Turning Up The Heat!

A Unit of Study Investigating Heat Energy

Including:

Source Of All Energy
Changing States Of Matter
Heat Transfer: Conduction
Heat Transfer: Convection
Heat Transfer: Radiation
Heat And Volume
Insulation
Design Challenge: Tree House

An Integrated Unit for Grade 7

Written by:

The Curriculum Review Team 2005

Length of Unit: approximately: 15 hours

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An Integrated Unit for Grade 7
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Unit Context

Students will learn that Heat is an integral part of life. They will investigate its properties and how these are related to temperature control and measurement. From the initial activity, the students will realize that all forms of heat energy (electrical, solar, natural, etc.) come from the miracle of creation. Throughout the unit, students will demonstrate the morals of "a responsible citizen who respects the environment and uses resources wisely (CGE 7i - Catholic Graduate Expectation). "

The students will complete all of the experiments and activities which will assist them in their role as junior energy consultants whose task will be to design a "high tech tree house." They will consistently connect the learned knowledge to the world outside the classroom. The culminating task not only considers the newly learned knowledge, but it also draws upon the students' prior knowledge, their personal experiences, and observations of the world.

Catholic Graduate Expectations:
CGE 2c - presents information and ideas clearly and honestly and with sensitivity to others.

CGE 5a - works effectively as an interdependent team member.

CGE 5e - respects the rights, responsibilities and contributions of self and others.

CGE 5f - exercises Christian leadership in the achievement of individual and group goals.

CGE 5g - achieves excellence, originality, and integrity in one's own work and supports these qualities in the work of others.

CGE 5b - thinks critically about the meaning and purpose of work.

Unit Summary

Students will investigate how heat affects all aspects of life from basic survival to the compositional changes of matter. Students will participate in various activities and investigations whereby they will experience firsthand the effects of heat. Catholic expectations are integrated throughout the student activities and form the foundation for the entire unit of study.

The unit is divided into three general categories:

1. Investigations;
2. Application of learned knowledge;
3. Putting it all together.

Working through the investigations, students will experience first hand the key elements of Heat. They will take part in a range of investigations demonstrating molecular motion, Particle-theory, conduction, convection, radiation, changing states of matter, insulation and the effects of heat on volume.

Students will apply knowledge gained from investigation to real life. They will be given the opportunity to demonstrate mastery of the expectations through all subtasks.

A "glossary of key terms" has been provided for reference purposes.

Finally, the students will experience the connection between the learned knowledge and the world outside of school in the culminating task.

Culminating Task Assessment

The students will be given the following challenge:

Your group of junior energy consultants has entered a contest to design an energy-efficient tree house. Your group is required to ensure that this project responds to the criteria of energy efficiency and conservation of thermal energy. In conclusion, your team must present its testing methods and propose a model which best exemplifies the highest standards of energy efficiency and conservation of thermal energy. Be prepared to justify your method of choice, as well as give a detailed floor plan of the tree house. You will also be required to present the potential positive and negative impacts that your development could have on the environment and community. Does the project provide for the use of renewable resources rather than non-renewable resources? Is there potential for the maximization of flow resources, e.g., sunlight, wind? Does the construction of the project promote the preservation of the ecosystem and animal habitat?

Summative assessment: A "student written report" will be generated from this activity (i.e., floor plan, recommendations, and diagrams). See "Research Rubrics 1 and 2."

Catholic Graduate Expectations:
CGE 7i - respects the environment and uses resources wisely.
• Within the scope of this expectation the students must bear in mind pollution control and the use of finite natural resources.

CGE 2e - uses and integrates the Catholic faith tradition, in the critical analysis of the arts, media, technology and information systems to enhance the quality of life.
• Students must consider the implications of technology and the implications of man made energy resources on our environment and our quality of life.

Links to Prior Knowledge

The students should be familiar with the following concepts:

• What is energy?
The students should be able to define energy as:
i the capacity for work or vigorous activity;
ii usable heat or power;
iii the capacity of a physical system to do work.

• Different types of energy
The students should be able to identify various forms of energy (such as mechanical, electrical, radiant, chemical, nuclear, etc.).

• Sources of energy (oil, waterfalls, wind, solar, etc.)
The students should be able to identify sources of energy forms such as water for hydroelectric power, the wind for wind turbine generators, the sun for solar energy, petroleum products and natural gas, etc.

• God as the Creator (including energy)
Ultimately students should realize that the source of all energy is part of the miracle of creation.

Considerations

Notes to Teacher

Ideally, investigations should be completed in groups of four. This allows for all students to take an active part in all investigations while ensuring that there are enough students to complete assigned tasks/roles. Further, many of the subtasks effectively integrate expectations from the English, Arts, and Data Management curriculum strands.

The culminating task should be explained to the students at the beginning of the unit. This allows students to keep separate notes, questions, reminders, logs, journal entries, etc. which they may need to complete the culminating task. The teacher should also make continuous reference to the culminating task as the students progress through the unit. A suggestion for teachers is to have the students keep a separate section of their notebook as a log section for the culminating task. The students and the teacher can use this section to highlight key points throughout the unit which are essential to the successful completion of the culminating task.

It is expected that teachers will have already reviewed with their students the proper safety precautions when working with science equipment (e.g., hot plates). Safety is the first priority.

Formative and Summative Assessment are achieved through the cooperative group activities, and through the "Analysis" and "Relating Science and Technology" questions present throughout the unit.

Unit Timeline

Subtask 1: Two classes to complete the lesson

Subtask 2: Two classes to complete the lesson

Subtask 3: One class to complete the lesson
You may wish to add an additional class at this point for research. The students may use this time to research questions regarding the previous investigations and link the answers to such questions to the culminating task.

Subtask 4: One class to complete the lesson

Subtask 5: One class to complete the lesson
You may wish to add an additional class at this point for research. The students may use this time to research questions regarding the previous investigations and link the answers to such questions to the culminating task.

Subtask 6: One class to complete the lesson

Subtask 7: Four classes to complete the lesson
You may wish to add an additional class period at this point for research. The students may use this time to research questions regarding the previous investigations and link the answers to such questions to the culminating task.

Culminating Task: Four classes to complete the lesson

Turning Up The Heat!

A Unit of Study Investigating Heat Energy An Integrated Unit for Grade 7

1 Source Of All Energy

These investigations will be completed over a span of two lessons.

Lesson 1

Students will brainstorm all of the various forms of energy in existence today. They will create a concept map or graffiti poster illustrating how these forms of energy can be transformed into heat energy. Also, through the examination of various household heating devices, the students will examine the differences between heat and temperature. The students will then explore the many different sources of energy, ultimately discovering that all of these forms of energy come from the miracle of creation.

Lesson 2

Students will view a video on Heat to serve as an introduction and preview to the unit. After viewing the video, the students will be introduced to the culminating task so that they will see the full scope of the unit.

Catholic Graduate Expectations:
CGE 7i - respects the environment and uses resources wisely.

2 Changing States Of Matter

In groups, the students will complete an investigation on how heat and temperature can change the physical structure of matter (i.e., changing solids to liquids, solids to gas, and liquids to gas). Through their investigation, the students will make observations allowing them to generate results in the form of tables, graphs, charts, and diagrams. The students will also apply these results to real-life situations and link the concepts learned to the culminating task.

3 Heat Transfer: Conduction

In groups, the students will complete an investigation on the conduction of heat. They will identify which type of matter is a better conductor of heat and the process by which heat is transferred outward from its source. Through their investigation, the students will make observations allowing them to generate results in the form of tables, graphs, charts, and diagrams. The students will also apply these results to real life situations and link the concepts learned to the culminating task.

Catholic Graduate Expectations:
CGE 5a - works effectively as an interdependent team member.

CGE 5e - respects the rights, responsibilities, and contributions of self and others.

CGE 5f - exercises Christian leadership in the achievement of individual and group goals.

CGE 5g - achieves excellence, originality, and integrity in one's own work and supports these qualities in the work of others.

4 Heat Transfer: Convection

In groups, the students will complete an investigation on the convection of heat. They will identify convection as a process of heat transfer. Through their investigation the students will make observations allowing them to generate results in the form of tables, graphs, charts, and diagrams. The students will also apply these results to real life situations and link the concepts learned to the culminating task.

The students will identify convection as one of God's natural creations.

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CGE 5g - achieves excellence, originality, and integrity in one's own work and supports these qualities in the work of others.

5 Heat Transfer: Radiation

In groups, the students will complete an investigation on the radiation of heat. They will identify radiant energy as yet another process of heat transfer. Through their investigation, the students will make observations allowing them to generate results in the form of tables, graphs, charts and diagrams. The students will also apply these results to real-life situations and link the concepts learned to the culminating task.

The students will identify the sun as the greatest source of radiant heat energy. They will explore how the sun is used in the water cycle and in creating convection currents. The students will identify how radiant heat energy from the sun allows for the survival of all plants and animals.

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CGE 5g - achieves excellence, originality, and integrity in one's own work and supports these qualities in the work of others.

6 Heat And Volume

In groups, the students will investigate the effects of heating and cooling on the volume of solids, liquids, and gases. Through their investigation the students will make observations allowing them to generate results in the form of tables, graphs, charts, and diagrams. The students will also apply these results to real-life situations and link the concepts learned to the culminating task.

Catholic Graduate Expectations:

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7 Insulation

All life on earth relies on heat. If plants and animals get too hot or too cold, they may perish. Animals use nature to control their heat transfer. Humans use what they learn from observing nature to develop technologies to control heat transfer. In groups, the students will design and build a container that will keep an ice cube frozen for the longest time possible.

The students will explore how the earth is naturally insulated. They will also contemplate how we, as humans, are responsible for global stewardship and care for the planet God has provided for us.

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CGE 5a - works effectively as an interdependent team member.

CGE 5e - respects the rights, responsibilities and contributions of self and others.

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CGE 5g - achieves excellence, originality, and integrity in one's own work and supports these qualities in the work of others

8 Design Challenge: Tree House

The students will be given the following challenge:

Your group of junior energy consultants has entered a contest to design an energy-efficient tree house. Your group is required to ensure that this project responds to the criteria of energy efficiency and conservation of thermal energy. In conclusion, your team must present its testing methods and propose a model which best exemplifies the highest standards of energy efficiency and conservation of thermal energy. Be prepared to justify your method of choice, as well as give a detailed floor plan of the tree house. You will also be required to present the potential positive and negative impacts that your development could have on the environment and community. Does the project provide for the use of renewable resources rather than non-renewable resources? Is there potential for the maximization of flow resources, e.g., sunlight, wind? Does the construction of the project promote the preservation of the ecosystem and animal habitat?

Summative assessment: A "student written report" will be generated from this activity (i.e., floor plan, recommendations, and diagrams). See "Research Rubrics 1 and 2."

Catholic Graduate Expectations:

CGE 7i - respects the environment and uses resources wisely.

- Within the scope of this expectation the students must bear in mind pollution control and the use of finite natural resources.

CGE 2e - uses and integrates the Catholic faith tradition, in the critical analysis of the arts, media, technology and information systems to enhance the quality of life.

- Students must consider the implications of technology and the implications of man made energy resources on our environment and our quality of life.

Turning Up The Heat!

A Unit of Study Investigating Heat Energy **An Integrated Unit for Grade 7**

Description

These investigations will be completed over a span of two lessons.

Lesson 1

Students will brainstorm all of the various forms of energy in existence today. They will create a concept map or graffiti poster illustrating how these forms of energy can be transformed into heat energy. Also, through the examination of various household heating devices, the students will examine the differences between heat and temperature. The students will then explore the many different sources of energy, ultimately discovering that all of these forms of energy come from the miracle of creation.

Lesson 2

Students will view a video on Heat to serve as an introduction and preview to the unit. After viewing the video, the students will be introduced to the culminating task so that they will see the full scope of the unit.

Catholic Graduate Expectations:
CGE 7i - respects the environment and uses resources wisely.

Expectations

7s73 A	– identify different forms of energy that can be transformed into heat energy (e.g., mechanical, chemical, nuclear, or electrical energy);
7e51	• contribute and work constructively in groups;
7s55 A	– distinguish between the concept of temperature and the concept of heat (e.g., temperature is a measure of the average kinetic energy of the molecules in a substance; heat is thermal energy that is transferred from one substance to another);
7s70 A	– recognize heat as a necessity for the survival of plants and animals;
7s75 A	– describe and explain issues related to heat pollution, including both positive and negative aspects (e.g., industrial processes and generation of electricity cause heat pollution of large bodies of water);

Groupings

Students Working In Small Groups
Students Working As A Whole Class

Teaching / Learning Strategies

Brainstorming
Collaborative/cooperative Learning
Homework
Numbered Heads

Assessment

Formative assessment of student graffiti posters and subsequent discussion.

Formative assessment of student responses to "Analysis" questions on the Student Investigation Page. (See blackline master "Source Of All Energy" in resources tab for the sample table the students will complete.)

Formative assessment of cooperative group work (see "Cooperative Group Work" rubric in the resources tab).

Assessment Strategies

Classroom Presentation
Performance Task

Questions And Answers (oral)

Assessment Recording Devices

Anecdotal Record

Teaching / Learning

Each student will be given an investigation page which includes all safety precautions, a material list, step-by-step procedures to complete the investigation, an analysis activity, application questions relating science and technology to the world outside of school, and inquiry questions connecting the learning expectations to the culminating task. (See blackline master, "Source Of All Energy," found in the resources tab for this investigation page).

Ideally, students should complete the following investigation in groups of four; however, the teacher may wish to complete the investigation as a class demonstration due to safety concerns and/or limited equipment. It is important for the teacher to continuously circulate among the students, assisting them in meeting the desired expectations.

Lesson 1

Procedure for the Investigation

1. Draw a circle in the centre of your paper and leave it empty for now.

2. Brainstorm common household items which use energy. Record these items on the outer edges of your paper using a black marker.

3. For each item on your paper, decide as a group which form (type) of energy the item uses. Record the form of energy under the item using a blue marker.

4. Exchange papers with another group.

5. Determine and record, as a group, the source of energy for each item and its respective form of energy; for example, a solar calculator uses radiant energy which comes from the sun or equivalent light source. Record the source of energy under the form of energy using a red marker.

6. Connect all of the items - forms of energy and the sources of energy - to the circle in the centre of the paper using the green marker.

7. Exchange papers again with another group.

8. Look at all of the sources of energy on your paper. Decide as a group from where these sources of energy originate. Who is responsible for creating them? Write your answer in the circle using the purple marker. The teacher may need to assist the students in discovering that all the sources of energy have come from the miracle of creation.

9. Tape your graffiti poster to the chalkboard.

10. Complete the analysis activity on the investigation page for homework.

Lesson 2

1. Share, as a class, the homework from the previous lesson. Have students read their responses to the class. Discuss as a class the student responses and reaffirm that the sources of energy have indeed come from the miracle of creation.

2. Write the words "Heat" and "Temperature" on the blackboard.

3. Brainstorm a list of household "heat sources." Ask the students to explain the difference between the two terms as they relate to each "heat source."

4. Explain and/or illustrate the differences between the two concepts as needed (see subtask notes). This should briefly introduce them to the "Particle Theory."

5. View a video on heat. It will serve as an excellent springboard for the balance of the unit.

6. After viewing the video, discuss with the class the sources of energy the students identified in the previous lesson. Split the class into groups and have each group generate a list of pros and cons for each source of energy, keeping in mind any environmental concerns. Students should be able to answer the question, "Would life exist as God intended without heat?"

Adaptations

Extra Support

- Group approach to this investigation will help. Numbered heads is very effective.

ESL Students

- Encourage ESL students to assume roles that are not language dependent (taking measurements, recording data, drawing a labeled diagram, etc.)

Resources

Source of all energy 1_Source of All Energy.cwk

Heat * Energy Disney Educational Production 1995

material list for subtask

Notes to Teacher

Background information

Define the difference between Heat and Temperature. "Temperature" is a measure of the average kinetic energy of the molecules in a substance. "Heat" is thermal energy that is transferred from one substance to another. For the "heat sources" blackline example, heat is being transferred from the stove burners to the cold water and to the air inside the oven. It is also being transferred from the dryer coils to the air inside the drum. This transfer of heat causes the water or air particles to move about rapidly. This increased motion of the particles generates a rise in temperature.

The many different sources of energy:

Solar Power - is the original energy source.

Wood - when cut and burned, releases its stored energy in the form of heat. Many homes are heated with wood-burning stoves.

Fossil Fuels - when prehistoric animals and plants perished, their remains collected under many layers of earth and, over time, they decomposed into a source of fuel. The energy stored within the remains of these plants and animals is referred to as "fossil fuel." The following three energy sources come from prehistoric fossils.

Coal - is burned to heat homes and run electrical machinery.

Oil - is burned to fuel motor vehicles and to provide for home heating.

Natural Gas - provides for home heating.

- It should be noted that most of the energy we use comes from these fossil fuels, which raises the issue of pollution control.

Other Energy Sources:

The following energy sources do not derive from the sun. They come from other aspects of the earth's ecosystem.

Water - is not an energy source, but is used to generate energy. Water flowing downhill is used to run turbines, which generate electricity. This is called hydroelectric power.

Geothermal Energy - is generated when pockets of boiling water under the earth's surface send steam to the surface of the earth. This hot water can also be used to generate electricity.

Wind - can be used to turn windmills, which generate electricity. Windmills have been used for centuries in many parts of the world.

Electricity - Ben Franklin first proved that lightning was a form of electricity in 1752.

Nuclear Power - comes from radioactive uranium ore. It produces far more power than any other energy source. Even though it does not contribute to air pollution, it does produce radioactive waste, which is

hazardous. Finding a safe place to dispose of this waste is a serious problem.

Refuse-derived fuel (Garbage) - is burned in a waste-to-energy facility. As it burns, it heats water pipes. This hot water is used to generate electricity. This is a small but growing source of energy.

Chemical energy - creates energy through chemical reactions, such as in a battery. When different chemicals react with one another, energy is released. Eventually the reaction stops, and the energy is lost.

Teacher Reflections

Outline potential changes/improvements you would make to the subtask, or raise questions/concerns for future thought.

Record decisions you wish to pass on in the Subtask Notes; contents of this field are not passed along in the published unit.

Description

In groups, the students will complete an investigation on how heat and temperature can change the physical structure of matter (i.e., changing solids to liquids, solids to gas, and liquids to gas). Through their investigation, the students will make observations allowing them to generate results in the form of tables, graphs, charts, and diagrams. The students will also apply these results to real-life situations and link the concepts learned to the culminating task.

Expectations

7s56 A – compare the motions of particles in a solid, a liquid, and a gas using the particle theory;

7s61 A – describe the effect of heat on the motion of particles and explain how changes of state occur (e.g., from a liquid into a gas or vapour);

7s53 A • identify, through experimentation, ways in which heat changes substances, and describe how heat is transferred;

7m70 A • collect and organize categorical, discrete, or continuous primary data and secondary data and display the data using charts and graphs, including relative frequency tables and circle graphs;

7s55 – distinguish between the concept of temperature and the concept of heat (e.g., temperature is a measure of the average kinetic energy of the molecules in a substance; heat is thermal energy that is transferred from one substance to another);

7m78 A – read, interpret, and draw conclusions from primary data (e.g., survey results, measurements, observations) and from secondary data (e.g., temperature data or community data in the newspaper, data from the Internet about populations) presented in charts, tables, and graphs (including relative frequency tables and circle graphs);

7m73 – collect data by conducting a survey or an experiment to do with themselves, their environment, issues in their school or community, or content from another subject and record observations or measurements;

Groupings

Students Working In Small Groups
Students Working Individually

Teaching / Learning Strategies

Collaborative/cooperative Learning
Experimenting
Homework
Note-making

Assessment

Summative assessment of student responses to "Analysis" questions on the Student Investigation Page. (See "Inquiry Rubric" in resources tab for this assessment tool.)

Summative assessment of student responses to questions "Relating Science and Technology to the World Outside" on the Student Investigation Page. (See "Relating Science Rubric" in resources tab for this assessment tool.)

Relating Science and Technology to the World Outside

1. Describe the transfer of heat when ice changes to water
(Heat is given off.)

2. Fruit growers will sometimes spray crops with water in the event of potential frost. Explain how this method is successful as it relates to changes of state.
(The sprayed water turns to ice overnight. In order for this water to freeze, it must lose heat energy. Some of this lost heat energy is transferred to the fruit. In the morning the ice melts or

sublimates and absorbs heat from the warmer morning air.)

3. Under natural conditions, water is one of the few substances that assumes all three states of matter: liquid, solid, gas. What name is given to water in gaseous form? Illustrate the molecular movement of water in all three states.
(ice - vibrating, constricted movement; water - molecules attracted to each other, freely move about and take on the shape of the container; vapour - molecules freely move about in all directions.)

Assessment Strategies

Performance Task
Questions And Answers (oral)
Select Response

Assessment Recording Devices

Rubric
Anecdotal Record

Teaching / Learning

Each student will be given an investigation page which includes all safety precautions, a material list, step-by-step procedures to complete the investigation, an analysis activity, application questions relating science and technology to the world outside of school, and inquiry questions connecting the learned expectations to the culminating task. (See blackline master: "Changing States of Matter ″ found in the resources tab for this investigation page.)

Ideally, students should complete the following investigation in groups of four. However, the teacher may wish to complete the investigation as a class demonstration due to safety concerns and/or limited equipment. It is important for the teacher to continuously circulate among the students, assisting them in meeting the desired expectations.

You will need two class periods to complete this investigation.

Lesson 1: **The "Big Meltdown" Challenge**

The first lesson will consist of an investigation in which the students will change a solid into a liquid.

Safety Precautions

- All work surfaces should be cleared.

Procedure for the Investigation

1. Brainstorm with the class a list of things that "melt."

2. Inform the groups that they will soon be getting a sealable plastic bag with three ice cubes inside. Their group task will be to melt the ice as quickly as possible and to measure the length of time it took for the ice to completely melt.

3. Allow a few minutes for each group to formulate the strategies they will use to melt the ice.

4. Distribute the bags of ice. Be sure to remind each group that they are not to begin until the signal is given to do so.

5. After the students have melted their ice and after they have timed their work, allow them to discuss the strategies they used in this investigation.

6. Each group is to place three drops of water in different spots in a petri dish. Leave them overnight near a closed window.

Lesson 2: "The Balloon Mix"

Safety Precautions:

- All work surfaces should be cleared.
- Students should only handle balloons when inflating and mixing.
- Check for any possible latex allergies.

Procedure for the Investigation

1. Fill a small container approximately 3/4 full with water and secure a balloon over the mouth.

2. Empty the water into the balloon.

3. Remove and thoroughly dry the small container.

4. Measure 1/4 teaspoon of the baking powder and empty it into the small container.

5. Again, secure the balloon over the mouth without mixing the baking powder and water.

6. Transfer the water from the balloon into the small secured container.

7. Observe what happens and draw a series of pictures outlining what took place.

- After lesson #2, the students are to investigate what happened to the drops of water placed in the petri dishes. The teacher may need to coach the students to identify evaporation. Upon this discovery, the teacher will lead a discussion on Particle Theory.

The information on Particle Theory may either be given to the students in the form of a handout or the teacher may lead the note-making via notes on the black board. (See note on Particle Theory in the subtask notes.)

Analysis Questions

1. Record the individual group melting durations on board. Calculate the class mean melting duration. Create a bar graph whose horizontal axis (x-axis) records group names and whose vertical axis (y-axis) records

melting duration. How did your melting time compare to the class mean?

2. Compare the individual group strategies used in the melting process. Indicate which methods promoted the fastest melting.

Relating Science and Technology to the World Outside

1. Describe the transfer of heat when ice changes to water.

2. Fruit growers will sometimes spray crops with water in the event of potential frost. Explain how this method is successful as it relates to changes of state.

3. Under natural conditions, water is one of the few substances that assumes all three states of matter: liquid, solid, gas. What name is given to water in gaseous form? Illustrate the molecular movement of water in all three states.

Culminating Task Considerations

Select a material which will generate minimum condensation in your tree house. Explain condensation as it applies to the changing states of matter. Record all observations, skills, facts and questions during the investigation. There is a direct correlation between this subtask and the culminating task. Having a thorough notebook will assist you in the end. You may wish to consult with your group and/or teacher regarding verification or clarification.

Adaptations

Extra Support

- Group approach to this investigation will help. Numbered heads is very effective.
- Diagrams of the apparatus set-up of the investigation will help students interpret the procedures better.

ESL Students

- Encourage ESL students to assume roles that are not language dependent (timing, recording data, drawing a labeled diagram, etc.)
- Have the students make a diagram of the apparatus set-up.
- Have the students illustrate observations using labels, arrows, and short sentences.

Resources

- **Inquiry Rubric**
- **Relating Science**
- **Changing States of Matter** — 2_Changing states of mat.cwk
- **Investigation equipment / material list**

Notes to Teacher

Background information

Particle Theory and States of Matter

Particle Theory

All matter is made up of extremely tiny particles that are separated by spaces. The particles are always moving and vibrating. When heat is added, the particles move around faster and vibrate faster.

Five main points of the Particle Theory:

1. Matter is made up of particles.
2. All particles are in constant motion.
3. The attractive forces that exist between particles increase as the particles move closer towards each other.
4. Pure substance particles are all the same.
5. The spaces between particles are larger than the particles themselves.

Matter may be found in a liquid, solid, or gas state.

Solid

Any matter that keeps a constant state/shape and has a constant volume. Examples include cars, fences, computers, bikes and appliances. The particles of a solid are rigid and not allowed to move freely. The particles can only vibrate in place with the addition of heat. As more heat is added, the particles may vibrate faster causing the solid to expand.

Liquid

Most solid matter will become liquid when enough heat is applied. Adding heat energy causes solid particles to move. This occurs because liquid particles are free to move between each other. Although liquid takes up space, it assumes the shape of the container. Adding heat to a liquid causes the particles to move about more vigorously. As more heat is added, the particles move about faster, causing the liquid to expand. Examples of solid matter turning into liquid when heat is applied are: metal, plastic, and ice. However, other matter will burn instead of liquefy. For example: paper, wood, and cloth will burn rather than liquefy. This is true for all organic materials.

Gas

Some solids will turn into a gas without becoming a liquid first. Limestone and moth balls are examples of this. Gases are formed by the increase in space between the particles of a substance. This may be caused by the effects of heat, e.g., when water turns into steam. The gas particles move about very quickly when heat is added. As heat continues to be added, the gas eventually expands as the space between the particles increases.

Teacher Reflections

Outline potential changes/improvements you would make to the subtask, or raise questions/concerns for future thought.

Record decisions you wish to pass on in the Subtask Notes; contents of this field are not passed along in the published unit.

Description

In groups, the students will complete an investigation on the conduction of heat. They will identify which type of matter is a better conductor of heat and the process by which heat is transferred outward from its source. Through their investigation, the students will make observations allowing them to generate results in the form of tables, graphs, charts, and diagrams. The students will also apply these results to real life situations and link the concepts learned to the culminating task.

Catholic Graduate Expectations:
CGE 5a - works effectively as an interdependent team member.

CGE 5e - respects the rights, responsibilities, and contributions of self and others.

CGE 5f - exercises Christian leadership in the achievement of individual and group goals.

CGE 5g - achieves excellence, originality, and integrity in one's own work and supports these qualities in the work of others.

Expectations

7s57 A	– explain how heat is transmitted by conduction, convection, and radiation in solids, liquids, and gases (e.g., conduction: a pot heating on a stove; convection: a liquid heating in the pot; radiation: the air being warmed by heat from the element);
7s67	– use appropriate vocabulary, including correct science and technology terminology, to communicate ideas, procedures, and results (e.g., state the boiling and freezing points of water, room temperature, and body temperature in degrees Celsius; correctly use the terms heat conductor and heat insulator);
7s68 A	– compile qualitative and quantitative data gathered through investigation in order to record and present results, using diagrams, flow charts, frequency tables, bar graphs, line graphs, and stem-and-leaf plots produced by hand or with a computer (e.g., plot a graph showing the decrease in temperature of various liquids from identical initial temperatures);
7s69 A	– communicate the procedures and results of investigations for specific purposes and to specific audiences, using media works, written notes and descriptions, charts, graphs, drawings, and oral presentations (e.g., use a diagram to illustrate convection in a liquid or a gas).
7e51 A	• contribute and work constructively in groups;
7m78	– read, interpret, and draw conclusions from primary data (e.g., survey results, measurements, observations) and from secondary data (e.g., temperature data or community data in the newspaper, data from the Internet about populations) presented in charts, tables, and graphs (including relative frequency tables and circle graphs);

Groupings

Students Working In Small Groups
Students Working Individually

Teaching / Learning Strategies

Experimenting
Graphing
Homework
Inquiry
Open-ended Questions

Assessment

Summative assessment of cooperative group work. (See "Cooperative Group Work" rubric in the resources tab.)

Summative assessment of student responses to "Analysis" questions on the Student Investigation Page. (See "Inquiry Rubric" in resources tab for this assessment tool.)

Summative assessment of student responses to questions "Relating Science and Technology to the World Outside" on the Student Investigation Page. (See "Relating Science Rubric" in resources tab for this assessment tool.)

Relating Science and Technology to

7m73	– collect data by conducting a survey or an experiment to do with themselves, their environment, issues in their school or community, or content from another subject and record observations or measurements;

the World Outside

1. According to your knowledge of conduction, would it be more advisable to install air-conditioning vents on the ceiling or on the floor? Would the same advice apply to furnace heating? Baseboard electrical heating?
(The ceiling vents would be more efficient because the released cold air would sink to the floor of the room.)

Assessment Strategies

Performance Task
Questions And Answers (oral)
Select Response

Assessment Recording Devices

Rubric
Anecdotal Record

Teaching / Learning

Each student will be given an investigation page which includes all safety precautions, a material list, step-by-step procedures to complete the investigation, an analysis activity, application questions relating science and technology to the world outside of school, and inquiry questions connecting the learned expectations to the culminating task. (See blackline master: "Heat Transfer: Conduction ″ found in the resources tab for this investigation page.)

Ideally, students should complete the following investigation in groups of four. However, the teacher may wish to complete the investigation as a class demonstration due to safety concerns and/or limited equipment. It is important for the teacher to continuously circulate among the students, assisting them in meeting the desired expectations.

Safety Precautions

- Safety goggles must be worn.
- All work surfaces should be cleared.
- Students should be standing when working with heat sources.
- Oven mitts must be worn when handling hot equipment.

Advanced Preparation

Ensure that you have already prepared ample boiling water for the students to use.

Procedure for the investigation

1. Pour 500 ml of hot water into your bowl.

2. Place the metal butter knife, plastic knife, and popsicle stick across the top of your bowl.

3. Place a cube of butter (centred) on each of the butter knife, plastic knife, and popsicle stick.

4. Place a sugar cube (centred) on each of the butter cubes. *(The sugar adds some weight on the butter to speed up the process.)*

5. Predict which butter cube will melt first, last. Record your predictions in your notebook.

6. Time how long it takes for the each of the cubes to melt and fall off of its respective base.

Upon completion of the investigation review the important key concepts which the students should have discovered. Coach the students to get them to verbalize their results and contribute to the discovery of the key concepts. (See subtask notes for background information on the key concepts.)

Analysis Questions

1. Construct a bar graph whose horizontal axis (x-axis) records the type of conductor and whose vertical axis (y-axis) records the duration of heat conduction. Plot and compare.

2. Explain the process of conduction as you observed it. In your observations, which material served as the best conductor? Worst conductor?.

Relating Science and Technology to the World Outside

1. According to your knowledge of conduction, would it be more advisable to install air-conditioning vents on the ceiling or on the floor? Would the same advice apply to furnace heating or baseboard electrical heating?

Culminating Task Considerations

Select a material which will generate optimum heat transfer through conduction. Consideration must be given to the placement of heating and cooling elements. Record all observations, skills, facts, and questions during the investigation. There is a direct correlation between this subtask and the culminating task. Having a thorough notebook will assist you in the end. You may wish to consult with your group and/or teacher regarding verification or clarification.

Adaptations

Extra Support

- Group approach to this investigation will help. Numbered heads is very effective.
- Concrete familiar examples will help some students.
- Diagrams of the apparatus set-up of the investigation will help students interpret the procedures better.

ESL Students

- Encourage ESL students to assume roles that are not language dependent (e.g., taking measurements,

recording data, drawing a labeled diagram, etc.)
- Have the students make a diagram of the apparatus set-up.
- Have the students illustrate observations using labels, arrows, and short sentences.

Resources

Inquiry Rubric

Relating Science

Heat Transfer: Conduction 3_Heat Transfer Conduct.cwk

Investigation equipment / material list

Notes to Teacher

Background information

Conduction is the only method of heat transfer in opaque solids. If the temperature at one end of a metal rod rises, heat is conducted to the colder end. The exact method of heat conduction in solids is believed to be partially due to the motion of free electrons in the solid matter, which transport energys if there is a difference in temperature. Materials such as gold, silver, and copper have high thermal conductivities and conduct heat readily, but materials such as glass and asbestos have values of thermal conductivity hundreds and thousands of times smaller, conduct heat poorly, and are referred to as "insulators." In engineering applications and architectural designs, it is frequently necessary to establish the rate at which heat will be conducted through a solid if a known temperature difference exists across the solid.

Teacher Reflections

Outline potential changes/improvements you would make to the subtask, or raise questions/concerns for future thought.

Record decisions you wish to pass on in the Subtask Notes; contents of this field are not passed along in the published unit.

Description

In groups, the students will complete an investigation on the convection of heat. They will identify convection as a process of heat transfer. Through their investigation the students will make observations allowing them to generate results in the form of tables, graphs, charts, and diagrams. The students will also apply these results to real life situations and link the concepts learned to the culminating task.

The students will identify convection as one of God's natural creations.

Catholic Graduate Expectations:
CGE 5a - works effectively as an interdependent team member.

CGE 5e - respects the rights, responsibilities, and contributions of self and others.

CGE 5f - exercises Christian leadership in the achievement of individual and group goals.

CGE 5g - achieves excellence, originality, and integrity in one's own work and supports these qualities in the work of others.

Expectations

7e1 A	• communicate ideas and information for a variety of purposes (to outline an argument, to report on observations) and to specific audiences, using forms appropriate for their purpose and topic (e.g., write a lab report for an audience familiar with the scientific terminology);
7e51 A	• contribute and work constructively in groups;
7s57 A	– explain how heat is transmitted by conduction, convection, and radiation in solids, liquids, and gases (e.g., conduction: a pot heating on a stove; convection: a liquid heating in the pot; radiation: the air being warmed by heat from the element);
7s67 A	– use appropriate vocabulary, including correct science and technology terminology, to communicate ideas, procedures, and results (e.g., state the boiling and freezing points of water, room temperature, and body temperature in degrees Celsius; correctly use the terms heat conductor and heat insulator);
7s68 A	– compile qualitative and quantitative data gathered through investigation in order to record and present results, using diagrams, flow charts, frequency tables, bar graphs, line graphs, and stem-and-leaf plots produced by hand or with a computer (e.g., plot a graph showing the decrease in temperature of various liquids from identical initial temperatures);
7s69 A	– communicate the procedures and results of investigations for specific purposes and to specific audiences, using media works, written notes and descriptions, charts, graphs, drawings, and oral

Groupings

Students Working In Small Groups
Students Working Individually

Teaching / Learning Strategies

Experimenting
Homework
Inquiry
Note-making

Assessment

Summative assessment of cooperative group work. (See "Cooperative Group Work" rubric in the resources tab.)

Summative assessment of student responses to "Analysis" questions on the Student Investigation Page. (See "Inquiry Rubric" in resources tab for this assessment tool.)

Summative assessment of student responses to questions "Relating Science and Technology to the World Outside" on the Student Investigation Page. (See "Relating Science Rubric" in resources tab for this assessment tool.)

presentations (e.g., use a diagram to illustrate convection in a liquid or a gas).

Relating Science and Technology to the World Outside

1. According to your knowledge of convection, determine the optimum location for air-return vents in home-heating systems.
(It is more efficient to place the cold air vents on or near the floor in order to evacuate the cold air that has settled.)

2. You are contracted to design a heating and cooling system for your school gymnasium. The principal informs you that you are allowed to use separate vents for heating and air-conditioning. Generate a three-dimensional drawing of your gymnasium which will indicate the optimum placement of these vents.
(Heating vents - near or on the floor due to the ascending heat; air-conditioning vents - near or on the ceiling due the descending cold air.)

3. Using the numbers 1-7, outline the development of a convection current.

__2__ air molecules move faster and farther apart, making this column of air less dense than the surrounding air

__6__ the temperature of the column of air rises as it approaches the heat source

__7__ the process is repeated

__1__ air above the heat source becomes warmer

Teaching / Learning

Each student will be given an investigation page which includes all safety precautions, a material list, step-by-step procedures to complete the investigation, an analysis activity, application questions relating science and technology to the world outside of school, and inquiry questions connecting the learning expectations to the culminating task. (See blackline master: "Heat Transfer: Convection " found in the resources tab for this investigation page.)

Ideally, students should complete the following investigation in groups of four. However, the teacher may wish to complete the investigation as a class demonstration due to safety concerns and/or limited equipment. It is important for the teacher to continuously circulate among the students, assisting them in meeting the desired

expectations.

Safety Precautions

- Safety goggles must be worn.
- All work surfaces should be cleared.
- Students should be standing when working with heat sources.

Advanced Preparation

The teacher will light the candles at the appropriate time.

Procedure

1. Begin at the centre of the paper and draw a spiral working your way to the outer edge.

2. Cut out the spiral.

3. Attach the centre of the spiral to the clamp.

4. Attach the clamp to the retort stand.

5. Observe the movement of the spiral cut-out. Make observations in your notebook.

6. Predict what will happen when you place heat below the spiral cut-out. Write the prediction in your notebook.

7. The teacher will light the candle provided.

8. Place the candle under the spiral cut-out.

9. Observe the movement of the spiral cut-out. Make observations in your notebook.

Analysis Questions

1. Did the spinner rotate in the direction you predicted? Define in your own words how the process of convection takes place. What, in particular, governs the direction of the spiral? Would the same results occur with other object shapes or object materials? Could this information assist you in determining which materials would better meet the temperature control and energy efficiency of your tree house?

Relating Science and Technology to the World Outside

1. According to your knowledge of convection, determine the optimum location for air-return vents in home-heating systems.

2. You are contracted to design a heating and cooling system for your school gymnasium. The principal informs you that you are allowed to use separate vents for heating and air-conditioning. Generate a three-dimensional drawing of your gymnasium which will indicate the optimum placement of these vents.

3. Using the numbers 1-7, outline the development of a convection current.

_____ air molecules move faster and farther apart, making this column of air less dense than the surrounding air

_____ the temperature of the column of air rises as it approaches the heat source

_____ the process is repeated

_____ air above the heat source becomes warmer

_____ surrounding air moves in to replace rising column of air

_____ cooler, denser air descends

_____ less dense air begins to rise

4. At what stage does convection take place in the water cycle?

Teacher Notes

Upon completion of the investigation, review the important key concepts which the students should have discovered. Coach the students to get them to verbalize their results and contribute to the discovery of the key concepts. (See subtask notes for background information on the key concepts.)

Convection determines the movement of large air masses above the earth, the action of the winds, rainfall and ocean currents; all natural occurrences.

Culminating Task Considerations

Select a material which will generate optimum heat transfer through convection. Consideration must be given to the placement of heating and cooling elements. Record all observations, skills, facts, and questions during the investigation. There is a direct correlation between this subtask and the culminating task. Having a thorough notebook will assist you in the end. You may wish to consult with your group and/or teacher regarding verification or clarification.

Adaptations

Extra Support

- Group approach to this investigation will help. Numbered heads is very effective.
- Concrete familiar examples will help some students.
- Diagrams of the apparatus set-up of the investigation will help students interpret the procedures better.

ESL Students

- Encourage ESL students to assume roles that are not language dependent (e.g., taking measurements, recording data, drawing a labeled diagram, etc.)
- Have the students make a diagram of the apparatus set-up.
- Have the students illustrate observations using labels, arrows and short sentences.

Resources

- **Inquiry Rubric**
- **Relating Science**
- **Heat Transfer: Convection** 4_Heat Transfer Convect.cwk
- **Investigation equipment / material list**

Notes to Teacher

Background information

Conduction occurs not only within a body but also between two bodies if they are brought into contact. If one of the substances is a liquid or a gas, then fluid motion will almost certainly occur. This process of conduction between a solid surface and a moving liquid or gas is called "convection." The motion of the fluid may be natural or forced. If a liquid or gas is heated, its mass per unit volume generally decreases. If the liquid or gas is in a gravitational field, the hotter, lighter fluid rises while the colder, heavier fluid sinks.

If, for example, water in a pan is heated from below, the liquid closest to the bottom expands and its density decreases. As a result, the hot water rises to the top and some of the cooler fluid descends to the bottom, thus setting up a circulatory motion. Similarly, in a vertical, gas-filled chamber, such as the air space between two window panes in a double-glazed window, the air near the cold outer pane will move down and the air near the inner, warmer pane will rise, leading to a circulatory motion.

The heating of a room by a radiator depends less on radiation than on natural convection currents. The warmer air rises upward along the wall while the cooler air descends to the radiator. Given the tendencies of hot air to rise and of cool air to sink, radiators should be placed near the floor and air-conditioning outlets near the ceiling for maximum efficiency. Convection also determines the movement of large air masses above the earth, the action of the winds, rainfall, ocean currents, and the transfer of heat from the interior of the sun to its surface.

Teacher Reflections

Outline potential changes/improvements you would make to the subtask, or raise questions/concerns for future thought.

Record decisions you wish to pass on in the Subtask Notes; contents of this field are not passed along in the published unit.

Description

In groups, the students will complete an investigation on the radiation of heat. They will identify radiant energy as yet another process of heat transfer. Through their investigation, the students will make observations allowing them to generate results in the form of tables, graphs, charts and diagrams. The students will also apply these results to real-life situations and link the concepts learned to the culminating task.

The students will identify the sun as the greatest source of radiant heat energy. They will explore how the sun is used in the water cycle and in creating convection currents. The students will identify how radiant heat energy from the sun allows for the survival of all plants and animals.

Catholic Graduate Expectations:
CGE 5a - works effectively as an interdependent team member.

CGE 5e - respects the rights, responsibilities and contributions of self and others.

CGE 5f - exercises Christian leadership in the achievement of individual and group goals.

CGE 5g - achieves excellence, originality, and integrity in one's own work and supports these qualities in the work of others.

Expectations

7e1	• communicate ideas and information for a variety of purposes (to outline an argument, to report on observations) and to specific audiences, using forms appropriate for their purpose and topic (e.g., write a lab report for an audience familiar with the scientific terminology);
7e51 A	• contribute and work constructively in groups;
7m70 A	• collect and organize categorical, discrete, or continuous primary data and secondary data and display the data using charts and graphs, including relative frequency tables and circle graphs;
7s57	– explain how heat is transmitted by conduction, convection, and radiation in solids, liquids, and gases (e.g., conduction: a pot heating on a stove; convection: a liquid heating in the pot; radiation: the air being warmed by heat from the element);
7s58 A	– describe how various surfaces absorb radiant heat;
7s69	– communicate the procedures and results of investigations for specific purposes and to specific audiences, using media works, written notes and descriptions, charts, graphs, drawings, and oral presentations (e.g., use a diagram to illustrate convection in a liquid or a gas).
7s68 A	– compile qualitative and quantitative data gathered through investigation in order to record and present results, using diagrams, flow charts, frequency tables, bar graphs, line graphs, and stem-and-leaf plots

Groupings

Students Working Individually
Students Working In Small Groups
Students Working As A Whole Class

Teaching / Learning Strategies

Experimenting
Inquiry
Note-making
Graphing
Homework
Open-ended Questions

Assessment

Summative assessment of cooperative group work. (See "Cooperative Group Work" rubric in the resources tab.)

Summative assessment of student responses to "Analysis" questions on the Student Investigation Page. (See "Inquiry Rubric" in resources tab for this assessment tool.)

Summative assessment of student

	produced by hand or with a computer (e.g., plot a graph showing the decrease in temperature of various liquids from identical initial temperatures);
7s72 A	– describe the water cycle as a process of energy transfer involving convection and radiation;
7s71 A	– explain how the heating and cooling of the earth's surface produces air movement that results in all weather effects (e.g., convection currents);
7s70	– recognize heat as a necessity for the survival of plants and animals;
7m73	– collect data by conducting a survey or an experiment to do with themselves, their environment, issues in their school or community, or content from another subject and record observations or measurements;

responses to questions "Relating Science and Technology to the World Outside" on the Student Investigation Page. (See "Relating Science Rubric" in resources tab for this assessment tool.)

Relating Science and Technology to the World Outside

1. Explain why the sun is considered a "radiant" energy source. Can the sun play an integral part in convectional or conductive heating? Justify your reasoning.
(see "subtask notes")

2. Describe how the water cycle is a process of energy transfer involving convection and radiation.
(Radiant energy from the sun evaporates water from the earth's surface. It condenses in clouds from the hot air rising - via the convection currents.)

3. Give five examples of heat transfer by radiation.
(Heat from hot stove/oven elements; heat emanating from a bonfire; the human body will give off heat by radiation; heat from an overhead light .)

4. Use the Particle Theory to explain the effect of the sun as a "radiant" energy source on human skin.
(*As an object absorbs radiant energy from the sun, its molecules begin to move faster; the more energy they absorb, the faster they move, thus warming the body. This causes the object to heat up.)*

Teaching / Learning

Each student will be given an investigation page which includes all safety precautions, a material list, step-by-step procedures to complete the investigation, an analysis activity, application questions relating science and technology to the world outside of school, and inquiry questions connecting the learned expectations to the culminating task. (See blackline master: "Heat Transfer: Radiation " found in the resources tab for this investigation page.)

Ideally, students should complete the following investigation in groups of four. However, the teacher may wish

to complete the investigation as a class demonstration due to safety concerns and/or limited equipment. It is important for the teacher to continuously circulate among the students, assisting them in meeting the desired expectations.

Safety Precautions

- Handle glass thermometers carefully.

Advanced Preparation

The teacher will supply ample room temperature water.

Procedure

1. Fully cover the outside of a bottle with black construction paper.

2. Fully cover the outside of another bottle with white construction paper.

3. Leave a third bottle clear.

4. Fill all three bottles equally with room temperature water.

5. Record the temperature of the water for each bottle.

6. Place the bottles in the same location, exposing them to the sun.

7. Predict what will happen to the temperature of the water in each of the bottles.

8. Record your predictions in your notebook.

9. Take the temperature of the three bottles: 10 trials at two minute intervals. Record the temperatures in a suitable table in your notebooks. Do not leave the thermometers sitting in the bottles between temperature readings.

Analysis Questions

1. Construct a line graph whose horizontal axis (x-axis) records the exposure time to radiant source and whose vertical axis (y-axis) records the internal temperature of the bottle. Plot and compare.

2. Analyse and share the results of your findings. Which bottle registered the highest internal temperature? Lowest temperature? Explain the process of radiation as it applied to this investigation.

Relating Science and Technology to the World Outside

1. Explain why the sun is considered a "radiant" energy source. Can the sun play an integral part in convectional or conductive heating? Justify your reasoning.

2. Describe how the water cycle is a process of energy transfer involving convection and radiation.

3. Give five examples of heat transfer by radiation.

4. Use the Particle Theory to explain the effect of the sun as a "radiant" energy source on human skin.

5. Examine the appliances in your home. Which provide energy transfer through radiation?

Culminating Task Considerations

Select a material whose colour will generate optimum heat transfer through radiation. Consideration must be given to the placement of windows and skylights. Record all observations, skills, facts, and questions during the investigation. There is a direct correlation between this subtask and the culminating task. Having a thorough notebook will assist you in the end. You may wish to consult with your group and/or teacher regarding verification or clarification.

Adaptations

Extra Support

- Group approach to this investigation will help. Numbered heads is very effective.
- Concrete familiar examples will help some students.
- Diagrams of the apparatus setup of the investigation will help students interpret the procedures better.

ESL Students

- Encourage ESL students to assume roles that are not language dependent (e.g., taking measurements, recording data, drawing a labeled diagram, etc.)
- Have the students make a diagram of the apparatus set-up.
- Have the students illustrate observations using labels, arrows and short sentences.

Resources

Inquiry Rubric

Relating Science

Heat Transfer: Radiation 5_Heat Transfer Radiat.cwk

Investigation / equipment material list

Notes to Teacher

Background information

Radiation heat transfer deals with the exchange of thermal radiation energy between two or more bodies. In its simplest form, radiation energy occurs when there are two or more bodies of different temperatures. Unlike conduction and convection, the substances exchanging heat do not need to be in contact with each other. They can be separated by a vacuum. The amount of heat which can be transferred between two bodies via radiant energy is dependant on the reflective property, surface area, surface texture, and temperature of the substances.

Teacher Reflections

Outline potential changes/improvements you would make to the subtask, or raise questions/concerns for future thought.

Record decisions you wish to pass on in the Subtask Notes; contents of this field are not passed along in the published unit.

Turning Up The Heat!

A Unit of Study Investigating Heat Energy **An Integrated Unit for Grade 7**

Description

In groups, the students will investigate the effects of heating and cooling on the volume of solids, liquids, and gases. Through their investigation the students will make observations allowing them to generate results in the form of tables, graphs, charts, and diagrams. The students will also apply these results to real-life situations and link the concepts learned to the culminating task.

Catholic Graduate Expectations:

CGE 5a - works effectively as an interdependent team member.

CGE 5e - respects the rights, responsibilities and contributions of self and others.

CGE 5f - exercises Christian leadership in the achievement of individual and group goals.

CGE 5g - achieves excellence, originality, and integrity in one's own work and supports these qualities in the work of others.

Expectations

7s59 A	– describe the effect of heating and cooling on the volume of a solid, a liquid, and a gas;
7s67 A	– use appropriate vocabulary, including correct science and technology terminology, to communicate ideas, procedures, and results (e.g., state the boiling and freezing points of water, room temperature, and body temperature in degrees Celsius; correctly use the terms heat conductor and heat insulator);
7s69	– communicate the procedures and results of investigations for specific purposes and to specific audiences, using media works, written notes and descriptions, charts, graphs, drawings, and oral presentations (e.g., use a diagram to illustrate convection in a liquid or a gas).
7e1	• communicate ideas and information for a variety of purposes (to outline an argument, to report on observations) and to specific audiences, using forms appropriate for their purpose and topic (e.g., write a lab report for an audience familiar with the scientific terminology);
7s54 A	• explain how the characteristics and properties of heat can be used, and identify the effect of some of these applications on products, systems, and living things in the natural and human-made environments.
7e51 A	• contribute and work constructively in groups;

Groupings

Students Working In Small Groups
Students Working Individually
Students Working As A Whole Class

Teaching / Learning Strategies

Experimenting
Inquiry
Note-making
Homework

Assessment

Summative assessment of cooperative group work. (See "Cooperative Group Work" rubric in the resources tab.)

Summative assessment of student responses to "Analysis" questions on the Student Investigation Page. (See "Inquiry Rubric" in resources tab for this assessment tool.)

Summative assessment of student responses to questions "Relating Science and Technology to the World Outside" on the Student Investigation Page. (See "Relating Science Rubric" in resources tab for this assessment tool).

Relating Science and Technology to the World Outside

1. Define the terms "expand" and "contract". Which term denotes energy increase? Energy decrease?
Expand - to increase in volume (requires energy). Contract - to decrease in volume (requires removal of energy.)

2. Predict whether a solid, liquid or gas will undergo the greatest degree of expansion when heated. Write a short report explaining the reasons for your prediction.
(A gas will expand more, because the molecules are not bound together as much as solids or liquids. The molecules of a gas repel one another.)

3. When laying rail down on a railway track, workers leave a considerable gap between the different sections of rail. Give two other examples where this building principle applies.
(The gap allows room for the rails to expand when they become heated during the hot summer months. Two other examples of this are in bridge spans and multi-story car parks.)

Assessment Strategies

Exhibition/demonstration
Performance Task
Questions And Answers (oral)
Select Response

Assessment Recording Devices

Anecdotal Record

Teaching / Learning

Each student will be given an investigation page which includes all safety precautions, a material list, step-by-step procedures to complete the investigation, an analysis activity, application questions relating science and technology to the world outside of school, and inquiry questions connecting the learned expectations to the culminating task. (See blackline master: "Heat and Volume " found in the resources tab for this investigation page.)

Ideally, students should complete the following investigation in groups of four. However, the teacher may wish to complete the investigation as a class demonstration due to safety concerns and/or limited equipment. It is important for the teacher to continuously circulate among the students, assisting them in meeting the desired expectations.

Safety Precautions

- All work surfaces should be cleared.

Procedure

1. Fill the flask 3/4 full with coloured water.
2. Mold the modeling clay around the straw, insert the straw into the flask, and fit the plasticine over the opening of the flask.
3. Note the level of water in the straw.
4. Warm the flask by placing your hands around it for several minutes. Be sure to note what happens to liquid in the straw.
5. Cool the flask in a bucket of ice water. Note what happens to the level of the liquid in the straw.
6. Draw three diagrams illustrating what happened to the level of water as noted in steps 3, 4, and 5.

Analysis Questions

1. What happens to liquids when they are heated? Cooled?

2. Could this apparatus serve as a thermometer? Why/why not?

3. Based on your observations during this investigation and your knowledge of the Particle Theory, explain how heat directly affects the volume of solids and gases.

Relating Science and Technology to the World Outside

1. Define the terms "expand" and "contract". Which term denotes energy increase? Energy decrease?

2. Predict whether a solid, liquid or gas will undergo the greatest degree of expansion when heated. Write a short report explaining the reasons for your prediction.

3. When laying rail down on a railway track, workers leave a considerable gap between the different sections of rail. Give two other examples where this building principle applies.

Culminating Task Considerations

Determine which materials used in the construction of your tree house will be subject to expansion or contraction, e.g., wood flooring. Record all observations, skills, facts, and questions during the investigation. There is a direct connection between this subtask and the culminating task. Having a thorough notebook will assist you in the end. You may wish to consult with your group and/or teacher regarding verification or clarification.

Adaptations

Extra Support

- Group approach to this investigation will help. Numbered heads is very effective.
- Concrete familiar examples will help some students.
- Diagrams of the apparatus set-up of the investigation will help students interpret the procedures better.

ESL Students

- Encourage ESL students to assume roles that are not language dependent (e.g., taking measurements, recording data, drawing a labeled diagram, etc.)

- Have the students make a diagram of the apparatus set-up.
- Have the students illustrate observations using labels, arrows, and short sentences.

Resources

Inquiry Rubric

Relating Science

Heat and Volume 6_Heat and volume.cwk

Investigation / equipment list

Notes to Teacher

Background information

Surface damage, such as potholes, regularly occurs on our roads as the formation of ice and subsequent thaw penetrate concrete and asphalt pathways. Consequently, sidewalks, bridges, railway tracks, driveways, and roadways are constructed with frequent spaces or gaps to allow for the expansion and contraction caused by the hot and cold seasonal temperature variations.

Teacher Reflections

Outline potential changes/improvements you would make to the subtask, or raise questions/concerns for future thought.

Record decisions you wish to pass on in the Subtask Notes; contents of this field are not passed along in the published unit.

Description

All life on earth relies on heat. If plants and animals get too hot or too cold, they may perish. Animals use nature to control their heat transfer. Humans use what they learn from observing nature to develop technologies to control heat transfer. In groups, the students will design and build a container that will keep an ice cube frozen for the longest time possible.

The students will explore how the earth is naturally insulated. They will also contemplate how we, as humans, are responsible for global stewardship and care for the planet God has provided for us.

Catholic Graduate Expectations:
CGE 5a - works effectively as an interdependent team member.

CGE 5e - respects the rights, responsibilities and contributions of self and others.

CGE 5f - exercises Christian leadership in the achievement of individual and group goals.

CGE 5g - achieves excellence, originality, and integrity in one's own work and supports these qualities in the work of others.

Expectations

7s54 A	• explain how the characteristics and properties of heat can be used, and identify the effect of some of these applications on products, systems, and living things in the natural and human-made environments.
7s64 A	– design and build a device that minimizes energy transfer (e.g., an incubator, a Thermos flask).
7s68	– compile qualitative and quantitative data gathered through investigation in order to record and present results, using diagrams, flow charts, frequency tables, bar graphs, line graphs, and stem-and-leaf plots produced by hand or with a computer (e.g., plot a graph showing the decrease in temperature of various liquids from identical initial temperatures);
7s70 A	– recognize heat as a necessity for the survival of plants and animals;
7a35 A	• produce two- and three-dimensional works of art that communicate a variety of ideas (thoughts, feelings, experiences) for specific purposes and to specific audiences, using appropriate art forms;
7s78 A	– identify and describe steps that can be taken to conserve energy (e.g., using insulation) and the reasons for doing so (e.g., rising fuel costs);
7e51 A	• contribute and work constructively in groups;

Groupings

Students Working In Small Groups
Students Working Individually

Teaching / Learning Strategies

Collaborative/co-operative Learning
Demonstration
Experimenting
Inquiry
Model Making
Simulation

Assessment

Summative assessment of cooperative group work. (See "Cooperative Group Work" rubric in the resources tab.)

Summative assessment of working model and diagrams. (See "Insulation Model" rubric in the resources tab.) (See "Designing and Building Rubric" in resources tab for this assessment tool.)

Summative assessment of student responses to questions "Relating Science and Technology to the World Outside" on the Student Activity Page. (See "Relating

Science Rubric" in resources tab for this assessment tool.)

Relating Science and Technology to the World Outside

1. Does insulation prevent heat from escaping or cold from entering? Use the Particle Theory to justify your answer. *(Insulation is designed to prevent quickly moving molecules from passing their energy on to more slowly moving ones. As a result, insulation is designed to prevent heat from escaping.)*

2. Define the term "dead air space." Using items of clothing as examples, explain how "dead air space" promotes good insulation. *(Air that is trapped within a space cannot flow out; materials with dead air spaces reduce heat loss through conduction (air is a poor conductor) and convection (constricted air flow); clothing with lots of dead air space: wool, down, thinsulate, polar fleece.)*

3. Construct a chart with subtitles "heat conductors" and "heat insulators." Provide three examples of metals under each column. For each metal, name a household product whose metallic composition contributes to its function. Explain how the process of conduction or insulation takes place in the household product.
(Answers will vary.)

Assessment Strategies

Classroom Presentation

Teaching / Learning

Each student will be given an activity page which includes all safety precautions, a material list, step-by-step procedures to complete the activity, application questions relating science and technology to the world outside of school and inquiry questions connecting the learned expectations to the culminating task. (See blackline master: "Insulation" found in the resources tab for this activity page.)

Ideally, students should complete the following investigation in groups of four. However, the teacher may wish to complete the investigation as a class demonstration due to safety concerns and/or limited equipment. It is important for the teacher to continuously circulate among the students, assisting them in meeting the desired expectations.

The students will have four periods to complete this task. The first period will be spent on the design of the container and approval from the teacher. The next two periods will be spent constructing the container. The final period will be spent on the testing of the container.

Safety Precautions

- Hazardous materials are not permitted.
- Any cutting of material must be done under adult supervision.

Procedure

1. Design a container that will keep an ice cube frozen for the longest time possible.

2. Create a drawing of your container showing the construction of all sides.

3. Include one drawing showing a labelled cut-out of one side of your container (i.e., insulation material, container material, and any other material you may have used).

4. Show drawings to the teacher for approval

5. Construct your container.

Relating Science and Technology to the World Outside

1. Does insulation prevent heat from escaping or cold from entering? Use the Particle Theory to justify your answer.

2. Define the term "dead air space." Using items of clothing as examples, explain how "dead air space" promotes good insulation.

3. Construct a chart with subtitles "heat conductors" and "heat insulators." Provide three examples of metals under each column. For each metal, name a household product whose metallic composition contributes to its function. Explain how the process of conduction or insulation takes place in the household product.

Culminating Task Considerations

Choose a metal which will generate optimum insulation in your tree house. Consideration must be given to the installation of windows, doors, vapour barriers, R-value, etc. Record all observations, skills, facts, and questions during the investigation. There is a direct connection between this subtask and the culminating task. Having a thorough notebook will assist you in the end. You may wish to consult with your group and/or teacher regarding verification or clarification.

Adaptations

Extra Support

- Group approach to this investigation will help. Numbered heads is very effective.
- Concrete familiar examples will help some students.
- Diagrams of the apparatus set-up of the investigation will help students interpret the procedures better.

ESL Students

- Encourage ESL students to assume roles that are not language dependent (e.g., taking measurements, recording data, drawing a labeled diagram, etc.)
- The physical construction of the model will help greatly.
- Have the students illustrate observations using labels, arrows, and short sentences.

Resources

Relating Science	
Insulation	9_Insulation.cwk
Insulation material list	

Notes to Teacher

Background information

Insulation is provided by any material poor in conduction of heat or electricity and used to suppress the flow of heat or electricity.

Thermal insulating materials are used to reduce the flow of heat between hot and cold regions. Thermal insulation may have to fulfil one or more of three functions: to reduce thermal conduction in the material where heat is transferred by molecular or electronic action; to reduce thermal convection currents, which can be set up in air or liquid spaces; and to reduce radiation heat transfer where thermal energy is transported by electromagnetic waves.

If surfaces are made highly reflective, radiation can also be reduced. Thus, thin aluminum foil can be used in building walls, and reflecting metal on roofs minimizes the heating effect of the sun. Insulated bottles provide insulation through an evacuated double-wall arrangement in which the walls have reflective silver or aluminum coatings.

In building materials, air pockets provide additional insulation in hollow glass bricks, insulating glass, and partially hollow concrete tile. Insulating properties are reduced if the air space becomes large enough to allow thermal convection, or if moisture seeps in and acts as a conductor. The insulating property of dry clothing, for example, is the result of air trapped between the fibres; this ability to insulate can be significantly reduced by moisture.

The effective resistance to heat flow is conventionally expressed by its R-value (resistance value).

Teacher Reflections

Outline potential changes/improvements you would make to the subtask, or raise questions/concerns for future thought.

Record decisions you wish to pass on in the Subtask Notes; contents of this field are not passed along in the published unit.

Description

The students will be given the following challenge:

Your group of junior energy consultants has entered a contest to design an energy-efficient tree house. Your group is required to ensure that this project responds to the criteria of energy efficiency and conservation of thermal energy. In conclusion, your team must present its testing methods and propose a model which best exemplifies the highest standards of energy efficiency and conservation of thermal energy. Be prepared to justify your method of choice, as well as give a detailed floor plan of the tree house. You will also be required to present the potential positive and negative impacts that your development could have on the environment and community. Does the project provide for the use of renewable resources rather than non-renewable resources? Is there potential for the maximization of flow resources, e.g., sunlight, wind? Does the construction of the project promote the preservation of the ecosystem and animal habitat?

Summative assessment: A "student written report" will be generated from this activity (i.e., floor plan, recommendations, and diagrams). See "Research Rubrics 1 and 2."

Catholic Graduate Expectations:
CGE 7i - respects the environment and uses resources wisely.
• Within the scope of this expectation the students must bear in mind pollution control and the use of finite natural resources.

CGE 2e - uses and integrates the Catholic faith tradition, in the critical analysis of the arts, media, technology and information systems to enhance the quality of life.
• Students must consider the implications of technology and the implications of man made energy resources on our environment and our quality of life.

Expectations

7s63 A	– identify systems that are controlled by sensory inputs and feedbacks (e.g., a thermostat);
7s65 A	– formulate questions about and identify needs and problems related to heat (e.g., interactions involving energy transfers), and explore possible answers and solutions (e.g., identify the steps that could be followed to test the effectiveness of the heating system in a home that uses solar energy);
7s66 A	– plan investigations for some of these answers and solutions, identifying variables that need to be held constant to ensure a fair test and identifying criteria for assessing solutions;
7s75 A	– describe and explain issues related to heat pollution, including both positive and negative aspects (e.g., industrial processes and generation of electricity cause heat pollution of large bodies of water);
7s78 A	– identify and describe steps that can be taken to conserve energy (e.g., using insulation) and the reasons for doing so (e.g., rising fuel costs);
7s79 A	– identify the components of a system that are designed

Groupings

Students Working Individually

Teaching / Learning Strategies

Brainstorming
Case Study
Learning Log/ Journal
Model Making
Problem-solving Strategies
Research
Role Playing
Writing Process

Assessment

Summative assessment of student written report (i.e., recommendations and diagrams). See "Research Rubrics 1 and 2" in the resources tab.

	to transfer heat energy (e.g., in a room, a house, or a shopping centre) and describe methods for conserving energy within that system.
7e1 A	• communicate ideas and information for a variety of purposes (to outline an argument, to report on observations) and to specific audiences, using forms appropriate for their purpose and topic (e.g., write a lab report for an audience familiar with the scientific terminology);
7s60	– investigate and identify factors affecting the rate of temperature change (e.g., mass, nature of liquid) using a constant heat source;
7s62	– compare, in qualitative terms, the heat capacities of common materials (e.g., water and aluminum have greater heat capacities than sand and Pyrex);
7s64 A	– design and build a device that minimizes energy transfer (e.g., an incubator, a Thermos flask).
7s74 A	– explain how mechanical systems produce heat (e.g., by friction), and describe ways to make these systems more efficient (e.g., by lubrication);
7s76	– explain why heat energy is considered to be the final or end form of energy transformation;
7s77 A	– identify the purpose of the specialized features of various instruments that are used to measure temperature (e.g., temperature probes provide accurate continuous readings);

Minimum Required Components

- A floor plan of your tree house indicating the location of all windows, doors and skylights, including the direction these items face;
- A diagram illustrating a "cutout" of your walls, labeling all insulation and construction materials from the finished interior wall to the finished exterior wall;
- A diagram illustrating the insulation of ceilings;
- A diagram illustrating the heat flow in the tree house, i.e., heating vents, air-conditioning vents, return air vents;
- A written report of your recommendations;
- Measures which will be taken to minimize the negative impacts your development could have on the environment and community.

Assessment Strategies

Essay
Observation
Performance Task
Learning Log

Assessment Recording Devices

Anecdotal Record

Teaching / Learning

Each student will be given an activity page which includes step-by-step procedures to complete the activity. (See blackline master: "Architectural Challenge" found in the resources tab for this activity page.)

It is important for the teacher to continuously circulate among the students, assisting them in meeting the desired expectations.

Four lesson periods (in addition to time spent throughout the unit on the culminating task) have been allotted for this activity. One class period should be spent brainstorming with the students and getting them started (steps 1 - 4 below). Two class periods should be spent on research (steps 5 - 9). One class period should be spent writing their final recommendations (step 10). It is expected that students will require additional homework time to complete the challenge.

Getting Started

1. Determine which features are vital to the physical structure and stability of your tree house.
2. Determine which features may contribute to maximizing energy efficiency and conservation of thermal energy.
3. Determine which features from #1 and #2 are feasible.
4. Include a list of material needed for construction.
5. Research and estimate the costs involved in purchasing the material.
6. Develop a floor plan.
7. Provide a detailed written report, outlining the phase developments of your construction.
8. Explain how you will insulate your tree house. Submit a detailed diagram, labeled and drawn to scale.
9. Suggest a time frame for the completion of your project.
10. Submit your proposal for approval.

Prompts for brainstorming and research

- How will your tree house be heated?
- Will this source of heating create environmental concerns?
- Can the surrounding environment contribute positively to the construction?
- How valid is direction when placing windows?
- How valid is the colour of material?
- What material will you choose to insulate your tree house?

You may wish to consult your notebook for observations, skills, facts, and questions at this time. Some of your questions may have already been answered in their respective investigations. Research those questions left unanswered. Apply acquired skills and facts to your architectural challenge.

Minimum Required Components

- A floor plan of your tree house indicating the location of all windows, doors and skylights, including the direction these items face;
- A diagram illustrating a "cutout" of your walls, labeling all insulation and construction materials from the finished interior wall to the finished exterior wall;
- A diagram illustrating the insulation of ceilings;
- A diagram illustrating the heat flow in the tree house, i.e., heating vents, air-conditioning vents, return air vents;
- A written report of your recommendations;
- Measures which will be taken to minimize the negative impacts your development could have on the environment and community.

Adaptations

Extra Support

- Diagrams of existing energy efficient homes requiring students to simply label energy conserving items will help.

ESL Students

- Have the students make diagrams in lieu of written report.
- Have the students illustrate observations using labels, arrows and short sentences.

- Oral report.

Resources

Architectural Challenge 8_Architectural Challe.cwk

Notes to Teacher

Energy Efficient Construction Considerations

Heating and Cooling
Doors and Windows
Landscaping
Lighting
Insulation, Weathering, and Ventilation
Foundations
Walls and Windows
Roofs and Ceilings

Teacher Reflections

Outline potential changes/improvements you would make to the subtask, or raise questions/concerns for future thought.

Record decisions you wish to pass on in the Subtask Notes; contents of this field are not passed along in the published unit.

Appendices

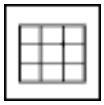
Turning Up The Heat!

A Unit of Study Investigating Heat Energy

Resource List:
Blackline Masters:
Rubrics:
Unit Expectation List and Expectation Summary:
Unit Analysis:

Turning Up The Heat!

A Unit of Study Investigating Heat Energy An Integrated Unit for Grade 7



Rubric

- ☐ **Inquiry Rubric** **ST 2**
  3
- ☐ **Inquiry Rubric** **ST 3**
  3
- ☐ **Inquiry Rubric** **ST 4**
  3
- ☐ **Inquiry Rubric** **ST 5**
  3
- ☐ **Inquiry Rubric** **ST 6**
  3
- ☐ **Relating Science** **ST 2**
  3
- ☐ **Relating Science** **ST 3**
  3
- ☐ **Relating Science** **ST 4**
  3
- ☐ **Relating Science** **ST 5**
  3
- ☐ **Relating Science** **ST 6**
  3
- ☐ **Relating Science** **ST 7**
  3

Blackline Master / File

- ☐ **Architectural Challenge** **ST 8**
  8_Architectural Challe.cwk
  Architectural Challenge studente instruction page
- ☐ **Changing States of Matter** **ST 2**
  2_Changing states of mat.cwk
  Student Investigation procedures and homework assignment.
- ☐ **Heat and Volume** **ST 6**
  6_Heat and volume.cwk
  Student investigation page for heat and volume (expansiion and contraction)
- ☐ **Heat Transfer: Conduction** **ST 3**
  3_Heat Transfer Conduct.cwk
  Student procedures for completing the investigation on conduction of heat.
- ☐ **Heat Transfer: Convection** **ST 4**
  4_Heat Transfer Convect.cwk
  Student information page for completing the investigation.
- ☐ **Heat Transfer: Radiation** **ST 5**
  5_Heat Transfer Radiat.cwk
  Student investigation page for radiation
- ☐ **Insulation** **ST 7**
  9_Insulation.cwk
  Student activity page for insulation
- ☐ **Source of all energy** **ST 1**
  1_Source of All Energy.cwk
  Student procedures and homework / analysis of the subtask.

Turning Up The Heat!

A Unit of Study Investigating Heat Energy An Integrated Unit for Grade 7

Print

☐ **Heat** **Unit**
Audrey Cartile and Alan J. Hirsch
ISBN 0-17-612012-2
Teacher's resource binder to the student textbook by Nelson Science

☐ **Science and Technology 7** **Unit**
Kyn Barker et al
ISBN 0-201-61394-8
Student textbook of Grade 7 Science program created by Addison-Wesley.

☐ **Science Power 7** **Unit**
Don Galbraith et al
ISBN 0-07-560357-8
Student textbook of grade 7 Science program by McGraw-Hill Ryerson

☐ **Science Power 7 Blackline Masters** **Unit**
Vijaya Balchandani et al
ISBN 0-07-560772-7
Blackline masters to the Science Power student textbook

Media

☐ **Encarta Encyclopedia Deluxe 2000** **Unit**
Microsoft
Multi-media encyclopedia

☐ **Heat * Energy** **ST 1**
Disney Educational Production 1995
Magic Lantern Communications Ltd.
Toll Free # 1-800-263-1717
e-mail video@magiclantern.ca
Website www.magiclantern.ca

☐ **Nelson Science & Technology 7** **Unit**
Nelson Canada
Computerized assessment bank.

Website

☐ **Energy and Environment Reseach Centre** **Unit**
http://www.eerc.und.nodak.edu/

☐ **Nelson Science and Technology** **Unit**
http://www.science.nelson.com
Website containing investigations performed by students and background information.

☐ **Solar Energy Network** **Unit**
http://www.solarenergy.net/tsenindex.html

Material

☐ **Insulation material list** **ST 7**
per group
- ice cube supplied by the teacher
- insulation material supplied by the students

☐ **material list for subtask** **ST 1**
per group
- 1 large newsprint sheet of paper
- black, green, purple, blue and red markers
- tape

Equipment / Manipulative

☐ **Investigation / equipment list** **ST 6**

per group

flask, plasticine, a bucket, narrow white drinking straws, water mixed with food colouring, ice water

☐ **Investigation equipment / material list** **ST 2**

per group

1 empty film can or other small mouthed container
measuring spoons
water
1 wide mouthed balloon
paper towels
fresh baking powder
sealable plastic bags
ice cubes
stop watches

☐ **Investigation equipment / material list** **ST 3**

per group

1 litre bowl
1 electric tea kettle
1 timing device (stopwatch)
1 metal butter knife
1 plastic knife
1 popsicle stick
3 cubes of butter (1 cm cubes)
3 sugar cubes

☐ **Investigation equipment / material list** **ST 4**

per group

1 retort stand or suitable facsimile
1 candle
matches
1 clamp
1 timing device (stopwatch)
10 to 30 centimetres of thread
1 sheet of white paper (letter size)
scissors

☐ **Investigation / equipment material list** **ST 5**

per group

1 timing device (stopwatch)
3 plastic pop bottles of equal size
white and black construction paper
3 thermometers
tape or glue
radiant heat source (preferably the sun)

Parent Community

☐ **Southridge Homes** **Unit**

Lasalle Ontario

Building material list with background information on home construction and energy efficiency.

Source Of All Energy

Material List (per group)

1 large newsprint sheet of paper
Black, Green, Purple, Blue and Red Markers
Tape

Procedure

1. Draw a circle in the centre of your paper and leave it empty for now.

2. Brainstorm common household items which use energy. Record these items on the outer edges of your paper using a black marker.

3. For each item on your paper, decide as a group which type of energy the item uses. Record the form of energy under the item using a blue marker.

4. Exchange papers with another group.

5. Determine and record as a group the source of energy for each item and its respective type of energy. For example, a solar calculator uses radiant energy which comes from the sun or equivalent light source. Record the source of energy under the type of energy using a red marker.

6. Connect all of the items, types of energy and the sources of energy to the circle in the centre of the paper using the green marker.

7. Exchange papers again with another group.

8. Look at all of the sources of energy on your paper. Decide as a group from where these sources of energy originate. Who is responsible for creating them? Write your answer in the circle using the purple marker. The teacher may need to assist the students in discovering that all the sources of energy have come from God.

9. Tape your graffiti poster to the chalkboard.

10. Complete the analysis activity on the investigation page for homework.

Analysis

Find 10 items in your home which consume energy. List the items under the first column. In the remaining columns, identify which form of energy your item uses, the source of the energy and any effects this item has on the environment. An example is included for you to follow.

Energy User	Forms of Energy	Sources of Energy	Effect on the Environment
Solar Calculator	Radiant	Sun or equivalent light source	Plastic components are not biodegradable

Changing States Of Matter

Lesson 1: The "Big Meltdown" Challenge

Safety Precautions

All work surfaces should be cleared.

Material List (per group)

sealable plastic bags
ice cubes
stop watch

Procedure

1. Your group will be getting a resealable plastic bag containing three ice cubes inside. Your task will be to melt the ice as quickly as possible. Your group must also time how long it actually took to completely melt the ice.
2. Your group will be given a few minutes to formulate strategies to melt the ice before you begin.
3. Do not touch the bags until the signal is given to do so.
4. After your ice has been melted and timed, you will be given some time to share and discuss the strategies your group used in this investigation.
5. After this discussion, place three drops of water in a petri dish and let sit overnight.
6. Predict what will happen to the water. Record these predictions in your notebooks.

Lesson 2: "The Balloon Mix"

Safety Precautions

- All work surfaces should be cleared.
- Only handle the balloons when they are inflating
- Inform the teacher if you have a latex allergy

Material List (per group)

1 empty film can or other small mouthed container
measuring spoons
water
1 wide mouthed balloon
paper towels
fresh baking powder

Procedure

1. Fill a small container approximately 3/4 full with water and secure a balloon over the mouth.
2. Empty the water into the balloon.
3. Remove and thoroughly dry the small container.
4. Measure 1/4 teaspoon of the baking powder and empty it into the small container.
5. Again secure the balloon over the mouth, without mixing the baking powder and water.
6. With the balloon still attached, transfer the water from the balloon into the small container.
7. Observe what happens and draw a series of pictures outlining what took place.

Analysis Questions

1. Record the individual group melting durations on board. Calculate the class mean melting duration. Create a bar graph whose horizontal axis (x-axis) records group names and whose vertical axis (y-axis) records melting duration. How did your melting time compare to the class mean?

2. Compare the individual group strategies used in the melting process. Indicate which methods promoted the shortest duration of melting.

Relating Science and Technology to the World Outside

1. Is heat transfer increased or decreased when ice changes to water?

2. Fruit growers will sometimes spray crops with water in the event of potential frost. Explain how this method is successful as it relates to changes of state.

3. Under natural conditions, water is one of the few substances that assumes all three states of matter: liquid, solid, gas. What name is given to water in gaseous form? Illustrate the molecular movement of water in all three states.

Culminating Task Considerations

Select a material which will generate minimum condensation in your tree house. Explain condensation as it applies to the changing states of matter. Record all observations, skills, facts, and questions during the investigation. There is a direct correlation between this subtask and the culminating task. Having a thorough notebook will assist you in the end. You may wish to consult with your group and/or teacher regarding verification or clarification.

Heat Transfer: Conduction

Safety Precautions

1. Safety goggles must be worn.
2. All work surfaces should be cleared.
3. Students should be standing when working with heat sources.
4. Oven mitts must be worn when handling hot equipment.

Material List (per group)

1 litre bowl
1 timing device (stopwatch)
1 plastic knife
3 cubes of butter (1 cm cubes)
1 electric tea kettle
1 metal butter knife
1 popsicle stick
3 sugar cubes

Advanced Preparation

Your teacher will already have brought to a boil enough water for your investigation

Procedure

1. Pour 500 ml of hot water into your bowl.
2. Place the metal butter knife, plastic knife and popsicle stick across the top of your bowl.
3. Place a cube of butter (centred) on each of the butter knife, plastic knife and popsicle stick.
4. Place a sugar cube (centred) on each of the butter cubes.
5. Predict which butter cube will melt first, last. Record your predictions in your notebook.
6. Time how long it takes for the each of the cubes to melt and fall off of its respective base.

Analysis Questions

1. Construct a bar graph whose horizontal axis (x-axis) records the type of conductor and whose vertical axis (y-axis) records the duration of heat conduction. Plot and compare.

2. Explain the process of conduction as you observed it. In your observations, which material served as the best conductor? Worst conductor?.

Relating Science and Technology to the World Outside

According to your knowledge of conduction, would it be more advisable to install air-conditioning vents on the ceiling or on the floor? Would the same advice apply to furnace heating? Baseboard electrical heating?

Culminating Task Considerations

Select a material which will generate optimum heat transfer through conduction. Consideration must be given to the placement of heating and cooling elements. Record all observations, skills, facts, and questions during the investigation. There is a direct connection between this subtask and the culminating task. Having a thorough notebook will assist you in the end. You may wish to consult with your group and/or teacher regarding verification or clarification.

Heat Transfer: Convection

Safety Precautions

- Safety goggles must be worn.
- All work surfaces should be cleared.
- Students should be standing when working with heat sources.

Material List (per group)

1 candle
matches
1 timing device (stopwatch)
1 sheet of white paper (letter size)
1 retort stand or suitable facsimile
1 clamp
10 to 30 centimetres of thread
scissors

Advanced Preparation

Your teacher will light the candle at the appropriate time.

Procedure

1. Begin at the centre of the paper and draw a spiral working your way to the outer edge.
2. Cut out the spiral.
3. Attach the centre of the spiral to the clamp.
4. Attach the clamp to the retort stand.
5. Observe the movement of the spiral cut-out. Make observations in your notebook.
6. Predict what will happen when you place heat below the spiral cut-out. Write the prediction in your notebook.
7. Light the candle provided.
8. Place the candle under the spiral cut-out.
9. Observe the movement of the spiral cut-out. Make observations in your notebook.

Analysis Questions

1. Did the spinner rotate in the direction you predicted? Define in your own words how the process of convection takes place.
2. What in particular governs the direction of the spiral?
3. Would the same results occur with other object shapes or object materials?
4. Could this information assist you in determining which materials would better meet the temperature control and energy efficiency of your tree house?

Relating Science and Technology to the World Outside

1. According to your knowledge of convection, determine the optimum location for air-return vents in home-heating systems.

2. You are contracted to design a heating and cooling system for your school gymnasium. The principal informs you that you are allowed to use separate vents for heating and air-conditioning. Generate a three-dimensional drawing of your gymnasium which will indicate the optimum placement of these vents.

3. Using the numbers 1-7, outline the development of a convection current.

_____air molecules move faster and farther apart, making this column of air less dense than the surrounding air

_____the temperature of the column of air rises as it approaches the heat source

_____the process is repeated

_____air above the heat source becomes warmer

_____surrounding air moves in to replace rising column of air

_____cooler, denser air descends

_____less dense air begins to rise

4. At what stage does convection take place in the water cycle?

Culminating Task Considerations

Select a material which will generate optimum heat transfer through convection. Consideration must be given to the placement of heating and cooling elements. Record all observations, skills, facts, and questions during the investigation. There is a direct connection between this subtask and the culminating task. Having a thorough notebook will assist you in the end. You may wish to consult with your group and/or teacher regarding verification or clarification.

Heat Transfer: Radiation

Safety Precautions

Handle glass thermometers carefully

Material List (per group)

1 timing device (stopwatch)
white and black construction paper
tape or glue
3 plastic pop bottles of equal size
3 thermometers
radiant heat source (preferably the sun)

Advanced Preparation

Your teacher will already have enough room temperature water for this experiment.

Procedure

1. Fully cover the outside of a bottle with black construction paper.

2. Fully cover the outside of another bottle with white construction paper.

3. Leave a third bottle clear.

4. Fill all three bottles equally with room temperature water.

5. Record the temperature of the water for each bottle.

6. Place the bottles in the same location, exposing them to the sun.

7. Predict what will happen to the temperature of the water in each of the bottles.

8. Record your predictions in your notebook.

9. Take the temperature of the three bottles: 10 trials at two minute intervals. Record the temperatures in a suitable table in your notebooks. **Do not leave the thermometers sitting in the bottles between temperature readings.**

Analysis Questions

1. Construct a line graph whose horizontal axis (x-axis) records the exposure time to radiant source and whose vertical axis (y-axis) records the internal temperature of the bottle. Plot and compare.

2. Analyse and share the results of your findings. Which bottle registered the highest internal temperature? Lowest temperature? Explain the process of radiation as it applied to this investigation.

Relating Science and Technology to the World Outside

1. Explain why the sun is considered a "radiant" energy source. Can the sun play an integral part in convectional or conductive heating? Justify your reasoning.

2. Describe how the water cycle is a process of energy transfer involving convection and radiation.

3. Give five examples of heat transfer by radiation.

4. Use the Particle Theory to explain the effect of the sun as a "radiant" energy source on human skin.

5. Examine the appliances in your home. Which provide energy transfer through radiation?

Culminating Task Considerations

Select a material whose colour will generate optimum heat transfer through radiation. Consideration must be given to the placement of windows and skylights. Record all observations, skills, facts, and questions during the investigation. There is a direct connection between this subtask and the culminating task. Having a thorough notebook will assist you in the end. You may wish to consult with your group and/or teacher regarding verification or clarification.

Heat And Volume

Safety Cautions

- Safety goggles must be worn.
- All work surfaces should be cleared.
- Students should be standing when working with heat sources.

Material List (per group)

flask	modeling clay
bucket	narrow white drinking straws
water mixed with food colouring	ice water

Procedure

1. Fill the flask 3/4 full with coloured water.
2. Mold the plasticine around the straw, insert the straw into the flask, and fit the plasticine over the opening of the flask.
3. Note the level of water in the straw.
4. Warm the flask by placing your hands around it for several minutes. Be sure to note what happens to liquid in the straw.
5. Cool the flask in a bucket of ice water. Note what happens to the level of the liquid in the straw.
6. Draw three diagrams illustrating what happened to the level of water as noted in steps 3, 4, and 5.

Analysis

1. What happens to liquids when they are heated? Cooled?
2. Could this apparatus be used as a thermometer? Explain why/why not.
3. Extend the knowledge gained in this investigation to explain how heat affects the volume of solids and gasses. Keep in mind what particle theory states about liquids and gasses.

Relating Science and Technology to the World Outside

1. Define the words "expand" and "contract." State which process requires the addition of energy and which the removal of energy.

2. Predict what will expand more when heated - a solid, a liquid, or a gas. Write a short report explaining the reasons for your prediction.

3. When laying rail down on a railway track, workers leave a considerable gap between the different sections of rail. Write a short report explaining why this is done. Find two other examples where this gap exists.

Culminating Task Considerations

Think of how the material involved in the construction of your building will need to expand and contract. (For example, wood flooring expands and contracts as heat is added or removed.) How would this affect the installation of your flooring? What other material in your remodeling will react this way? Make notes for yourself based on the knowledge you have learned in this investigation. List any questions regarding expansion and contraction you will need answered to help you in completing the culminating task.

Design Challenge: Tree House

Challenge

Your group of junior energy consultants has entered a contest to design an energy-efficient tree house. Your group is required to ensure that this project respond to the criteria of energy efficiency and conservation of thermal energy. In conclusion, your team must present its testing methods and propose a model which best exemplifies the highest standards of energy efficiency and conservation of thermal energy. Be prepared to justify your method of choice, as well as give a detailed floor plan of the tree house. You will also be required to present the potential positive and negative impacts that your development could have on the environment and community. Does the project provide for the use of renewable resources rather than non-renewable resources? Is there potential for the maximization of flow resources, e.g., sunlight, wind? Does the construction of the project promote the preservation of the ecosystem and animal habitat?

Getting Started

1. Determine which features are vital to the physical structure and stability of your tree house.
2. Determine which features may contribute to maximizing energy efficiency and conservation of thermal energy.
3. Determine which features from #1 and #2 are feasible.
4. Include a list of material needed for construction.
5. Research and estimate the costs involved in purchasing the material.
6. Develop a floor plan.
7. Provide a detailed written report, outlining the phase developments of your construction.
8. Explain how you will insulate your tree house. Submit a detailed diagram, labeled and drawn to scale.
9. Suggest a time frame for the completion of your project.
10. Submit your proposal for approval.

Prompts for brainstorming and research

- How will your tree house be heated?
- Will this source of heating create environmental concerns?
- Can the surrounding environment contribute positively to the construction?
- How valid is direction when placing windows?
- How valid is the colour of material?
- What material will you choose to insulate your tree house?

You may wish to consult your notebook for observations, skills, facts, and

questions at this time. Some of your questions may have already been answered in their respective investigations. Research those questions left unanswered. Apply acquired skills and facts to your architectural challenge.

Minimum Required Components

- a floor plan of your tree house indicating the location of all windows, doors and skylights, including the direction these items face;
- a diagram illustrating a "cutout" of your walls, labeling all insulation and construction materials from the finished interior wall to the finished exterior wall;
- a diagram illustrating the insulation of ceilings;
- a diagram illustrating the heat flow in the tree house, i.e., heating vents, air-conditioning vents, return air vents;
- a written report of your recommendations;
- measures which will be taken to minimize the negative impacts your development could have on the environment and community.

Assessment

Your project will be assessed according to the Architectural Challenge Rubric.

The following is a general list to consider when constructing an energy efficient home:

Heating and Cooling
Doors and Windows
Landscaping
Lighting
Insulation, Weathering, and Ventilation
Foundations
Walls and Windows
Roofs and Ceilings

Insulation

Safety Precautions

- No hazardous materials are allowed.
- Any cutting of material must be done under adult supervision.

Material List (per group)

- ice cube supplied by the teacher
- insulation material supplied by the students

Procedure

1. Design a container that will keep an ice cube frozen for the longest time possible.

2. Create a drawing of your container showing the construction of all sides.

3. Include one drawing showing a labelled cut-out of one side of your container (i.e., insulation material, container material, and any other material you may have used).

4. Show drawings to the teacher for approval

5. Construct your container.

Relating Science and Technology to the World Outside

1. Does insulation prevent heat from escaping or cold from entering? Use the Particle Theory to justify your answer.

2. Define the term "dead air space." Using items of clothing as examples, explain how "dead air space" promote good insulation.

3. Construct a chart with subtitles "heat conductors" and "heat insulators." Provide three examples of metals under each column. For each metal, name a household product whose metallic composition contributes to its function, e.g., insulated bottle. Explain how the process of conduction or insulation takes place in the household product.

4. Explain how God naturally insulated the Earth. Are we maintaining God's natural insulation? Are technological advances destroying God's natural insulation?

Culminating Task Considerations

Choose a metal which will generate optimum insulation in your tree house. Consideration must be given to the installation of windows, doors, vapour barriers, R-value, etc. Record all observations, skills, facts and questions during the investigation. There is a direct correlation between this subtask and the culminating task. Having a thorough notebook will assist you in the end. You may wish to consult with your group and/or teacher regarding verification or clarification.

Student Name: _____
Date: _____

Inquiry Rubric
for use with Subtask 2 : Changing States Of Matter
from the Grade 7 Unit: **Turning Up The Heat!**

Expectationsfor this Subtask to Assess with this Rubric:

7m70 • collect and organize categorical, discrete, or continuous primary data and secondary data and display the data using charts and graphs, including relative frequency tables and circle graphs;

7m81 – identify and describe trends, based on the distribution of the data presented in tables and graphs, using informal language;

7s53 • identify, through experimentation, ways in which heat changes substances, and describe how heat is transferred;

Category/Criteria	Level 1	Level 2	Level 3	Level 4
Understanding of basic concepts – analysis and interpretation of statistical data and explaining concepts	– gives explanations showing limited understanding of the concepts – demonstrates limited ability to interpret statistical data	– gives partial explanations – demonstrates some ability to interpret statistical data	– usually gives complete or nearly complete explanations – demonstrates considerable ability to interpret statistical data	– gives thorough explanations – demonstrates ability to interpret statistical data with thoroughness and accuracy
Communication of required knowledge	– communicates with little clarity and precision – rarely uses appropriate science and technology terminology	– communicates with some clarity and precision – sometimes uses appropriate science and technology terminology	– generally communicates with clarity and precision – usually uses appropriate science and technology terminology	– consistently communicates with clarity and precision – consistently uses appropriate science and technology terminology
Recording of Statistical Data	– with assistance – unclearly and imprecisely – rarely using appropriate statistical methods	– independently and with some clarity and precision – sometimes uses appropriate statistical methods	– independently – clearly and precisely – usually using appropriate statistical methods	– independently – clearly, precisely, and confidently – always using appropriate statistical methods

Student Name: _____
Date: _____

Relating Science
for use with Subtask 2 : Changing States Of Matter
from the Grade 7 Unit: **Turning Up The Heat!**

Expectationsfor this Subtask to Assess with this Rubric:

7s53 • identify, through experimentation, ways in which heat changes substances, and describe how heat is transferred;

7s56 – compare the motions of particles in a solid, a liquid, and a gas using the particle theory;

7s61 – describe the effect of heat on the motion of particles and explain how changes of state occur (e.g., from a liquid into a gas or vapour);

Category/Criteria	Level 1	Level 2	Level 3	Level 4
Application of knowledge and skills	– demonstrates limited ability to apply skills	– demonstrates some ability to apply skills	– demonstrates considerable ability to apply skills	– applies skills thoroughly
Connects concepts to the world outside of the school	– makes limited connections between the concepts and the world beyond the classroom	– makes some connections between the concepts and the world beyond the classroom	– makes considerable connections between the concepts and the world beyond the classroom	– makes thorough connections between the concepts and the world beyond the classroom
Understands the implications of science and technology	– demonstrates limited ability to identify implications which science and technology may have in the world outside of school	– demonstrates some ability to identify implications which science and technology may have have in the world outside of school	– demonstrates considerable ability to identify implications which science and technology may have in the world outside of school	– identifies implications which science and technology may have in the world outside of school and can explain potential consequences and benefits

Student Name: _____
Date: _____

Inquiry Rubric
for use with Subtask 3 : Heat Transfer: Conduction
from the Grade 7 Unit: **Turning Up The Heat!**

Expectationsfor this Subtask to Assess with this Rubric:

7m102- – display data on bar graphs, pictographs, and circle graphs, with and without the help of technology;-REMOVED 2005

7s57 – explain how heat is transmitted by conduction, convection, and radiation in solids, liquids, and gases (e.g., conduction: a pot heating on a stove; convection: a liquid heating in the pot; radiation: the air being warmed by heat from the element);

7s68 – compile qualitative and quantitative data gathered through investigation in order to record and present results, using diagrams, flow charts, frequency tables, bar graphs, line graphs, and stem-and-leaf plots produced by hand or with a computer (e.g., plot a graph showing the decrease in temperature of various liquids from identical initial temperatures)

Category/Criteria	Level 1	Level 2	Level 3	Level 4
Understanding of basic concepts – analysis and interpretation of statistical data and explaining concepts	– gives explanations showing limited understanding of the concepts – demonstrates limited ability to interpret statistical data	– gives partial explanations – demonstrates some ability to interpret statistical data	– usually gives complete or nearly complete explanations – demonstrates considerable ability to interpret statistical data	– gives thorough explanations – demonstrates ability to interpret statistical data with thoroughness and accuracy
Communication of required knowledge	– communicates with little clarity and precision – rarely uses appropriate science and technology terminology	– communicates with some clarity and precision – sometimes uses appropriate science and technology terminology	– generally communicates with clarity and precision – usually uses appropriate science and technology terminology	– consistently communicates with clarity and precision – consistently uses appropriate science and technology terminology
Recording of Statistical Data	– with assistance – unclearly and imprecisely – rarely using appropriate statistical methods	– independently and with some clarity and precision – sometimes uses appropriate statistical methods	– independently – clearly and precisely – usually using appropriate statistical methods	– independently – clearly, precisely, and confidently – always using appropriate statistical methods

Student Name: _____
Date: _____

Relating Science
for use with Subtask 3 : Heat Transfer: Conduction
from the Grade 7 Unit: **Turning Up The Heat!**

HEAT

Expectationsfor this Subtask to Assess with this Rubric:

7s69 – communicate the procedures and results of investigations for specific purposes and to specific audiences, using media works, written notes and descriptions, charts, graphs, drawings, and oral presentations (e.g., use a diagram to illustrate convection in a liquid or a gas).

Category/Criteria	Level 1	Level 2	Level 3	Level 4
Application of knowledge and skills	– demonstrates limited ability to apply skills	– demonstrates some ability to apply skills	– demonstrates considerable ability to apply skills	– applies skills thoroughly
Connects concepts to the world outside of the school	– makes limited connections between the concepts and the world beyond the classroom	– makes some connections between the concepts and the world beyond the classroom	– makes considerable connections between the concepts and the world beyond the classroom	– makes thorough connections between the concepts and the world beyond the classroom
Understands the implications of science and technology	– demonstrates limited ability to identify implications which science and technology may have in the world outside of school	– demonstrates some ability to identify implications which science and technology may have have in the world outside of school	– demonstrates considerable ability to identify implications which science and technology may have in the world outside of school	– identifies implications which science and technology may have in the world outside of school and can explain potential consequences and benefits

Student Name: _____
Date: _____

Inquiry Rubric

for use with Subtask 4 : Heat Transfer: Convection
from the Grade 7 Unit: **Turning Up The Heat!**

HEAT

Expectationsfor this Subtask to Assess with this Rubric:

7s57 – explain how heat is transmitted by conduction, convection, and radiation in solids, liquids, and gases (e.g., conduction: a pot heating on a stove; convection: a liquid heating in the pot; radiation: the air being warmed by heat from the element);

7s67 – use appropriate vocabulary, including correct science and technology terminology, to communicate ideas, procedures, and results (e.g., state the boiling and freezing points of water, room temperature, and body temperature in degrees Celsius; correctly use the terms heat conductor and heat insulator);

7s69 – communicate the procedures and results of investigations for specific purposes and to specific audiences, using media works, written notes and descriptions, charts, graphs, drawings, and oral presentations (e.g., use a diagram to illustrate convection in a liquid or a gas).

Category/Criteria	Level 1	Level 2	Level 3	Level 4
Understanding of basic concepts – analysis and interpretation of statistical data and explaining concepts	– gives explanations showing limited understanding of the concepts – demonstrates limited ability to interpret statistical data	– gives partial explanations – demonstrates some ability to interpret statistical data	– usually gives complete or nearly complete explanations – demonstrates considerable ability to interpret statistical data	– gives thorough explanations – demonstrates ability to interpret statistical data with thoroughness and accuracy
Communication of required knowledge	– communicates with little clarity and precision – rarely uses appropriate science and technology terminology	– communicates with some clarity and precision – sometimes uses appropriate science and technology terminology	– generally communicates with clarity and precision – usually uses appropriate science and technology terminology	– consistently communicates with clarity and precision – consistently uses appropriate science and technology terminology
Recording of Statistical Data	– with assistance – unclearly and imprecisely – rarely using appropriate statistical methods	– independently and with some clarity and precision – sometimes uses appropriate statistical methods	– independently – clearly and precisely – usually using appropriate statistical methods	– independently – clearly, precisely, and confidently – always using appropriate statistical methods

Student Name: _____

Date: _____

Relating Science
for use with Subtask 4 : Heat Transfer: Convection
from the Grade 7 Unit: **Turning Up The Heat!**

HEAT

Expectationsfor this Subtask to Assess with this Rubric:

7e1 • communicate ideas and information for a variety of purposes (to outline an argument, to report on observations) and to specific audiences, using forms appropriate for their purpose and topic (e.g., write a lab report for an audience familiar with the scientific terminology);

7s57 – explain how heat is transmitted by conduction, convection, and radiation in solids, liquids, and gases (e.g., conduction: a pot heating on a stove; convection: a liquid heating in the pot; radiation: the air being warmed by heat from the element);

7s67 – use appropriate vocabulary, including correct science and technology terminology, to communicate ideas, procedures, and results (e.g., state the boiling and freezing points of water, room temperature, and body temperature in degrees Celsius; correctly use the terms heat conductor and heat insulator);

7s68 – compile qualitative and quantitative data gathered through investigation in order to record and present results, using diagrams, flow charts, frequency tables, bar graphs, line graphs, and stem-and-leaf plots produced by hand or with a computer (e.g., plot a graph showing the decrease in temperature of various liquids from identical initia temperatures);

7s69 – communicate the procedures and results of investigations for specific purposes and to specific audiences, using media works, written notes and descriptions, charts, graphs, drawings, and oral presentations (e.g., use a diagram to illustrate convection in a liquid or a gas).

Category/Criteria	Level 1	Level 2	Level 3	Level 4
Application of knowledge and skills	– demonstrates limited ability to apply skills	– demonstrates some ability to apply skills	– demonstrates considerable ability to apply skills	– applies skills thoroughly
Connects concepts to the world outside of the school	– makes limited connections between the concepts and the world beyond the classroom	– makes some connections between the concepts and the world beyond the classroom	– makes considerable connections between the concepts and the world beyond the classroom	– makes thorough connections between the concepts and the world beyond the classroom
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Student Name: _____

Date: _____

Inquiry Rubric

for use with Subtask 5 : Heat Transfer: Radiation

from the Grade 7 Unit: **Turning Up The Heat!**

Expectationsfor this Subtask to Assess with this Rubric:

7m70 • collect and organize categorical, discrete, or continuous primary data and secondary data and display the data using charts and graphs, including relative frequency tables and circle graphs;

7s58 – describe how various surfaces absorb radiant heat;

7s68 – compile qualitative and quantitative data gathered through investigation in order to record and present results, using diagrams, flow charts, frequency tables, bar graphs, line graphs, and stem-and-leaf plots produced by hand or with a computer (e.g., plot a graph showing the decrease in temperature of various liquids from identical initial) temperatures.)

Category/Criteria	Level 1	Level 2	Level 3	Level 4
Understanding of basic concepts – analysis and interpretation of statistical data and explaining concepts	– gives explanations showing limited understanding of the concepts – demonstrates limited ability to interpret statistical data	– gives partial explanations – demonstrates some ability to interpret statistical data	– usually gives complete or nearly complete explanations – demonstrates considerable ability to interpret statistical data	– gives thorough explanations – demonstrates ability to interpret statistical data with thoroughness and accuracy
Communication of required knowledge	– communicates with little clarity and precision – rarely uses appropriate science and technology terminology	– communicates with some clarity and precision – sometimes uses appropriate science and technology terminology	– generally communicates with clarity and precision – usually uses appropriate science and technology terminology	– consistently communicates with clarity and precision – consistently uses appropriate science and technology terminology
Recording of Statistical Data	– with assistance – unclearly and imprecisely – rarely using appropriate statistical methods	– independently and with some clarity and precision – sometimes uses appropriate statistical methods	– independently – clearly and precisely – usually using appropriate statistical methods	– independently – clearly, precisely, and confidently – always using appropriate statistical methods

Student Name: _____
Date: _____

Relating Science
for use with Subtask 5 : Heat Transfer: Radiation
from the Grade 7 Unit: **Turning Up The Heat!**

HEAT

Expectationsfor this Subtask to Assess with this Rubric:

7s71 – explain how the heating and cooling of the earth's surface produces air movement that results in all weather effects (e.g., convection currents);

7s72 – describe the water cycle as a process of energy transfer involving convection and radiation;

Category/Criteria	Level 1	Level 2	Level 3	Level 4
Application of knowledge and skills	– demonstrates limited ability to apply skills	– demonstrates some ability to apply skills	– demonstrates considerable ability to apply skills	– applies skills thoroughly
Connects concepts to the world outside of the school	– makes limited connections between the concepts and the world beyond the classroom	– makes some connections between the concepts and the world beyond the classroom	– makes considerable connections between the concepts and the world beyond the classroom	– makes thorough connections between the concepts and the world beyond the classroom
Understands the implications of science and technology	– demonstrates limited ability to identify implications which science and technology may have in the world outside of school	– demonstrates some ability to identify implications which science and technology may have have in the world outside of school	– demonstrates considerable ability to identify implications which science and technology may have in the world outside of school	– identifies implications which science and technology may have in the world outside of school and can explain potential consequences and benefits

Student Name: _____
Date: _____

Inquiry Rubric
for use with Subtask 6 : Heat And Volume
from the Grade 7 Unit: **Turning Up The Heat!**

Expectationsfor this Subtask to Assess with this Rubric:

7s54 • explain how the characteristics and properties of heat can be used, and identify the effect of some of these applications on products, systems, and living things in the natural and human-made environments.

7s59 – describe the effect of heating and cooling on the volume of a solid, a liquid, and a gas;

7s67 – use appropriate vocabulary, including correct science and technology terminology, to communicate ideas, procedures, and results (e.g., state the boiling and freezing points of water, room temperature, and body temperature in degrees Celsius; correctly use the terms heat conductor and heat insulator);

Category/Criteria	Level 1	Level 2	Level 3	Level 4
Understanding of basic concepts – analysis and interpretation of statistical data and explaining concepts	– gives explanations showing limited understanding of the concepts – demonstrates limited ability to interpret statistical data	– gives partial explanations – demonstrates some ability to interpret statistical data	– usually gives complete or nearly complete explanations – demonstrates considerable ability to interpret statistical data	– gives thorough explanations – demonstrates ability to interpret statistical data with thoroughness and accuracy
Communication of required knowledge	– communicates with little clarity and precision – rarely uses appropriate science and technology terminology	– communicates with some clarity and precision – sometimes uses appropriate science and technology terminology	– generally communicates with clarity and precision – usually uses appropriate science and technology terminology	– consistently communicates with clarity and precision – consistently uses appropriate science and technology terminology
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Student Name: _____
Date: _____

Relating Science
for use with Subtask 6 : Heat And Volume
from the Grade 7 Unit: **Turning Up The Heat!**

Expectationsfor this Subtask to Assess with this Rubric:

7s54 • explain how the characteristics and properties of heat can be used, and identify the effect of some of these applications on products, systems, and living things in the natural and human-made environments.

7s59 – describe the effect of heating and cooling on the volume of a solid, a liquid, and a gas;

7s67 – use appropriate vocabulary, including correct science and technology terminology, to communicate ideas, procedures, and results (e.g., state the boiling and freezing points of water, room temperature, and body temperature in degrees Celsius; correctly use the terms heat conductor and heat insulator);

Category/Criteria	Level 1	Level 2	Level 3	Level 4
Application of knowledge and skills	– demonstrates limited ability to apply skills	– demonstrates some ability to apply skills	– demonstrates considerable ability to apply skills	– applies skills thoroughly
Connects concepts to the world outside of the school	– makes limited connections between the concepts and the world beyond the classroom	– makes some connections between the concepts and the world beyond the classroom	– makes considerable connections between the concepts and the world beyond the classroom	– makes thorough connections between the concepts and the world beyond the classroom
Understands the implications of science and technology	– demonstrates limited ability to identify implications which science and technology may have in the world outside of school	– demonstrates some ability to identify implications which science and technology may have have in the world outside of school	– demonstrates considerable ability to identify implications which science and technology may have in the world outside of school	– identifies implications which science and technology may have in the world outside of school and can explain potential consequences and benefits

Student Name: _____
Date: _____

Relating Science
for use with Subtask 7 : Insulation
from the Grade 7 Unit: **Turning Up The Heat!**

Expectationsfor this Subtask to Assess with this Rubric:

7s54 • explain how the characteristics and properties of heat can be used, and identify the effect of some of these applications on products, systems, and living things in the natural and human-made environments.

7s70 – recognize heat as a necessity for the survival of plants and animals;

7s78 – identify and describe steps that can be taken to conserve energy (e.g., using insulation) and the reasons for doing so (e.g., rising fuel costs);

Category/Criteria	Level 1	Level 2	Level 3	Level 4
Application of knowledge and skills	– demonstrates limited ability to apply skills	– demonstrates some ability to apply skills	– demonstrates considerable ability to apply skills	– applies skills thoroughly
Connects concepts to the world outside of the school	– makes limited connections between the concepts and the world beyond the classroom	– makes some connections between the concepts and the world beyond the classroom	– makes considerable connections between the concepts and the world beyond the classroom	– makes thorough connections between the concepts and the world beyond the classroom
Understands the implications of science and technology	– demonstrates limited ability to identify implications which science and technology may have in the world outside of school	– demonstrates some ability to identify implications which science and technology may have have in the world outside of school	– demonstrates considerable ability to identify implications which science and technology may have in the world outside of school	– identifies implications which science and technology may have in the world outside of school and can explain potential consequences and benefits

Turning Up The Heat!

A Unit of Study Investigating Heat Energy An Integrated Unit for Grade 7

		Selected	Assessed
English Language---Writing			
☐ **7e1**	• communicate ideas and information for a variety of purposes (to outline an argument, to report on observations) and to specific audiences, using forms appropriate for their purpose and topic (e.g., write a lab report for an audience familiar with the scientific terminology);	2	2
English Language---Oral and Visual Communication			
☐ **7e51**	• contribute and work constructively in groups;	1	5
Mathematics---Data Management and Probability			
☐ **7m70**	• collect and organize categorical, discrete, or continuous primary data and secondary data and display the data using charts and graphs, including relative frequency tables and circle graphs;		2
☐ **7m73**	– collect data by conducting a survey or an experiment to do with themselves, their environment, issues in their school or community, or content from another subject and record observations or measurements;	3	
☐ **7m78**	– read, interpret, and draw conclusions from primary data (e.g., survey results, measurements, observations) and from secondary data (e.g., temperature data or community data in the newspaper, data from the Internet about populations) presented in charts, tables, and graphs (including relative frequency tables and circle graphs);	1	1
Science and Technology---Energy and Control			
☐ **7s53**	• identify, through experimentation, ways in which heat changes substances, and describe how heat is transferred;		1
☐ **7s54**	• explain how the characteristics and properties of heat can be used, and identify the effect of some of these applications on products, systems, and living things in the natural and human-made environments.		2
☐ **7s55**	– distinguish between the concept of temperature and the concept of heat (e.g., temperature is a measure of the average kinetic energy of the molecules in a substance; heat is thermal energy that is transferred from one substance to another);	1	1
☐ **7s56**	– compare the motions of particles in a solid, a liquid, and a gas using the particle theory;		1
☐ **7s57**	– explain how heat is transmitted by conduction, convection, and radiation in solids, liquids, and gases (e.g., conduction: a pot heating on a stove; convection: a liquid heating in the pot; radiation: the air being warmed by heat from the element);	1	2
☐ **7s58**	– describe how various surfaces absorb radiant heat;		1
☐ **7s59**	– describe the effect of heating and cooling on the volume of a solid, a liquid, and a gas;		1
☐ **7s60**	– investigate and identify factors affecting the rate of temperature change (e.g., mass, nature of liquid) using a constant heat source;	1	
☐ **7s61**	– describe the effect of heat on the motion of particles and explain how changes of state occur (e.g., from a liquid into a gas or vapour);		1
☐ **7s62**	– compare, in qualitative terms, the heat capacities of common materials (e.g., water and aluminum have greater heat capacities than sand and Pyrex);	1	
☐ **7s63**	– identify systems that are controlled by sensory inputs and feedbacks (e.g., a thermostat);		1
☐ **7s64**	– design and build a device that minimizes energy transfer (e.g., an incubator, a Thermos flask).		2
☐ **7s65**	– formulate questions about and identify needs and problems related to heat (e.g., interactions involving energy transfers), and explore possible answers and solutions (e.g., identify the steps that could be followed to test the effectiveness of the heating system in a home that uses solar energy);		1
☐ **7s66**	– plan investigations for some of these answers and solutions, identifying variables that need to be held constant to ensure a fair test and identifying criteria for assessing solutions;		1
☐ **7s67**	– use appropriate vocabulary, including correct science and technology terminology, to communicate ideas, procedures, and results (e.g., state the boiling and freezing points of water, room temperature, and body temperature in degrees Celsius; correctly use the terms heat conductor and heat insulator);	1	2
☐ **7s68**	– compile qualitative and quantitative data gathered through investigation in order to record and present results, using diagrams, flow charts, frequency tables, bar graphs, line graphs, and stem-and-leaf plots produced by hand or with a computer (e.g., plot a graph showing the decrease in temperature of various liquids from identical initial temperatures);	1	3
☐ **7s69**	– communicate the procedures and results of investigations for specific purposes and to specific audiences, using media works, written notes and descriptions, charts, graphs, drawings, and oral presentations (e.g., use a diagram to illustrate convection in a liquid or a gas).	2	2
☐ **7s70**	– recognize heat as a necessity for the survival of plants and animals;	1	2
☐ **7s71**	– explain how the heating and cooling of the earth's surface produces air movement that results in all weather effects (e.g., convection currents);		1
☐ **7s72**	– describe the water cycle as a process of energy transfer involving convection and radiation;		1
☐ **7s73**	– identify different forms of energy that can be transformed into heat energy (e.g., mechanical, chemical, nuclear, or electrical energy);		1

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		Selected	Assessed
☐ **7s74**	– explain how mechanical systems produce heat (e.g., by friction), and describe ways to make these systems more efficient (e.g., by lubrication);		1
☐ **7s75**	– describe and explain issues related to heat pollution, including both positive and negative aspects (e.g., industrial processes and generation of electricity cause heat pollution of large bodies of water);		2
☐ **7s76**	– explain why heat energy is considered to be the final or end form of energy transformation;	1	
☐ **7s77**	– identify the purpose of the specialized features of various instruments that are used to measure temperature (e.g., temperature probes provide accurate continuous readings);		1
☐ **7s78**	– identify and describe steps that can be taken to conserve energy (e.g., using insulation) and the reasons for doing so (e.g., rising fuel costs);		2
☐ **7s79**	– identify the components of a system that are designed to transfer heat energy (e.g., in a room, a house, or a shopping centre) and describe methods for conserving energy within that system.		1

The Arts---

☐ **7a35**	• produce two- and three-dimensional works of art that communicate a variety of ideas (thoughts, feelings, experiences) for specific purposes and to specific audiences, using appropriate art forms;		1

Expectation Summary

Selected **Assessed**

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English Language

7e1 **2** **2**	7e2	7e3	7e4	7e5	7e6	7e7	7e8	7e9	7e10
7e11	7e12	7e13	7e14	7e15	7e16	7e17	7e18	7e19	7e20
7e21	7e22	7e23	7e24	7e25	7e26	7e27	7e28	7e29	7e30
7e31	7e32	7e33	7e34	7e35	7e36	7e37	7e38	7e39	7e40
7e41	7e42	7e43	7e44	7e45	7e46	7e47	7e48	7e49	7e50
7e51 **1** **5**	7e52	7e53	7e54	7e55	7e56	7e57	7e58	7e59	7e60
7e61	7e62	7e63	7e64	7e65	7e66	7e67	7e68	7e69	7e70

Core French

7f1	7f2	7f3	7f4	7f5	7f6	7f7	7f8	7f9	7f10
7f11	7f12	7f13	7f14	7f15	7f16	7f17			

Mathematics

7m1	7m2	7m3	7m4	7m5	7m6	7m7	7m8	7m9	7m10
7m11	7m12	7m13	7m14	7m15	7m16	7m17	7m18	7m19	7m20
7m21	7m22	7m23	7m24	7m25	7m26	7m27	7m28	7m29	7m30
7m31	7m32	7m33	7m34	7m35	7m36	7m37	7m38	7m39	7m40
7m41	7m42	7m43	7m44	7m45	7m46	7m47	7m48	7m49	7m50
7m51	7m52	7m53	7m54	7m55	7m56	7m57	7m58	7m59	7m60
7m61	7m62	7m63	7m64	7m65	7m66	7m67	7m68	7m69	7m70 **2**
7m71	7m72	7m73 **3**	7m74	7m75	7m76	7m77	7m78 **1** **1**	7m79	7m80
7m81	7m82	7m83	7m84	7m85	7m86				

Science and Technology

7s1	7s2	7s3	7s4	7s5	7s6	7s7	7s8	7s9	7s10
7s11	7s12	7s13	7s14	7s15	7s16	7s17	7s18	7s19	7s20
7s21	7s22	7s23	7s24	7s25	7s26	7s27	7s28	7s29	7s30
7s31	7s32	7s33	7s34	7s35	7s36	7s37	7s38	7s39	7s40
7s41	7s42	7s43	7s44	7s45	7s46	7s47	7s48	7s49	7s50
7s51	7s52	7s53 **1**	7s54 **2**	7s55 **1** **1**	7s56 **1**	7s57 **1** **2**	7s58 **1**	7s59 **1**	7s60 **1**
7s61 **1**	7s62 **1**	7s63 **1**	7s64 **2**	7s65 **1**	7s66 **1**	7s67 **1** **2**	7s68 **1** **3**	7s69 **2** **2**	7s70 **1** **2**
7s71 **1**	7s72 **1**	7s73 **1**	7s74 **1**	7s75 **2**	7s76 **1**	7s77 **1**	7s78 **2**	7s79 **1**	7s80
7s81	7s82	7s83	7s84	7s85	7s86	7s87	7s88	7s89	7s90
7s91	7s92	7s93	7s94	7s95	7s96	7s97	7s98	7s99	7s100
7s101	7s102	7s103	7s104	7s105	7s106	7s107	7s108	7s109	7s110
7s111	7s112	7s113	7s114	7s115	7s116	7s117	7s118	7s119	7s120
7s121	7s122	7s123	7s124	7s125	7s126	7s127	7s128	7s129	7s130
7s131									

Geography

7g1	7g2	7g3	7g4	7g5	7g6	7g7	7g8	7g9	7g10
7g11	7g12	7g13	7g14	7g15	7g16	7g17	7g18	7g19	7g20
7g21	7g22	7g23	7g24	7g25	7g26	7g27	7g28	7g29	7g30
7g31	7g32	7g33	7g34	7g35	7g36	7g37	7g38	7g39	7g40
7g41	7g42	7g43	7g44	7g45	7g46	7g47	7g48	7g49	7g50
7g51	7g52	7g53							

History

7h1	7h2	7h3	7h4	7h5	7h6	7h7	7h8	7h9	7h10
7h11	7h12	7h13	7h14	7h15	7h16	7h17	7h18	7h19	7h20
7h21	7h22	7h23	7h24	7h25	7h26	7h27	7h28	7h29	7h30
7h31	7h32	7h33	7h34	7h35	7h36	7h37	7h38	7h39	7h40
7h41	7h42	7h43	7h44	7h45	7h46	7h47	7h48	7h49	7h50
7h51	7h52								

Health and Physical Education

7p1	7p2	7p3	7p4	7p5	7p6	7p7	7p8	7p9	7p10
7p11	7p12	7p13	7p14	7p15	7p16	7p17	7p18	7p19	7p20
7p21	7p22	7p23	7p24	7p25	7p26	7p27	7p28	7p29	7p30
7p31	7p32	7p33	7p34	7p35	7p36	7p37	7p38	7p39	7p40
7p41	7p42								

The Arts

7a1	7a2	7a3	7a4	7a5	7a6	7a7	7a8	7a9	7a10
7a11	7a12	7a13	7a14	7a15	7a16	7a17	7a18	7a19	7a20
7a21	7a22	7a23	7a24	7a25	7a26	7a27	7a28	7a29	7a30
7a31	7a32	7a33	7a34	7a35 **1**	7a36	7a37	7a38	7a39	7a40
7a41	7a42	7a43	7a44	7a45	7a46	7a47	7a48	7a49	7a50
7a51	7a52	7a53	7a54	7a55	7a56	7a57	7a58	7a59	7a60
7a61	7a62	7a63	7a64	7a65	7a66	7a67	7a68	7a69	7a70
7a71	7a72	7a73	7a74	7a75	7a76	7a77	7a78		

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Analysis Of Unit Components

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-- Unique Expectations --
2 Language Expectations
3 Mathematics Expectations
27 Science And Tech Expectations
1 Arts Expectations

Resource Types

11 Rubrics
8 Blackline Masters
0 Licensed Software
4 Print Resources
3 Media Resources
3 Websites
2 Material Resources
5 Equipment / Manipulatives
0 Sample Graphics
0 Other Resources
1 Parent / Community
0 Companion Bookmarks

Groupings

3 Students Working As A Whole Class
7 Students Working In Small Groups
7 Students Working Individually

Teaching / Learning Strategies

2 Brainstorming
1 Case Study
3 Collaborative/cooperative Learning
1 Demonstration
6 Experimenting
2 Graphing
6 Homework
5 Inquiry
1 Learning Log/ Journal
2 Model Making
4 Note-making
1 Numbered Heads
2 Open-ended Questions
1 Problem-solving Strategies
1 Research
1 Role Playing
1 Simulation
1 Writing Process

Assessment Recording Devices

8 Anecdotal Record
5 Rubric

Assessment Strategies

2 Classroom Presentation
1 Essay
3 Exhibition/demonstration
1 Learning Log
4 Observation
8 Performance Task
6 Questions And Answers (oral)
6 Select Response