety of new technological processes throughout this unit.

Teaching/Learning Strategies

This unit uses a variety of experiential learning strategies, including teacher-directed, group work, and co-operative learning strategies. The teacher provides students with the resources necessary to complete each task, including acting as a resource to the task. Students will be expected to work independently and in groups in problem solving, hands-on fabricating, following design procedures, report writing, brainstorming, and making classroom presentations. Assessment methods may include: standardized tests such as classroom tests or examinations, personal communication assessment (for example, instructional questions and answers), the application of student-generated project assessment criteria and the application of performance assessments. Performance assessments may involve projects, skills demonstrations, conferences, classroom discussions, journals or log books. A sample rubric for assessment included in each activity may be used by the teacher and/or students.

Resources

Resources required for this unit include: video cameras, editing suite (optional), digital camera, computers with AutoCad, CorelDraw, computer software capable of generating an animation from individual still frames, modeling materials, computers that may be opened to examine components, encyclopedias, drafting textbooks, assorted plastics, adhesives, buffing compounds, cutting knives, light emitting diodes, 1000 ohm resistors, nine-volt batteries, soldering iron, nine-volt battery clip, and internet access.

Activity #1: Creating a Simple Stop-Motion Activity

Time: 180 minutes

Description

Small groups of students plan and produce a short stop-motion animation using a video camera and physical props such as paper drawings, toy cars, action figures, or modeling putty. The activity begins with an introduction to animation techniques. Students create a storyboard or script to plan and describe their animation. They then produce it. Proper camera techniques, including the use of tripods and lighting, may be introduced as students record their animation. Evaluation will be based primarily on the ability of students to plan and properly record animations by following activity guidelines and by using equipment safely and properly. A secondary part of the evaluation will be based on the creativity or content of the finished work.

Strands and Expectations

Strands: Theory and Foundations, Skills and Process, Impact and Consequences

Expectations: TFV.02X, TFS.01X, TFS.03X, TFS.04X, SPV.01X, SPV.04X, SPS.01X, SPS.03X

Planning Notes

To promote the creation of animation without bias or harmful stereotypes, teachers ensure students properly represent races, cultures, disabilities, and appearances, as well as advance positive gender role models.

Materials required to record and produce an animation include: a camcorder capable of stop-motion or single-frame recording – or a digital camera; computer, and computer software which can generate an animation from individual still frames (ranging from shareware GIF animators to commercial packages such as Adobe Premiere); a camera tripod; objects or materials to animate, including coloured construction paper (plus markers, pencil crayons, glue stick, etc.), coloured modeling putty, toy cars, action figures, Lego, food, or other objects. Optional materials and equipment useful for recording or editing an animation are: a video editing system, including audio editing and titling capability; additional light sources; software tools such as a video editing program (for example, Adobe Premiere), a paint program (for example, Corel Photo-Paint), and an audio editing program (for example, Cool Edit).

Prior Knowledge Required

Students should be familiar with the operation of the camcorder or digital camera. If the animation is to be edited, teachers may wish to assign an editing activity to familiarize students with the process and to help them meet expectations for video and audio editing. Experience with script and story writing may also be helpful.

Teaching/Learning Strategies

Students will be given the challenge of designing and producing a stop-motion animation. The following sequence and time required for each of the instructional steps are adaptable. Each group of students will be able to adapt each step required to create an animation production and thereby align the process with their prior knowledge and rate of learning. The teacher may introduce the challenge by demonstrating several animated commercials. Students will be asked to note visual differences in playback frame rates based on the smoothness of motion in the animation, as well as the relative complexity of the animation (for example, static subjects/backgrounds vs. moving subjects vs. subjects and backgrounds in simultaneous, but directionally different, motion).

1. <u>Animation Concepts</u> The teacher describes the animation challenge activity with a discussion of animation concepts and how animations are created from successive still images. The concepts of motion, animation smoothness or fluidity, and frame rates – both the animation's playback rate and the physical frame rate of the output device – are important to the final animation and should be contrasted (see Appendices). The teacher must be aware of any equipment limitations regarding the frame rate and must determine the requirements for the animation length given the limitations of class time and equipment. At this point the students should be grouped and select the subject of their animation.

2. <u>Frame Rate</u> The teacher prepares students to record motion by discussing the difference between the physical or output frame rate and playback frame rate (see Appendices). Knowing these frame rates will enable students to plan the appropriate length for motion sequences in their animations. For example, if an action figure is required to throw an object in half a second, and the playback frame rate is 5 frames per second (fps), students must record two or three images of the action figure performing the throw. Students describe the benefits and shortcomings of high and low playback frame rates.

3. <u>Pre-Production Planning</u> The teacher describes the creation of a script or storyboard and its use in planning and recording animations. The teacher outlines the final requirements of the animation. These requirements may include: animation length (in seconds or as a specific number of frames), required frame rate, types of objects or materials that may be animated, required motions or movements, and types of editing, if any, required to complete the animation (see Appendices). Students complete a script or storyboard before beginning to record their animation. The script or storyboard includes a list of required materials, a description of any special techniques to be used and the length of each scene either as a time duration or frame count.

4. <u>Animation Production</u> Students will use the camera or camcorder to record the single frames that will make up their animation. Students must consider how camera and subject location will affect their ability to recreate the setup if recording must occur over multiple days. Students may, time permitting, record a short test animation to verify the timing of any recorded motions, so as to produce a more realistic final animation. The teacher will monitor progress and may make suggestions regarding camera placement, action, and lighting.

5. <u>Editing</u> (optional): If editing facilities exist, either for video or computer animation, the teacher will determine the requirements of the final edited animation based on time and equipment

limitations. Students use the editing system or software to add titles, soundtracks, or audio effects to their animation to meet the requirements as set out by the teacher (see Appendices).

6. Evaluation/Screening When complete, students view the animations and compare them to the animation requirements outlined by the teacher. Students suggest how the animations could be improved by commenting on planning, materials used, recording techniques, editing, and the successful achievement of requirements.

8. Further Exploration The teacher may lead students in exploring the length of time involved in creating a simple animation, and discussing alternative methods of animation. Advantages and disadvantages of 3D computer animation can be explored by viewing examples of 3D animation or using a 3D rendering or animation program, if available.

Assessment/Evaluation Techniques

The teacher evaluates students' abilities to plan and properly record animations on existing equipment. A secondary part of the evaluation may relate to creativity or animation content. The assessment and evaluation activities may be divided into four main parts: pre-production planning, animation production, editing, and creativity.

Pre-production Planning and Script/Storyboard Creation: The assessment of pre-production planning is based on the students' ability to think through, and account for, all elements of the animation production. Example assessment items include the ability of a script or storyboard to communicate animation content, music, effects, camera angles, scene duration, and the appropriateness of material choices (for example, the script and effects) to meet the animation's requirements.

Animation Production: Production evaluation reflects how well students use their knowledge of tools and equipment to produce animations which meet teachers' requirements. Example assessment items include meeting requirements for length, motion, camera angles, construction of animated objects, and final quality, as well as students' abilities to set up and use equipment safely and properly.

Editing: When editing facilities or equipment exist, editing evaluation determines how well students use their knowledge of tools and equipment to edit animations and meet teachers' requirements. Example assessment items include the presence and quality of all required titles, credits, leaders, trailers, audio tracks/effects, and constructive editing to make the production animation suitable for public viewing.

Creativity: Students may be assessed on their ability to develop creative solutions to the requirement of producing animations. Assessment may be based on factors such as the production of effective storyboards, the extent of detailed materials to be animated, and the level of careful editing of the final animation. This aspect of the production provides multiple opportunities for the teacher to enhance the activity for learners who require enrichment activities.

	Level 1	Level 2	Level 3	Level 4
Knowledge of facts TFV 01X	demonstrates limited knowledge of pre- production, planning, animation, and editing	demonstrates some knowledge of pre-production, planning, animation, and editing	demonstrates considerable knowledge of pre- production, planning, animation, and editing	demonstrates thorough knowledge of pre- production, planning, animation, and editing
Thinking Skills TFV 02X TFS 01X SPS 01X	accounts for all aspects of the animation process with limited effectiveness	accounts for all aspects of the animation process with moderate effectiveness	accounts for all aspects of the animation process with considerable effectiveness	accounts for all aspects of the animation process with a high degree of effectiveness
Communicates for different audiences TFS 03X TFS 04X	communicates with a limited sense of audience and purpose	communicates with some sense of audience and purpose	communicates with a clear sense of audience and purpose	communicates with a strong sense of audience and purpose
Communication of information SPS 01X	communicates information with limited clarity	communicates information with moderate clarity	communicates information with considerable clarity	communicates information with a high degree of clarity, and with confidence
Application of procedures, equipment and technology SPS 01X SPS 03X SPS 04X	uses procedures equipment and technology safely and correctly only with supervision	uses procedures equipment and technology safely and correctly with some supervision	uses procedures equipment and technology safely and correctly	demonstrates and promotes the safe use of procedures equipment and technology

Accommodations

Students with special needs can be easily accommodated during the animation activity by changing any or all of the animation requirements. Students with varying artistic skills, for example, may use pre-made objects rather than create objects to be animated. Changing specific production and editing requirements can accommodate students of many ability levels. Other accommodations within this activity may include: simplified or expanded story boards, adjustment in the modeling medium (Lego instead of clay), in-class peer tutors familiar with the technical processes, extra time provided after school or at lunch, etc.

Resources

General reference materials providing background information for this activity include:
Videography-The Guide to Making Videos by Peter Hitchcock Productions
Software - 3D rendering software, such as POV-RAY; Animation software, such as AutoDesk 3D Studio Max
http://www.angelfire.com/bc/BarryMoffatt/index.html

Expansion on the Teaching/Learning Strategies

1. Animation concepts: A paper flip-book animation can demonstrate how individual still images show animated motion when displayed rapidly in succession. Students can explore animation concepts and terms by researching animation and animation techniques in the library or on the Internet.

In animations, motion is represented by how much or how far still objects move from one frame of an animation to the next. Smooth motion in animations is related to the playback frame rate – the number of still-frame images per second that make up the final animation. The physical frame rate of the output device can be different from the playback frame rate, and is important in determining on how many frames (i.e. one or more) in which a particular image must appear.

The final output device determines the physical frame rate of the animation, which for video is 30 fps. Most camcorders capable of frame recording utilize a fixed lower recording frame rate, such as 5 fps. This means that the camcorder will record a single frame image on six successive frames, and when playing back the recording at 30 fps on a television, these six frame images will repeat or change at a rate of 5 fps.

This concept is described below in mathematical terms.

output device frame rate / # of frames per image = playback frame rate

Inserting the information noted above:

30 fps / 6 frames per image = 5 fps playback rate

2. Frame Rate: The advantage of a reduced playback frame rate is that fewer still frame images need to be recorded for a given length of animation. To record a two-second animation at a playback rate of 5 fps requires that only ten images need to be recorded. In comparison, a two- second animation at a 30 fps playback rate requires that 60 images need to be recorded. The disadvantage of a reduced playback rate, however, is the resulting lack of smoothness of any motion in the animation.

Note: If using a camcorder with a single frame recording mode, teachers must be aware of the number of frames per image recorded in the single frame mode. This information is usually available in the technical specifications of the camcorder. When using a digital camera and computer software, many programs give the user the capability to determine the final frame rate. Consult the software manual regarding settings for this capability.

3. Demonstration: Effective demonstrations can be found in commercial animations such as Sesame Street's animated letter or number sequences, action clips from cartoons such as Pingu, or segments of Disney animated movies.

4. Pre-Production Planning: Students' success in this activity is related to their ability to conceptualize the final product. Students who have a good grasp of what their animation should look like have a better chance of recording a successful animation quickly. Since this is a short activity, students must complete all planning ahead of time to allow the recording process to proceed as smoothly and quickly as possible.

If the time lines for this activity are limited, students may bring action figures or toy cars from home to quickly animate a short sequence. For example, a camera can be used to record a race between two toy cars from a single vantage point above a table. Then, by moving each car between successive frames, the students will record an animation that shows the movement and acceleration of the cars across the table.

Students with more time or creative ability may use other materials to enhance animation content. Continuing with the car race example, students could use paper or construction paper to draw or even build a simple race track for the toy cars to move on, or cut out paper figures to animate, such as the car drivers or race officials. The camera may also be moved to a different location in order to record an alternate view of the action-- for example, from above for the start of the race and to track level at the turns.

If time permits, students may use materials to create the entire contents of their animation. For example, students could create an animation of a rocket launch by making coloured paper cutouts of a rocket and flames and smoke plumes of various sizes. Students then record their animation by arranging these objects in sequence on drawn backgrounds of a launch pad, sky, and space.

5. Editing: Teachers will demonstrate, or provide activities demonstrating, how to use the audio/video editing system. Time and equipment permitting, students may be required to add a black leader and trailer, a title, an audio track or audio effects, and credits.
If a digital camera will be used to record animation image frames, teachers will demonstrate, or provide activities demonstrating, the computer system and software required to copy images from the digital camera to the computer.
Teachers may demonstrate, or provide activities demonstrating, how to use computer software to create an animation from individual still-frame images. Students will use the computer to transfer images from the digital camera to a program that can create animations. They will also use the program to create a finished animation. If facilities, equipment, and time permit, students will use the computer software to add titles, soundtracks, or audio effects to their animations.

Activity #2: Electronic Poster

Time: 300 minutes

Description

Students design and construct an electronically illuminated poster that reflects their personal interests or is used as a promotional device for a business (for example, to advertise a specific product). To accommodate varying student needs, the poster can feature a hand drawn picture, a photograph, a picture from a magazine, or a computer generated image. Students design and construct an electrical circuit to illuminate the poster and create new visual effects. For example, actual lights can be installed in pictorial depictions of street lights or car taillights. Students will develop an artistic appreciation for the integration of electronic technology into images on paper as they develop posters of professional quality.

Strands and Expectations

Strands: Theory and Foundations, Skills and Process, Impact and Consequences

Expectations: TFV.01X, TFV.03X, TFS.01X, TFS.04X, SPV.01X, SPV.04X, SPS.01X, SPS.02X, SPS.07X, SPS.08X, ICV.02X, ICS.01X

Planning Notes

It is important for teachers to learn about and be able to explain the theory of how the electronic poster operates. This theory may be described as follows. Activating a switch enables an electrical current to flow from a battery. The current flows through resistors to diodes and back to the other side of the battery. This process results in the emission of light. The light is emitted through the light emitting diodes (LED) strategically mounted in the poster. Since resistors limit current, a nine-volt battery will last a long time in this circuit. Note, if the diodes are reversed in the circuit, the current will not flow.

Prior Knowledge Required

By the end of Grade 6, students will: investigate ways in which electrical energy can be transformed into other forms of energy (for example, light, heat, and sound); identify different types of switches that are used to control electrical devices (for example, contact and tilt) and explain the key differences among them (for example, differences in design, use). It is helpful for students to have some knowledge of visual arts and electricity, as well as experience with soldering equipment. Teachers must emphasize the potential hazards of lead solder and the necessity to wear safety glasses and follow specific safety guidelines, including hand washing after handling lead solder. Knowledge of basic hand tool safety is important for all students in this activity, as a variety of tools will be used.

Teaching/Learning Strategies

For many students, this may be the first time they have been exposed to aspects of electrical and electronic technology. Therefore much of the design process is restricted to allowing students the opportunity to choose a poster theme and select various coloured light emitting diodes for use in their poster. Students should be encouraged to discuss personal interests in selecting poster themes, share information about themselves, and take pride in their accomplishments. Students are encouraged to rely on their emerging analytic skills and aesthetic sensibilities to select or create their own pictures. The remaining stages in this activity require students to select and read resistors, glue, cut foam core, solder, heat sink, identify the cathode and anode of a diode, and install an electrical circuit. The activity is easily enriched, to accommodate learners who need a greater challenge, by expanding the complexity of the electronic circuit to perform various functions. For example, light sensors or variable timers could be added to have the LED's function under various pre-designed conditions. Prior to allowing students to use hand and power tools, teachers must review all appropriate safety precautions. Examples of these precautions include:

1. Soldering possesses a risk of severe burns, therefore students must wear eye protection, work in a well ventilated area, and be carefully supervised.
2. Safety glasses must be worn while operating tools or equipment such as the scroll saw.
3. The use of hot glue guns must be carefully supervised and hot glue guns must never be used while in the seated position.
4. Horseplay is not acceptable in a technology lab at any time.

Activity Instructions

The teacher will introduce the concept and ask students to discuss poster ideas. Students create or select a picture and carefully glue it to a piece of quarter-inch foam core.
Students solder a Light Emitting Diode (LED) to a resistor of 300 to 1000 ohm. The LED can be any colour and can produce flashing light pulses. Students must also learn to heatsink the diode by clamping an alligator clip near the LED. This heatsinking process prevents heat from burning out the light. Note: Diodes burn out quickly without enough resistance (provided by the resistors) and the resistors must be in the electronic circuit in series with the diode. The larger the resistor, the dimmer the light -- however, the battery will last longer.
The teacher directs students to connect a switch on one side of the LED-resistor unit using small stranded wire.
Under teacher supervision, students solder a nine-volt battery clip to the two wires emerging from the LED circuit. The black lead must connect to the short lead on the LED or to the lead that goes to the flat spot on the glass of the LED.
The teacher asks students to select locations on the foam board where the LED will be installed. A sharp pencil will be pushed into the selected locations to produce holes. Students then push the LED through the appropriate hole in the foam core and picture.
Students connect a nine-volt battery to the battery clip.

Students can then operate the switch. When the switch is closed the light or lights come on and produce a dynamic effect on the picture.
Students construct a battery holder on the back of the foam core.
Students are then ready to frame their pictures.

Assessment/Evaluation Techniques

	Level 1	**Level 2**	**Level 3**	**Level 4**
Knowledge of facts TFV 01X	demonstrates limited knowledge of electrical circuitry	demonstrates some knowledge of electrical circuitry	demonstrates considerable knowledge of electrical circuitry	demonstrates thorough knowledge of electrical circuitry
Thinking skills TFV 03X TFS 01X SPV 04X SPS 07X	uses thinking skills with limited effectiveness	uses thinking skills with moderate effectiveness	uses thinking skills with considerable effectiveness	uses thinking skills with a high degree of effectiveness
Communica-tion of Information TFS 04X	uses a picture from a magazine and a pre-designed electrical circuit	uses a picture and adds features to an electrical circuit	takes and develops photographs and add features to an electrical circuit	designs and draws a picture, and designs the electrical circuit
Application of procedures equipment and technology SPV 01X SPS 01X SPS 08X	uses soldering equipment safely and correctly only with supervision	uses soldering equipment safely and correctly with some supervision	uses soldering equipment safely and correctly	demonstrates and promotes the safe and correct use of soldering equipment

Accommodations

The Electronic Poster activity can be varied to suit different needs, interests, and skill levels. Students who enjoy art may draw or design their own pictures. Students with an interest in photography may use a camera to take pictures and develop the photographs using darkroom techniques.
Students may wish to work with magazine pictures by reviewing, discussing, selecting, cutting, and then pasting them on the foam core. Additionally, students can make the electronic circuitry as complicated or as simple as their comfort levels dictate. Projects may include several lights and switches, or they may include only one light and one switch.

Resources

Materials required for this activity include a picture, foam core, light emitting diodes, 1000-ohm resistors, a nine-volt battery, and a nine-volt battery clip. A soldering iron is also required to complete the project. All of these items are available from local electronic stores and electronic repair services.
http://www.iserv.net/~alexx/glossary.htm (Giant Glossary of Electronic Terminology)
http://www.howstuffworks.com/digital-electronics.htm
Other useful resources include: The Electronic Workbench software product by Richard Parker and Bob Legresley, and the following books: Introduction to Electricity and Electronics (Book 1) by

Frank D. Petruzella, Applied Electricity by Kurt Harding Schick, Computer Technology by O.R. Lawerence, Electronics: A Practical Introduction by P.W. Braby, Electrical Systems Technology by Walter L. Bartkiw and Kenny T. Sookhoo.
As well, books and encyclopedia references are available in local libraries.

Activity #3: Memo Pad Activity

Time: 270 minutes

Description

Students follow a design process in designing and constructing a personalized memo pad and construct a plastic holder from thermoforming plastic (for example, acrylic) to fit their memo pad. The completed memo pad should meet the needs of a high school student and it should be designed for a specific application such as mounting on a wall, locker, desk, refrigerator, etc.

Strands and Expectations

Strands: Theory and Foundations, Skills and Processes, Impact and Consequences

Expectations: TFV.01X, TFS.03X, SPV.01X, SPV.03X, SPS.01X, SPS.03X, SPS.04X, ICV.01X, ICS.01X, ICS.03X

Planning Notes

Teachers require a sample memo pad and holder. Handouts about Corel tools and demonstration sheets and/or overheads that illustrate common Corel features such as extrude, blend, and fit text to path will be used in the instruction for this activity. An introductory video to Corel may be useful but is not a requirement. The following materials are also required: coloured photocopy or printer paper, padding glue, weights for pressing the memo pad while gluing, cardboard, and acrylic plastic up to 3 mm thick. The following equipment is required: computers with Corel3, printer (colour capabilities offer more design options), paper cutter or guillotine, band saw or scroll saw, plastic strip heater or oven to heat plastic, buffer, and plastic adhesive. A scanner is useful, but not essential. Using the guillotine can be one of the highlights of this activity, as students master a large, sharp machine. A paper sheer may also be used with care to cut sheets to the same size.

Prior Knowledge Required

Students know how to open, save, and exit a computer program. By Grade 8, students will have learned to communicate procedures and results of investigations for specific purposes and to specific audiences using a variety of mediums, including written notes, descriptions, drawings, and oral presentations. Students will be aware of the basic safety precautions in using hand and machine tools.

Teaching/Learning Strategies

In introducing the memo pad challenge, teachers should help students develop ideas for potential uses for a memo pad and the related design criteria. Criteria may include: size determination, such as four sections to a sheet of letter-sized paper (commonly the finished pad is _ of a letter sized sheet of paper); writing area or space for doodling on the memo page; and an imprint such as a name, graphic or clip art. Variations on the assignment could include one design repeated four times, or two designs, or four separate designs. All of the design criteria will be used as assessment criteria later on in the activity. It is important to ensure students follow the design process and prepare thumbnail sketches and a comprehensive for each final design. Stages of the design process may be expanded or eliminated to accommodate different learners. For example, roughs may be omitted since refined self-criticism and design development is difficult for many Grade 9 students. The learning activity may be enhanced by allowing students to prepare more complex computer generated graphics, such as pixel edited scanned images, for use on their memo pad. Students must use Corel Draw or a similar graphics design program to prepare graphics for the project. They will need to know procedures to follow when using a paper cutter or guillotine, band saw or scroll saw, plastic strip heater or oven to heat plastic, buffer, and plastic adhesive. Teachers must review all appropriate safety precautions before allowing students to use hand and power tools. For example:

1. Review the importance of having one operator assigned to the paper shear/guillotine as well as the need for careful supervision and ensure all guards are in place.
2. Safety glasses must be worn and no loose clothing or hair is allowed while students operate tools or equipment such as the scroll saw, buffer, drill press, etc.
3. Students must wear gloves and be carefully supervised while working with hot plastic forming equipment and plastic.
4. Hot plastic or plastic adhesives must never be handled in a seated position.
5. Students must avoid letting the edge of the plastic work piece catch on the rotating buffer.
6. Horseplay is not acceptable in a technology lab at any time.

Activity Instructions

1. Students write a proposal for the memo pad in memo format. The proposal includes an explanation of what the memo pad will be used for (for example, homework lists, telephone messages, shopping list, doodling, etc.) and a list of skills and knowledge students require to complete the project.

2. Students prepare a minimum of four thumbnail sketches for different designs. These thumbnails follow from the proposal and meet the stated criteria.

3. Students critique their thumbnails and choose the best two to develop further.
   (Steps 4 and 6 - may be completed as homework)

4. Students create full-size "roughs" and make improvements to their designs. After selecting the best concept, students prepare a coloured comprehensive, making the design match as much as possible the final computer mechanical envisioned.

5. Groups of students will take turns experimenting with Corel draw, learning how to draw lines, rectangles, and circles; and to select, move, size, fill, and add text and clip art. Students will be encouraged to experiment with special effects such as extruding, blending, fitting text to path, etc. Students type in their name and apply three different effects, blend two shapes and apply text, and draw an ellipse and fit text to path. After experimenting, students will use their work to prepare a Design Report title page. The title page includes the course title, student's name, project title, and date, plus clip art, blended and extruded features, and text fit to a path.

6. Students make their computer mechanical after the teacher approves the final design. Students may scan in images and import them into their Corel file or import clip art as desired. The final printout should include four images on the page. After approval of the finished product, students will print 25 sheets on coloured paper.

7. Students trim their paper stack into the four sections, and trim a piece of cardboard as a backing.

8. Students glue the spine of the memo pad with padding glue and an old brush. Steps include placing the edge of the pad slightly over a work table edge, then placing weights on the paper close to the edge. Next, students liberally apply the padding glue and leave overnight to dry.

9. While students wait to trim and glue the memo pad, they will begin to design the holder. Students produce thumbnail sketches of simple designs that can be formed from a single piece of plastic. After checking sizes required to fit their memo pad (s), students use drafting equipment to create the flat pattern development for the holder. The teacher should caution students about the need to consider bend allowances and plastic thickness. Students construct a test model from paper or cardboard before proceeding with the plastic product.

10. Students cut a piece of plastic the size of the blank. They then transfer their pattern to the plastic and mark any bends. It is usually easier to finish the edges before bending. Students then cut, heat, bend, and shape the plastic, and complete a final polishing. Students use a rubric to evaluate the memo pad and holder, checking on finished sizes, inclusion of all design elements, quality of construction, and quality of finish.

11. Students produce a Design Report, including their Corel title page, thumbnails, roughs if produced, comprehensive and mechanical, description of the method used to make the memo pad and holder, and evaluation of the project design and process, plus the self-evaluation rubric.

Assessment and Evaluation

Students demonstrate appropriate use of computers and are able to save their work successfully. The proposal should be in correct format and include the design brief, plus the knowledge and skills students are expected to learn.

Students produce a minimum of four different ideas on their thumbnails. All thumbnails should meet the criteria and agree with students' proposals. Students' critiques should demonstrate careful thought (that is, something more than "This is best because I like cars"). Roughs and comprehensives should show development and refinement of design ideas. The comprehensive should be neatly and carefully finished, duplicating the text styles and graphics closely. The title page should include course title, student’s name, the project title, and date, plus clip art, blended and extruded features, and text fit to a path.

The Corel mechanical should demonstrate mastery of basic Corel techniques and creative use of Corel features. The teachers should see four images correctly positioned on the page. The copy should be neatly trimmed to the correct size, and padded correctly.

The holder design should fit the memo pad. The holder can be made from a single sheet of acrylic since bends, and not separate pieces, form the piece. Pattern development should be neatly drawn to correct size. Students should make allowance for bends in the plastic. Students need to demonstrate the safe operation of plastic forming equipment, saws, knives, and buffers, and an awareness of the care needed, as well as hazards associated with plastic solvent use. The blank should be cut to the correct size and the pattern transferred to the plastic. Students should ensure the holder is bent to shape and finished neatly.

The teacher assesses that the Design Report includes the Corel title page, thumbnails, roughs, comprehensive and mechanical, description of the method used, and evaluation of the project design and process, plus the self-evaluation rubric. Students should produce the report using a word processing program and ensure it is correctly formatted. Students will need to have completed the self-evaluation fairly.

	Level 1	Level 2	Level 3	Level 4
Knowledge of facts, terminology, procedures and standards TFV 01X TFS 03X	demonstrates limited knowledge of design procedure	demonstrates some knowledge of design procedure	demonstrates considerable knowledge of design procedure	demonstrates thorough knowledge of design procedure
Application of an inquiry/design process SPV 01X SPV 03X SPS 01X SPS 03X	applies few of the skills and strategies of the design process	applies some of the skills and strategies of the design process	applies most of the skills and strategies of the design process	applies all or almost all of the skills and strategies of the design process
Communication of information SPS 04X	communicates information with limited clarity	communicates information with moderate clarity	communicates information with considerable clarity	communicates information with a high degree of clarity and with confidence
Application of procedures, equipment and technology ICV 01X ICS 01X ICS 03X	uses equipment and technology correctly and safely only with supervision	uses equipment and technology safely and correctly with some supervision	uses equipment and technology safely and correctly	demonstrates and promotes the safe and correct use of equipment and technology

Accommodations

Teachers may provide sample patterns and holders for students who experience difficulty visualizing a pattern. A WordPerfect Design Report template will help students write a report by filling in the blanks.
To extend activities, students may be directed to design other stationary items, such as personalized note paper for their Grade 9 technology notebook. Students may also develop patterns for other shapes of boxes, such as dustpans, tote boxes and dodecahedrons and isosahedrons (see Resources).

Resources

The Corel manual; The Corel Video; a basic drafting book such as Stirling; a more advanced reference such as Jensen's Engineering Graphics and Design; Kidder Plastics reference books, assorted plastics, adhesives, buffing compounds, cutting knives etc. http://www.corel.com/index.htm
http://desktoppublishing.com/linkus.html
http://strategis.ic.gc.ca/SSG/am00793e.html

Activity #4: AutoCAD - Habitat 2000

Time: 270 minutes

Description

Students investigate the problems of supplying low-cost, yet attractive, housing in urban settings. Using AutoCAD or other CAD software, students develop drawings of a Habitat-style condominium complex. Students also establish design criteria for their housing ideas and evaluate their solutions according to the criteria they have identified. Three-dimensional modeling using simple materials provides a suitable celebration of the activity. Modeling in 3-D by computer can be an exciting extension of this activity.

Strands and Expectations

Strands: Theory and Foundations, Skills and Processes, Impact and Consequences
Expectations: ICV.01X, ICV.03X, ICV.04X, ICS.04X, ICS.07X,TFV.02X, TFS.03X, SPV.03X, SPS.03X, SPS.04X

Planning Notes

Presentation: Teachers need photographs and overhead transparencies of several apartment buildings typical of the area or nearby town; photographs and articles on Habitat, the architect Moshe Safde, Pueblo villages, and perhaps Mediterranean villages; plus an overhead transparency of a typical apartment floor plan.
Package preparation: Each group will need a package with photocopies of modular rooms, including kitchen, bathroom, living/dining area, hall, roof garden, and bedrooms, drawn to a modular design and 1:50 scale. It should be ensured that the patio space fits above the bedrooms or living room of the unit below. Students will need tracing paper, tape, pencils, coloured pencils, and a metric scale. It is ideal to have enough finished apartment units to create a three-storey Habitat 2000 complex of 12 to 15 units. However, two or more copies of each unit can be made to build a bigger building in the final stage of the activity.
Computer preparation: Teachers should provide an AutoCAD quick reference sheet. Teachers will need to prepare AutoCAD or other software to ensure all blocks such as doors, windows, furniture, and landscape materials, are available to students. Standardized components, such as kitchen and bathrooms, may be drawn ahead by the teacher or a senior student and made available to students in this activity. For some students with special needs, all rooms might be prepared as blocks so students can manipulate them into position and add furniture. Styrofoam or similar material and glue are required to build the 3-dimensional model. This important final step allows students to visualize and celebrate their projects.
New Skills To Be Learned – Students will: identify components of an architectural plan, including walls, windows, doors and arches, fixtures, and furnishings; use 1:50 scale to determine room sizes; use AutoCAD commands to polyline, double line, offset, copy, move, rotate, mirror, fillet, trim, and extend; insert ready-made blocks of furniture and other components and then move and rotate them into position; add a correct border, title block, and information to the drawing; create an assembly drawing from several files; print a drawing to correct scale.

Prior Knowledge Required

This activity builds on an introduction to AutoCAD in a previous activity. Students should have mastered the use of drawing setup, line, erase, undo, zoom, snap, grid, text, save, save as, and exit. By Grade 8, students will have learned to communicate procedures and results of investigations for specific purposes and to specific audiences using a variety of mediums, including written notes, descriptions, drawings, and oral presentations. A knowledge of basic hand tool safety such as how to properly use a utility knife to avoid injury.

Teaching/Learning Strategies

Students are provided with examples of traditional and innovative design and encouraged to discuss and assess these designs in terms of rationale and effect. After becoming familiar with design concepts, students will be assigned AutoCAD design tasks. These tasks will help them identify architectural components and determine room sizes to correct scale, and optimum placement. Students evaluation of their own designs against the original need and purpose will help them conceive and make modifications to improve the quality of products.

1. The teacher shows pictures of typical high-rise apartment and condominium buildings, preferably from local neighbourhoods or communities. Students discuss the reasons for the numbers of such buildings and determine the physical and social problems associated with typical high-rise buildings. During the discussion, students may consider expensive land cost, accommodation affordability, ease of construction, lack of individuality, lack of outdoor living space, boxy designs, poor ventilation, crowding, an undeveloped sense of belonging, no concept of neighborhood or community, and difficult access for the disabled, police and fire personnel.

2. The teacher shows pictures of Habitat in Montreal and southwest Pueblo architecture. Students will be encouraged to discuss how these designs attempt to overcome some of the previously discussed problems of traditional high-rise apartment and condominium buildings.

3. The teacher shows a typical apartment floor plan and lead students to identify all components, such as walls, doors, windows, bathroom fixtures, etc. Students work with their packages in small groups, manipulating units to create a plan for an individualized two- to three-bedroom apartment with outdoor patio or roof garden. Individual components may be rotated or mirrored as required. Each unit should have windows on at least two sides, and a view in at least two directions.

4. Students tape together their solution and make a tracing, showing all rooms, plus locations of doors, windows, and closets.

5. Students scale the drawing and determine the real life dimensions of the apartment, noting them on the drawing.

6. Students divide the work into separate room components. Using AutoCAD to draw each room, students will insert prepared blocks of furniture, kitchen and bathroom fixtures, windows and doors, plus plants and furniture for the roof garden.

7. Students print out their individual drawing, complete with border and title block. Students will consolidate their drawings into one drawing using the "insert file" command, and make any required adjustments. Two copies of the composite drawing will be printed to scale (1:50 or 1:100, depending on the capacity of the printer). One copy will be handed in with the project report.

8. Students cut a piece of foam to the shape and size of their apartment plan drawing, and paste a cutout of their plan onto the foam. The teacher will work with the class to create the full "Habitat 2000" building, in 3-D.

9. Student groups complete a design report using a word processing program.

Accommodations

Teachers may pair students so they may take turns giving directions to each other. Smaller and simpler room drawings may be assigned to students experiencing difficulties. To minimize working with a lot of text, the AutoCAD reference sheet can be shown with sequence diagrams. Teachers may separate tasks, so that some students may begin cutting the foam blocks using the original tracings and arranging them in a three dimensional setting, while others complete the assembled drawing. Extension activities can be developed in the following ways. Students can use AutoCAD to extrude the walls to the correct height, and also extrude windows and doors. The base elevation may be changed to suit windows. The design can be viewed and printed as a three dimensional object. A very exceptional student could take all the plans and create a 3-D view of the whole complex. Scale models could be made with wood or Bristol board, showing elevations and designed with lift-off tops to show interior views. Students may wish to design roads, paths, parking, landscaping, and playgrounds. (This could be made into a separate construction activity). Students could create sales brochures in Corel Draw, importing the plan from AutoCAD and a scanned drawing of their "Artist's Concept". This latter activity would also be a good Communications Technology activity.

Assessment and Evaluation

	Level 1	Level 2	Level 3	Level 4
Knowledge of facts, technical terminology, procedures and standards TFV 02X	demonstrates limited knowledge of the design process	demonstrates some knowledge of the design process	demonstrates considerable knowledge of design process	demonstrates thorough knowledge of design process
Thinking skills ICS 07X	is able to describe the problem with limited effectiveness	is able to describe the problem with moderated effectiveness	is able to describe the problem with considerable effectiveness	describes the problem with a high degree of effectiveness
Application of a design process ICV 03X ICV 04X	applies few of the skills of a design process	applies some of the skills of a design process	applies most of the skills of the design process	applies all or almost all of the skills of the design process
Communication of information TFS 03X SPV 03X	communicates design with limited clarity	communicates design with moderate clarity	communicates design with considerable clarity	communicates design with a high degree of clarity and with confidence
Application of procedures, equipment and technology SPV 03X SPV 04X ICV 01X	uses computers correctly only with supervision	uses computers correctly with some supervision	uses computers correctly	demonstrates and promotes the correct use of computers
Making Connections ICS 04X	Makes connections with limited effectiveness	makes connections with moderate effectiveness	makes connections with considerable effectiveness	makes connections with a high degree of effectiveness

The teacher observes participation levels, abilities to focus on task, efforts, and cooperation.
Students will be asked to demonstrate an understanding of the design problem by restating it clearly and describing the solution. Students will be expected to demonstrate knowledge of the environmental and social effects of different housing conditions, and to show how lives are influenced by housing options. Students should also be able to describe environmental, ecological, and social considerations relating to housing technologies.
Students evaluate the solution, relating it to the individual design criteria and suggesting appropriate design modifications. Students will be required to demonstrate the correct use of the 1:50 scale to determine room sizes.
Students identify and demonstrate acceptable use guidelines for software and computer use. Students will be assessed on their safe handling of computer hardware and software.
Students will be required to complete a drawing of a room to the correct size, using an appropriate selection of AutoCAD commands to create a professional drawing. All corners should meet exactly and windows and doors should be placed correctly. Students will be asked to demonstrate their ability to insert ready-made blocks of furniture, for example, and move and rotate them into position. Students' abilities to add correct borders and title blocks to drawings and print drawings to correct scale could also be assessed.
Students may be asked to describe how to create an assembly drawing from several files and how to use AutoCAD to share information from one file to another. The teacher could assess students' abilities to use both AutoCAD or other CAD software and word processing programs to communicate and describe design and research ideas and to document the design process.

Resources

Internet references to Moshe Safde, Montreal, McGill, ancient South West Native cultures;
Books - Encyclopaedia;
Common drafting books - Stirling or Berman recommended; AutoCAD reference manuals and tutorials;
Choosing a House Design - published by Central Mortgage and Housing, provides good room sizes, arrangement, and spacing requirements.
http://www.cadsoftware.com/
http://www.clr.toronto.edu:1080:1080/VIRTUALLIB/ARCH/org.html
http://www.greatbuildings.com/buildings/Habitat_'67.html

Activity #5: Computer Game Activity

Time: 300 minutes

Description

Students demonstrate knowledge of computer hardware components and their associated functions by designing and creating a board game based on the operation of the computer. Students learn how to communicate knowledge of computer operations by analyzing computer systems and applying key concepts to game design. Students produce a game by utilizing computer graphics, creating hand illustrations, and/or fabricating associated components. This activity integrates design, communications, and computer engineering.

Strands and Expectations

Strands: Theory and Foundations, Skills and Processes, Impact and Consequences
Expectations: TFV.01X, TFV.02X, TFS.01X, TFS.03X, TFS.06X, SPV.01X, SPV.03X, SPS.01X, SPS.03X, SPS.06X, SPS.08X ,ICV.02X , ICS.01X, ICS.02X

Planning Notes

Teachers can use a number of ways to help students visualize how data flows through a computer system. Teachers may describe how the input of a character from the keyboard is converted to binary code, stored in memory to await further work, processed by the Central Processing Unit (CPU), addressed and sent to the data bus, converted to a pixel character map, and outputted via the video card to screen display. Teachers may extend this visualization of computer operation by comparing the computer and the human brain in the following ways: computer/brain, input/sense, memory/store, process/think, output/do.

Descriptions of how data is stored in Random Access Memory (RAM) or magnetic media, how digital gates such as "AND", "OR", or "NOT" control data flow, and the role of the CPU in fetching, decoding, and executing instructions can help students conceive ideas for gaming strategies. It is important to provide students with opportunities to physically see and handle components of a computer system. Old computers obtained from parents, board technicians, or local industries may be provided for students to disassemble. Alternatively, teachers may open computers in the classroom, without removing parts, to facilitate student observation and discussion. Comparing advertisements, features, and prices of current computer models help students develop analytic and evaluation skills, as well as a knowledge base for making wise computer purchase decisions with their families. In addition, comparisons with older systems help to illustrate technical progress.

Commercial board games should be brought into the classroom for research and analysis. Students should be made aware of the comparative features of games. Identifying game types such as those involving the collection of clues to solve mysteries, accumulation of points to achieve a goal, and competitions to solve puzzles or questions will help students match game features with computer operations. Students should be aware of design process components, including identifying needs and criteria, researching current situations, proposing and analyzing possible solutions, fabricating prototypes, testing solutions against established criteria, and preparing analysis for further developments.

During game production, students should be encouraged to positively highlight Canadian values and culture, with a focus on Canada's multicultural profile, and provide positive roles for all persons including those with disabilities.

Prior Knowledge Required

A working knowledge of computer operations such as word processing, creating graphics, printing and managing files is required. During the game manufacturing stage, teachers will emphasize and implement safety procedures pertaining to the use of hand and power tools for fabrication and repair. It is expected that students have some limited knowledge of creating computer graphics. Students with little or no knowledge in this area may be given the option to hand draw graphics.
This activity derives from the following specific expectations in the Grades 1 to 8 Science and Technology Document: By the end of Grade 3, students will: demonstrate an understanding of the properties of materials that can be magnetized or charged and how materials are affected by magnets or static electric charges. By the end of Grade 4, students will: investigate different ways in which light and sound are produced and transmitted, and design and make devices that use these forms of energy. By the end of Grade 6, students will: investigate ways in which electrical energy can be transformed into other forms of energy (e.g., into light, heat, and sound); identify different types of switches that are used to control electrical devices (e.g., contact, tilt) and explain the key differences among them (e.g., differences in design, use). By the end of Grade 7, students will: demonstrate an understanding of the factors, (e.g. availability of resources) that must be considered in the designing and making of products that meet a specified need. By the end of Grade 8, students will: demonstrate an understanding of the factors that contribute to the efficient operation of mechanisms and systems; demonstrate understanding of the factors that can affect the manufacturing of product, including the needs of the consumer.

Teaching/Learning Strategies

This activity uses a variety of experiential learning strategies, including hands-on fabricating, problem solving design procedures, communicating ideas through graphic design, presenting completed work, writing technical reports, and group designing activities. Individual work includes report writing and vocabulary research. Group activities include brainstorming design and dividing fabrication duties. Final products may be presented within the classroom, or to other classrooms or community groups. Teachers must review all appropriate safety precautions before allowing students to use hand and power tools.

Activity Instructions

1. The teacher will describe the task of designing a board or card game based on the operations and functions of the computer. Students will research and identify the features and commonalties of a variety of board and/or card games, including player icons, control of player movements, methods of chance and skill, and strategies for winning. Games should be brought into the classroom for analysis.

2. Students will identify various input and output devices of the personal computer. The teacher describes the operation of the computer, focusing on input, storage, process, and output.

3. A personal computer will be opened for classroom instruction and discussion. The teacher works with students to identify various components inside a computer and the functions of these components. These components include: motherboard, Central Processing Unit (CPU), BIOS Integrated Circuit (IC), memory ICs, keyboard and mouse ports, the data/address bus, expansion slots, video card, serial and parallel ports, hard drive/floppy controller and drives, CD ROM, sound card, modem or network card, and power supply. The teacher and students compare features and pricing of computers by analysing current advertisements.

4. The teacher describes the roles of the operating system and application software, and data types such as numbers, text, formatted text, and graphics. Students should be encouraged to discuss personal stories of computer viruses, crashes, and "glitches". The teacher may prepare a vocabulary list of

components and functions from class discussions. Alternatively, the teacher may conduct a vocabulary test.

5. Organized in groups, students form companies or teams to design board games based on their research. Students brainstorm key concepts, produce sketches, and write proposals for teacher approval. Alternatively, students may sell or promote their ideas to the teacher and/or class.

6. As teams create games, students combine hand illustrations and computer graphics to produce game graphics and packaging; work with workshop tools to fabricate player pieces, boards and associated materials; use word processors to compose instructions and/or advertising materials. The teacher discusses safety issues and explains cleanup tasks before students begin working with tools.

7. Teams exchange completed games for play. Alternatively, teams present their games to the class or other groups to analyse the quality of finished products and assess how effective they are. These analysis sessions will be used to critique products and suggest improvements in performance and marketability. Students then word process a final report document, outlining the design process and analysis of the end product and optionally including pictures and graphics of their work.

Assessment/Evaluation Techniques

	Level 1	**Level 2**	**Level 3**	**Level 4**
Understanding of concepts TFV 01X	demonstrates limited understanding of computer concepts	demonstrates some understanding of computer concepts	demonstrates considerable understanding of computer concepts	demonstrates thorough and insightful understanding of computer concepts
Thinking/Inquiry TFS 01X TFS 06X	uses thinking skills to identify and solve problems with limited effectiveness	uses thinking skills to identify and solve problems with moderate effectiveness	uses thinking skills to identify and solve problems with considerable effectiveness	uses thinking skills to identify and solve problems with a high degree of effectiveness
Application of Inquiry/design TFS 03X SPV 03X SPS 01X	applies few skills and strategies of an inquiry/design process	applies some of the skill and strategies of an inquiry/design process	applies most of the skills and strategies of an inquiry/design process	applies all or almost all of the skills and strategies of an inquiry/design process
Communication of Information TFV 02X TFS 03X ICV 02X SPS 03X SPS 06X	communicates information with limited clarity	communicates information with moderate clarity	communicates information with considerable clarity	communicates information with a high degree of clarity
application of equipment, procedures and technology SPS 08X ICS 02X ICS 01X	uses procedures, equipment and technology safely and correctly only with supervision	uses procedures, equipment and technology safely and correctly with some supervision	uses procedures, equipment and technology safely and correctly	demonstrates and promotes the safe and correct use of procedures, equipment and technology

Accommodations

This activity can be adapted by varying the extent of research required, depth of detail in computer concepts covered, and quantity of restrictions in game types allowed. Teachers may opt to provide more guidance in the area of game design. As an enrichment activity or extension, alternative projects may include the design of a miniature golf course. Specifically, student teams design and fabricate one of nine golf course holes representing the data path within PCs. Students may also program games on computers using programming languages such as Visual Basic.

Resources

Resources required for this activity include computers that can be opened to examine components, and informational resources for computer terminology and system design, such as libraries, Internet sources, and teaching packages. Other resources include commercial board games, computer graphic software, word processing software, fabrication tools for (but not limited to) wood, plastics, and cardboard.
A free kit, The Journey Inside, is available by calling 1-800-346-3029, or by visiting the following web site: http://www.intel.com/education/journey/index.htm
Vocabulary resources are located at the following web sites: - http://www.howstuffworks.com - http://www.iserv.net/~alexx/glossary.htm (Giant Glossary of Electronic Terminology) - http://www.pcwebopedia.com/ (PC Webopedia)
As well, books and encyclopedia references are available in local libraries.