GRADE: 5
ACTIVITY TITLE: Keep It Hot! / Garde la chaleur!

KEY WORDS:	**MOTS CLÉS:**
insulation	l'isolation
energy	l'énergie
temperature	la temporature
evaporation	l'évaporation
condensation	la condensation
materials	le materiel
change of state	le changement d'état
heat	la chaleur

INTRO: Material Selection for a Product - Changes of state require the addition or removal of heat. Use coffee cups made of various materials to examine the connection between materials choice and product performance. Students could measure how fast ice melts, or for how quickly boiling water cools when placed in the insulated cup.
INQUIRY TYPE: teacher initiated, partially designed; partially student designed, run and tested

MATERIALS RESOURCES:

In the Catalyzer:
thermometers
measuring cups (tri-pour beakers)

Provided by Teacher:
coffee cups made of various materials (e.g., paper, Styrofoam, glass, ceramic, double-cupped, etc.)
standard lid or cover for mug (i.e., piece of cardboard)
hot water
safety goggles
Highly recommended: heat & water resistant gloves and aprons if using boiling water

TARGET PROCESS SKILL: Inquiry: Experimentation (Plan & Conduct Investigations; Collect Data)

STRAND: Understanding Matter and Energy

BIG IDEA:
There are three states of matter.
The properties of materials determine their use and may have an effect on society and the environment.

ENGAGE:
Simulation - Perform the following dramatization for your class.

- Enter the class carrying a cup of coffee (or other suitable liquid, e.g., tea, hot chocolate, etc.). Ensure students are paying attention as you take a sip from the cup. As you sip, immediately make a disgusted face and say "Yuck!" (To be more dramatic, you may want to spit the mouthful out into the garbage.) Complain to your students, "I just poured this cup of coffee not even 10 minutes ago. Why is it cold already!?! I wonder if a different type of cup would keep the coffee hotter longer?"
- Using a Say and Switch tactic as a diagnostic assessment (refer to the Evaluate section below), have students discuss similarities and differences among coffee cups, and a suggestion for a cup that might work better.

EXPLORE:
Prep: Enlarge TM-1: Inquiry Cards - Step 1 onto chart paper. Make multiple copies (one per group).

- Place students into groups of 3 or 4. Give each group a copy of Step 1 from the Inquiry Cards (TM-1), and a selection of different types of cups.
- Explain to students that scientists must keep accurate documentation of their work, and that as a group, they will record their work on the chart.
- Also explain that scientists examine objects/specimens very carefully and in great detail. One way they do this is through their senses. Inform students that they will observe the different cups using the senses of sight and touch. This information should be recorded under the heading "What Did I Observe" (left hand column Step 1 of TM-1). You may choose to have students divide this section up in order to separate observations for each cup examined.
- Follow the observation with time to generate and share questions (right hand column Step 1 of TM-1). Prompt responses with the questions: "What else would you like to know about the cups? What are you curious about? What do you wonder?" Use the think-pair-share tactic to collect responses. Students should be encouraged to list as many questions as they can about the different cups.

(At this point, you may want to remind students of the questioning and observing skills that they worked on previously. Refer to STAGE 1 lessons of the Smarter Science program to review these skills and how they were developed.)

EXPLAIN:
Explain to students that scientists can't always answer their questions by observing. Often scientists need to design experiments or tests in order to answer their questions. The teacher should model this process using a sample testable question.

- To begin, remind the class about the scenario from earlier:
  Teacher prompt: *"Remember earlier I came into class disgusted with a cold cup of coffee? I wondered if a different type of cup would keep my coffee hotter longer. How could I find an answer to my question?*

- Use TM-1: Inquiry Cards (Chart) Steps 2 - 6 to model developing an experiment. (Refer to TM-2: Inquiry Cards - Sample (Reference) for an example of how the cards might be completed.)

- Continue to use a "think aloud" strategy as you work through the inquiry cards with the class. For example when working through Step 3 - Choosing Variables (on the Inquiry Cards), it will be important to discuss how scientists ensure that they have developed a fair test.
  Teacher prompt: *"How can we be sure that any effect on the change in temperature is due only to the material that the cups are made of and not to any of the other variables? How can we ensure that it is not the type or amount of liquid, or the size or type of lid?"*
- Continue to prompt students to understand that all the other things (variables) they initially brainstormed changing (from Part 2(a) - Inquiry Cards) must not be changed in order to ensure a fair test.)
- As a class, continue to work through the remainder of the Inquiry Cards to develop the experiment.

- Step 6 of the Inquiry Cards requires teachers to lead students through a shared writing activity to develop the procedures for the "Test Set-Up" and the "Control Set-Up". Work as a class to record each procedure step by step. Have students consider: how will I answer my question? what will I do? what will I compare my test to? how will I know if the variable has had any effect?

EXTEND:
Assign each group one of the cups to test. They should carry out the experiment, and record results on a class chart. (TM-4 Sample Recording Sheet provides an example of what this class chart could look like.) Students should compare their results to others and discuss possible reasons for any differences in their data. Students should also reflect on the accuracy of their predictions.

Additional Activities:
1. Have students design and build their own cup (i.e., "use skills of technological problem solving to design and build a device that minimizes heat transfer (e.g., a device that keeps an ice cube from melting for as long as possible)").
2. Students reflect on the impact of the materials chosen on the environment e.g., Styrofoam vs. paper.

EVALUATE:

Diagnostic

- Activate and assess prior knowledge using a Think-Pair-Share or Say & Switch instructional tactic. (Refer to TM-3: Say & Switch Description (Reference) for more information.) Place students into pairs. (Each pair should be numbered off - Partner A and Partner B.) Pose the following question to the class: "What do all coffee cups have in common? What type of coffee cup would keep the coffee hotter longer?"
- Have Partner A respond first while Partner B listens. Pairs should switch roles on the teacher's command (so that Partner A listens, while Partner B switches).
- Select sample pairs to share with the whole class what they were discussing. Summarize the ideas of the class. (Do not correct any misconceptions at this time.)

Formative

- The teacher should review and respond to the work of each student as they progress through the lesson.
- Students should record their observations and questions on the inquiry cards (Step 1 of TM-1: Inquiry Cards). (The skills of observation and questioning were emphasized in Stage 1 of the Smarter Science program. The quality of observations and questions can be used as diagnostic information as well as formative. Provide suggestions to students about how these skills could be improved.)
- As students work through the "Extend" section to develop experiments to answer their own questions, teachers should observe student work, dialogue about their ideas and plans, as well as provide specific feedback to improve learning.
- Have students complete a journal entry to reflect on their own learning. Reflections - What does the evidence tell us about how the type of material effects the function of the coffee cup?

BACKGROUND INFORMATION:

Heat always moves from hot objects to cold objects. So the heat from the hot coffee is transfered to the cup and then to the air. Different materials have different heat properties - some materials conduct heat and others insulate. Many of the materials used in coffee cups insulate against heat transfer.

LOOK FORS:

Students are:

- identifying differences of detail in different materials that serve the same function (Stage 1 Skill)
- asking a variety of questions about the materials (Stage 1 Skill)
- recognizing the difference between a testable question and one that cannot be answered by investigation (Stage 1 Skill)
- suggesting how answers to questions of various kinds can be found (Stage 1 Skill)
- making predictions about possible outcomes to investigations based on prior knowledge and data collected from various sources (Stage 1 Skill)
- planning a simple fair test by identifying the variable that has to be changed and the things that should be kept the same (Stage 2 Skill)
- identifying what to look for or what to measure to obtain a result in an investigation (Stage 2 Skill)
- recording and organizing information and results (Stage 2 Skill)

SEQUENCE:

After learning about the three states of matter, and chemical and physical changes, students would be ready to complete this activity.

TEACHING STRATEGIES:

Think Pair Share

Say & Switch

SAFETY:

If using hot water for the test, teachers will need to boil the water and pour it into the cups. Safety equipment (goggles, aprons and water-resistant & heat-resistant mitts) will be required. Water can not be hotter than 60 degrees Celsius. Ensure that cups are in a safe location so that they will not spill and potentially burn a student.

BLACK LINE MASTER[S]:
TM-1: Inquiry Cards (Chart)
TM-2: Inquiry Cards - Sample (Reference)
TM-3: Say & Switch Description (Reference)
TM-4 Sample Recording Sheet (Chart)

TEXT REFERENCES:
Addison Wesley Changes of Matter Text

Science & Tech Curriculum Expectations:
2.1 follow established safety procedures for working with heating appliances and hot materials
2.2 measure temperature and mass, using appropriate instruments
2.4 use scientific inquiry/experimentation skills (see page 12) to determine how the physical properties of materials make them useful for particular tasks
2.5 use appropriate science and technology vocabulary, including *mass*, *volume*, *properties*, *matter*, *physical/reversible changes*, and *chemical/irreversible changes*, in oral and written communication

Mathematics Curriculum Connections:
5m31 estimate, measure, and record perimeter, area, temperature change, and elapsed time, using a variety of strategies
5m35 measure and record temperatures to determine and represent temperature changes over time (e.g., record temperature changes in an experiment or over a season)

Additional Numeracy Activities:
- graph change in temperature for all of the cups (water temperature vs. time)

Language Curriculum Connections:
* working in whole class, small group and/or partner activity
5e5 Active Listening Strategies 1.2 demonstrate an understanding of appropriate listening behaviour by adapting active listening strategies to suit a range of situations, including work in groups
5e14 Interactive Strategies 2.2 demonstrate an understanding of appropriate speaking behaviour in a variety of situations, including paired sharing, dialogue, and small- and large group discussions
5e15 Clarity and Coherence 2.3 communicate orally in a clear, coherent manner, presenting ideas, opinions, and information in a readily understandable form
5e16 Appropriate Language 2.4 use appropriate words and phrases from the full range of their vocabulary, including inclusive and non-discriminatory language, and stylistic devices suited to the purpose, to communicate their meaning accurately and engage the interest of their audience.

* filling in graphic organizer (Inquiry Cards), developing procedure and communicating results
5e51 Classifying Ideas 1.4 sort and classify ideas and information for their writing in a variety of ways

Steps to Inquiry

Step 1: Initiating the Experiment

What did I observe? *(What do you notice about the object(s) or event? Use your senses to describe the object(s) or event.)*	What am I wondering? (What questions or predictions do you have about the object(s) or event?)

Step 2(a): What could I change or vary about the object or the event?

- Brainstorm *(Place sticky notes of the same colour in the squares below.)*

Variable	Variable
Variable	Variable
Variable	Variable

Step 2(b): What could I measure or observe about the object, or event?

- Brainstorm (*Place sticky notes of a new colour in the squares below.*)

Measure / Observe	Measure / Observe

Step 3: **What will I change and not change?**

- Choosing Variables

One thing (variable) I will change:

I will measure or observe this result:

Changed Variable *(Place a sticky note from Part B(i) here)*	o	Measure / Observe *(Place a sticky note from Part B(ii) here)*

Things (variables) I will NOT change:
(What conditions will be held constant so it is a fair test?)
Place remaining sticky notes from Part A here.

Unchanged Variable	Unchanged Variable
Unchanged Variable	Unchanged Variable
Unchanged Variable	Unchanged Variable

Step 4: What is the question I want to explore?

When I change this one variable....

Changed Variable

If I don't change this one variable....

Write your question here:

What will happen to:

Measure / Observe

Write your question here:

Step 5: What is my prediction (what and why)?

Based upon my question, I predict that :

What?

when I change ____
(Changed Variable)

then I predict this will happen to what I will measure or observe:

____ .
(Measure / Observe)

Why?

I think this will happen because ________________________________

____ .

Step 6: How do I test my Prediction?

My Test Set-Up:

Here's how I will change the variable...

(What will I do? How will I change the variable?)

Changed Variable

My Control Set-Up:

Here's how I won't change this variable...

(What will I do? How will I keep the variable the same?)

My Test Steps:

My Control Steps:

References:
Based on Goldsworthy, A. and Feasey, R.(1994) ***Making Sense of Primary Science Investigations****, Hatfield: ASE*
Buttemer, H. "Inquiry on Board" ***Science and Children****, October 2006*

Steps to Inquiry

Step 1: Initiating the Experiment

What did I observe?	What am I wondering?
(What do you notice about the object(s) or event? Use your senses to describe the object(s) or event.)	(What questions or predictions do you have about the object(s) or event?)

Step 2(a): What could I change or vary about the object or the event?

- Brainstorm *(Place sticky notes of the same colour in the squares below.)*

Variable	Variable
Variable	Variable
Variable	Variable

Step 2(b): What could I measure or observe about the object, or event?

- Brainstorm (*Place sticky notes of a new colour in the squares below.*)

Measure / Observe	Measure / Observe

Step 3: What will I change and not change?

- Choosing Variables

One thing (variable) I will change:

Changed Variable

(Place a sticky note from Part B(i) here)

o

I will measure or observe this result:

Measure / Observe

(Place a sticky note from Part B(ii) here)

Things (variables) I will NOT change:

(What conditions will be held constant so it is a fair test?)

Place remaining sticky notes from Part A here.

Unchanged Variable

Unchanged Variable

Unchanged Variable

Unchanged Variable

Unchanged Variable

Unchanged Variable

Step 4: What is the question I want to explore?

When I change this one variable.... → **Changed Variable** ← If I don't change this one variable....

Write your question here:

What will happen to:

Measure / Observe

Write your question here:

Step 5: What is my prediction (what and why)?

Based upon my question, I predict that :

What?

when I change ____
(Changed Variable)

then I predict this will happen to what I will measure or observe:

____ .
(Measure / Observe)

Why?

I think this will happen because ________________________________

____ .

Step 6: How do I test my Prediction?

<u>My Test Set-Up:</u>

Here's how I will change the variable...

(What will I do? How will I change the variable?)

Changed Variable

<u>My Control Set-Up:</u>

Here's how I won't change this variable...

(What will I do? How will I keep the variable the same?)

My Test Steps:

My Control Steps:

References:

Based on Goldsworthy, A. and Feasey, R.(1994) ***Making Sense of Primary Science Investigations****, Hatfield: ASE*

Buttemer, H. "Inquiry on Board" ***Science and Children****, October 2006*

Steps to Inquiry

Step 1: Initiating the Experiment

What did I observe?

(What do you notice about the object(s) or event? Use your senses to describe the object(s) or event.)

Styrofoam Cup - white - made up of tiny, individual pieces - fairly firm - easy to rip pieces off	Tim Horton's Cup - brown with logo - seam runs the length of the cup along one side - white lip around the top - easy to bend or rip
Stainless Steel - hard - shiny - black, plastic handle connected to black lip around the top - wider section at top, narrower bottom half	Glass - hard - heavy - transparent - glass handle
Porcelin - dark green colour - matching handle - funnel shape	

What am I wondering?

(What questions or predictions do you have about the object(s) or event?)

< Which cups cost the most to make?

< How much coffee does each cup hold?

< Will the cups keep other liquids cold (e.g., juice, pop, etc.)?

< Does the size of the cup effect the coffee's temperature?

< What are the advantages of one cup over the other?

< Isn't Styrofoam bad for the environment?

< Which one will keep the coffee hotter longer?

Step 2(a): What could I change or vary about the object or the event?

- Brainstorm *(Place sticky notes of the same colour in the squares below.)*

Temperature of Liquid	Amount of Liquid
Type of Liquid	Size of Lid
Type of Cup	Lid Material

Step 2(b): What could I measure or observe about the object, or event?

- Brainstorm (*Place sticky notes of a new colour in the squares below.*)

Change in Temperature	

Step 3:

What will I change and not change?
- Choosing Variables

One thing (variable) I will change: I will measure or observe this result:

Type of Cup	o	**Change in Temperature**

Things (variables) I will NOT change:
(What conditions will be held constant so it is a fair test?)
Place remaining sticky notes from Part A here.

Temperature of Liquid	Amount of Liquid
Type of Liquid	Size of Lid

Lid Material

Step 4: What is the question I want to explore?

When I change this one variable....

Type of Cup

If I don't change this one variable....

Write your question here:
When I change the type of coffee cup, what happens to the change in temperature of the liquid?

What will happen to:

Change in Temperature

Write your question here:
When I don't change the type of cup, what happens to the change in temperature of the liquid?

Step 5: What is my prediction (what and why)?

Based upon my question, I predict that :

What?

when I change ________***the type of cup***____________________________
(Changed Variable)

then I predict this will happen to what I will measure or observe:

__***that the liquid will stay hotter longer in the stainless steel mug***.
(Measure / Observe)

Why?

I think this will happen because ***my parents always use this type of cup***

for travelling in the car with______________________________ .

Step 6: How do I test my Prediction?

My Test Set-Up:

Here's how I will change the variable...

(What will I do? How will I change the variable?)

Cup Material

My Control Set-Up:

Here's how I won't change this variable...

(What will I do? How will I keep the variable the same?)

My Test Steps:

1. Obtain 150 mL of water at approx. 60°C.
2. Pour the water into the first type of cup.
3. Record the exact temperature of the water.
4. Over the next 15 minutes record the temperature of water every minute.
5. Carefully empty out the water.
6. Run the procedure again to verify your results (if time allows).
7. Repeat procedure using a different type of cup.

My Control Steps:

Follow the procedure outlined under "My Test Steps" using original coffee cup.

References:
Based on Goldsworthy, A. and Feasey, R.(1994) ***Making Sense of Primary Science Investigations****, Hatfield: ASE*
Buttemer, H. "Inquiry on Board" ***Science and Children****, October 2006*

Say and Switch

(Grades K to 12)

(<u>Cooperative Learning</u>, page 204 Barrie Bennett - Carol Rolheiser - Laurie Stevahn)

Description

- a cooperative structure in which partners sequentially take turns responding to a question or discussion topic at signalled (and sometimes unpredictable) intervals.

Procedures

Step 1 Place students into partners.

Step 2 Identify the discussion topic.

Step 3 Identify the signal when roles will switch.

Step 4 Cue first partner to respond to question/topic.

Step 5 First partner shares while the second partner listens carefully.

Step 6 Use the signal to switch roles so the other partner shares while the first partner listens.

Step 7 Several switches may take place throughout the period of time allotted for discussion.

Prior Knowledge Required

- content for discussion
- active listening skills
- taking turns

Classroom Management Considerations

- remind students to use appropriate voice volume so others can hear their partner
- thought should be put into placement of partners around classroom
- thought should be put into who will work well as partners in this situation

Materials

- bell or some kind of noise-maker to signal the switch

Key Benefits	Effective Uses	Extensions / Modifications
• fosters oral communication skills and active listening skills • promotes student participation	• use as a structure for reviewing, rehearsing, or checking for understanding	• at the end of the session, have students summarize their partners' thoughts or their own thoughts orally with the class or in written form as a check for understanding • in Step 6 when the switch occurs, the challenge is for the second partner to complete or continue the first partner's line of thought before introducing new ideas

Teacher Notes and/or Reflections:

Sample Recording Sheet

Time (min)	Temperature of 150 mL of Water (°C)				
	Cup A	Cup B	Cup C	Cup D	Cup E
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
Change in Temperature (°C)					

GRADE: 5
ACTIVITY TITLE: Spin and Save / Economie et Eolienne

KEY WORDS:	**MOTS CLÉS:**
kinetic energy	l'énergie kinétique
wind	le vent
convection	la convection
turbine	la turbine
renewable energy	l'énergie renouvelable
structure	la structure
stable	stable
voltage	le voltage
power	le pouvoir
electricity	l'électricité
voltmeter	le voltimètre

INTRO:
In this lesson, students will design and build a model wind turbine. Electricity will be generated by the spinning of a small hobby motor, and that elctricity will be measured using a volt meter. Students will be challenged to build a model that is as efficient as possible, thus generating the greatest voltage.

INQUIRY TYPE: teacher initiated, partially designed; partially student designed, run and tested

MATERIALS RESOURCES:
<u>In the Catalyzer:</u>
hobby motors
voltmeter
wire X 10m
jinx wood (found in intermediate kit)
wooden dowel (found in intermediate kit)
gussets (found in intermediate kit)
glue guns & glue sticks (found in intermediate kit)

<u>Provided by Teacher:</u>
cardboard
straws
cardstock
plastic containers
goggles
corks
stiff rulers
paper clips
tape
scissors
rubber bands
box fans or hand held hair dryers for testing purposes

TARGET PROCESS SKILL: Technological Problem Solving (Develop Possible Plans; Select & Carry Out the Plan)

STRAND: Earth & Space systems (Structures & Mechanisms)

BIG IDEAS:
- Choices about using energy and resources have both immediate and long-term impacts.
- Energy sources are either renewable or non-renewable.
- Energy can neither be created nor destroyed but it can be transformed.

ENGAGE:

- Begin the lesson with a discussion on wind turbines; their purpose, their design; their location (reference can be made to the wind turbines found in the Port Burwell area)
- View all or a combination of the following videos to prompt discussion on various models of wind turbines.

Energy from the Wind
- wordless video of a wind turbine in action allows for discussion and student questioning
http://www.youtube.com/watch?v=9gCeNCnWZhE

Aerotecture Wind Turbine
- a vertical axis wind turbine
- this provides students with different design ideas beyond the common three blade tower type of wind power generator
http://www.youtube.com/watch?v=ZQPQkhDE8eY&mode=related&search

Encore Clean Energy SideWinder Wind Turbine
- another design for a vertical axis wind turbine to get students thinking creatively.
http://www.youtube.com/watch?v=MZhHCyuEEDk&mode=related&search

- Possible follow up questions for discussion:
  - Which turbine do you think is the most efficient? Why?
  - Which model would be best at catching prevailing winds?
  - Which model would be the easiest to build? ...the easiest to maintain?

EXPLORE:

- Present "the Situation" to students as outlined on TM-1 Design Brief. Make sure students understand the goal of the task. (Note: An example of the support frame design is given on the Design Brief. The idea is that all students would create the same support frame, but would design different heads for the windmill - number of blades, size of blades, shapes of blades. Depending on your comfort level and students skill level with design and build, you may choose to allow students to design their own support frame.)

- Use a "placemat" strategy to have students develop possible sketches of their design. Put students into groups of 3 or 4. Provide each group with a large piece of paper. Have groups divide the paper into equal sections based on the number of members in the group, and put a square or circle in the centre of the paper.
- Instruct students to draw sketches of their windmill design in their section of the placemat. Remind students that these are just sketches - drawn roughly, and quickly without a lot of detail - just the basic structure of the design.
- Have students share their designs within their groups. A round robin tactic (where each child takes turns sharing their design) will help to organize the sharing. Have students justify why they have think their particular design will work. "I think my design will work because....."

(As an alternative, you may choose to have students work individually using Part 2 - Thumbnail Sketches of the Design Brief.)

- In their groups, have students record the strengths of their designs in the centre of the placemat. These can be shared with the whole class.

EXPLAIN:

- Using Part 3 of the Design Brief, explain to students the importance of sketching possible designs (thumbnail sketches) before making a decision about what to build.
- Emphasize that even though at this point they will be finalizing the design that they would like to build, changes can still be made throughout the building process.

- Have students design and build their windmill by working through Parts 3 & 4 of the Design Brief. (Teacher support should be given as needed. Extra adult volunteers may be useful during the construction phase.)

EXTEND:

- Students test their design to evaluate its success. Encourage them to use the chart provided on Part 5 of the Design Brief to keep track of their results.
- You may choose to have students complete Part 6 (or sections of Part 6) from the Design Brief to reflect on their learning.

EVALUATE:

Diagnostic:

- Activate and assess prior knowledge using a "Thumbs It" tactic. Have students respond to questions or statements given using the position of their thumb.
    - Thumbs Up - If student feels they know a lot about the particular topic or agrees with the statement given.
    - Thumbs Sideways - If student feels they know some about the particular topic, or is unsure
    - Thumbs Down - If student feels they know very little about the particular topic, or disagrees with the statement given.
- This activity will quickly assess the collective prior knowledge of the group as well as any misconceptions the students may have. You may choose to have some students respond orally to the statements/questions so that students know that they could be called upon at any time.
- Some statements could include:
    - There are a variety of forms of energy.
    - Energy sources are either renewable or nonrenewable.
    - Energy can not be created nor destroyed. It is only transformed.
    - Energy use impacts our environment.
    - Technological problem-solving involves planning or designing before building and testing the device or object.

Formative:

- As students are working through the technological problem-solving process, the teacher should circulate and note students skill levels in the designing, building and testing of the model. (The teacher will observe and gather anecdotal evidence of student understanding of the technological problem-solving process.)
  Consider:
    - Do the students take note of the differences in the various wind turbines and what possible influences their design differences may have on their energy production?
    - During planning of the model do the students hypothesize the influence of blade number and size on the output of energy?
    - Is the student able to identify the the variable that has to change(Blade size and number) and the things that should be kept the same(wind) for a fair test?

- Completed design briefs, especially part 6 will enable you to assess students understanding of the task.

BACKGROUND INFORMATION:

Wind power is a renewable energy source used to generate electricity by converting wind energy into useful mechanical energy. In the simplest of terms, wind power is generated through the use of a turbine, usually mounted to a tower. The wind turns the blades of the turbine. This turns a rotor shaft. This produces mechanical power used to drive an electric generator.

For additional information be sure to check out the Kid Wind Project website. Easy to read and understand information related to electricity, renewable energy and wind power basics. (http://kidwind.org/lessons/teachers.html)

LOOK FORS:

(Taken from the Continuum for Technological Problem-Solving Skills, Ontario Curriculum Grades 1-8: Science & Technology 2007, pg. 17)

Students:

- identify practical problems to solve in the community
- identify possible solutions to a practical problem and explain how each might solve the problem
- selects a possible solution to implement, and provides reason for the choice
- outlines (individually or in small groups) the steps of a plan, including labelled drawings and/or diagrams, to solve the problem

- carries out the pre-determined plan (individually or in small groups)
- designs, builds and tests (on the basis of pre-determined criteria) a device or an object to solve the problem
- records results in a variety of ways

SEQUENCE (where in the unit does this lesson best fit?):
This design lesson should follow lessons on renewable and non-renewable energy sources.

TEACHING STRATEGIES:
placemat
round robin

SAFETY:
All designs should be approved by teacher before construction can begin. Instruction should be given on how to use special tools (e.g., saw, mitre box, hand drill, etc.). Wear goggles during all building and testing of the turbines. Instruction should be given on the proper use of box fans and blow dryers.
Students should be carefully monitored while drilling, cutting and assembling of their designs. Hot glue guns should be used by adults only.

BLACK LINE MASTER[S]:
TM 1 Design Brief (student handout or overhead)

TEXT REFERENCES:

Additional References

Kid Wind Project
This site has a wealth of information and activities concerning wind turbines. Numerous links to other sites and activities.
http://www.kidwind.org

Canadian Wind Energy Association
Includes a brief history of wind power, the building of wind turbines, and the impact of this technology on a small rural community. A great video link to the Manitoba St. Leon wind farm project.
http://www.canwea.ca/videoclips.cfm

Re-Energy.ca
This site is maintained by The Pembina Institute. It contains lessons on the history of wind power, as well as lessons on wind energy. An alternative lesson building a vertical wind turbine using a plastic pop bottle and magnets is also found there.
http://www.re-energy.ca/t_windenergy.shtml

Science and Technology Curriculum Expectations:
2.1 follow established safety procedures for using tools and materials
2.3 use technological problem-solving skills (see page 16) to design, build, and test a device that transforms one form of energy into another
2.4 use appropriate science and technology vocabulary, including *energy*, *heat*, *light*, *sound*, *electrical*, *mechanical*, and *chemical*, in oral and written communication
3.2 identify renewable and non-renewable sources of energy
3.3 describe how energy is stored and transformed in a given device or system
3.4 recognize that energy cannot be created or destroyed but can only be changed from one form to another

Mathematics Curriculum Connections:
5m1 5m2 5m3 5m5 5m6 5m7 5m71 5m72 5m75 6m76 5m79 5m80

Data Management:
Using the different speeds on the hand dryer and box fan the students can record the electrical output on the voltmeter. These differences would be recorded using bar graphs to make easy comparisons. Additional comparisons can also be made

with blade size and number.

Language Curriculum Connections:
5e1 5e2 5e3 5e4 5e5 5e14 5e15 5e20 5e77 5e78 5e79

Design Brief

Part 1

The Situation:
In the future people will need to find cleaner sources of energy. Wind and moving water are both clean sources of energy. Windmills and water wheels can be used to capture the energy from the wind and moving water. Windmills and water wheels have paddles that are attached to a wheel. The wheel spins when the paddles are hit by the wind or water. The moving wheel can then make other devices move.

Your Task:
You will build a free standing support frame that will support and be of sufficient height to allow the windmill to run freely.

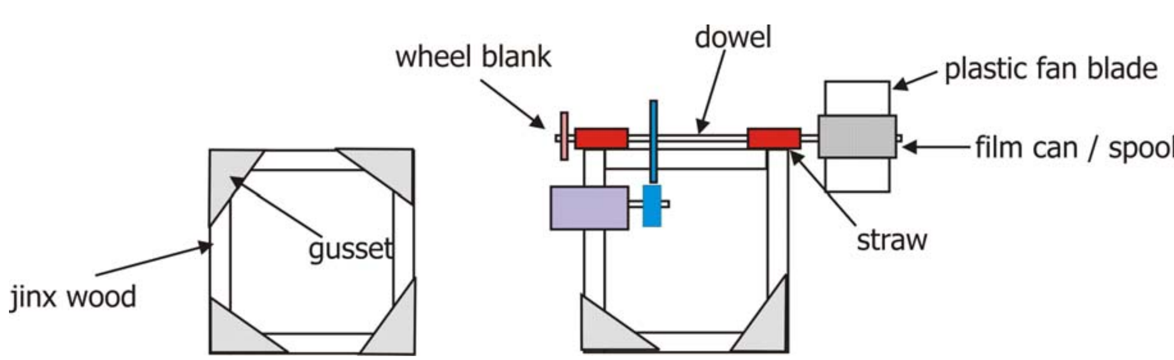
The stand must be stable enough to withstand the force of the wind, or the moving water that will be used to turn the paddles.

A generator will be attached to the drive shaft of the paddle wheel with gears and used to convert the motion of the paddle wheel into electricity.

The support frame must hold the motor and gear assemble in a safe and secure manner.

Materials

- 1cm x 1cm jinx wood
- straw
- dowel
- film can or spool
- plastic margarine containers and lids
- gears
- generator (motor)
- duct tape
- white glue
- straw
- paper gussets



Part 2

Thumbnail Sketches

Using the sheet provided:

- draw three different thumbnail sketches of your windmill design.
- choose one of the sketches which you believe will work best.
- explain in words why you have chosen to test this design in box #4.

Remember, a thumbnail sketch is a rough pencil sketch of 3 different ideas for the design. This should include the basic structure of the design.

Design #1	Design #2
Design #3	I have chosen to test design #______ because:_________________________ ________________________________ ________________________________ ________________________________ ________________________________ ________________________________

PART 3:

Pre-Construction Sketch

A pre-construction sketch is a design based on one of your thumbnail sketches. It should include enough detail to help build your windmill. Your pre-construction sketch should include:

- locations of the main parts (wheels, axle, pulley)
- measurements (height, width, and length)
- appropriate science and technology vocabulary

Although this drawing will assist you with the hands-on building phase, changes in your design of your windmill are to be expected as you build it. You may find it helpful to identify the parts of your windmill; however, labelling your drawing is not necessary. Use pencil please.

List materials, tools and equipment you need to create your windmill. Use your pre-construction drawing to help you. Use scientific/technological vocabulary when listing your materials.

PART 4

Explanation of Procedures

Using the appropriate scientific/technological vocabulary, list the steps you followed to build your windmill.

- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________

*If necessary, use the back of the page.

PART 4 (CONTINUED)

Post-Construction Drawing

On this page, you must include a detailed diagram of your windmill including labels. Use scientific/technological vocabulary to describe the mechanical systems that you have used to make your windmill more. Don't forget to add the necessary measurements and design details.

The final drawing may be different from your pre-construction sketch due to possible modifications you have made throughout the actual design process.

**Use pencil for your drawing.*

PART 5

Trials and Modifications Recording Sheet

When the construction of your final design is complete, test your windmill. Each time you test your windmill, you must fill in the following observation chart.

T	Observations	Problem	Solution
1			
2			
3			

*If necessary, use the back of the sheet to record more trials.

PART 6

Design Reflection

Answer the following questions using complete sentences. Remember to use appropriate scientific/technological vocabulary when describing your ideas.

1. Describe how the windmill was able to move using energy from wind and moving water to produce motion. Use the appropriate scientific/technological vocabulary to explain the process.

- Writers from the *Energy of the Future* magazine need some ideas for an upcoming article on how to generate “environmentally friendly” energy. List as many suggestions as you can to help them.

3. List some of the advantages and disadvantages of energy produced from wind and moving water in real life:

Advantages	Disadvantages

4. What do you think the design challenges would be when building a full-sized wind mill? List as many as you can.

5. If I were to do this project again, I would: