Earth and Space Science:
Earth's Crust
Appendix

Time After Time (45 minutes) Student Notes

Outcomes

Students will be expected to

- develop a chronological model or geological time scale of major events in Earth's history (209-4, 311-6)

Assessment

Beginning (you need to come for help and try again)	It's OK if you are OK with it	Wow!
model incomplete or incorrect as outlined not all questions answered little evidence of thought or understanding of outcomes	model is complete and correct as outlined all questions answered evidence of thought and understanding of outcomes	model is complete and correct with evidence of extra attention and detail all questions answered thoroughly using detail and showing thought and understanding evidence of thought and understanding of outcomes evidence of extra creativity, detail

Question

What does a time line of the Earth look like?

Materials

4.5 metres of 8–10 cm wide paper (adding machine paper works well), metre stick, pencil and colours (markers, coloured pencils)

Procedure

Using the time chart, calculate what measurements you will use to represent each time period. Hint: the Earth is 4.5 billion years old; you have 4.5 metres of paper.

- Using the metre stick and a pencil, mark off the time eras on the paper. Do not use colours until you have decided that the measurements are correct.
- Subdivide the eras into periods.
- Colour code the eras. Sketch some events which occurred in each era.
- Answer the following questions to show you understand some of the formation of the Earth.

Results

When you are finished, you and your partner will have created a visual representation of Earth's time line.

Analysis

- From your time model, comment on the amount of time humans have been on Earth.
- When do living things appear on your model?
- What kinds of living things appear to have been the most successful at surviving on Earth? Why do you think that is so?
- Cape Breton is our coal supplier. To see the trees that are now coal, how far back in time would you have to travel? What other living things would you see?
- Amber is a fossilized resin which often has insects and plant matter trapped in it. When was this amber actual resin?
- Why would it have been scientifically impossible for Fred Flintstone to have had Dino as a pet?
- Which came first, the horse or the rider?
- Compare the length of time on Earth between dinosaurs and humans. (How many times longer were dinosaurs on Earth?)
- Why do you think you have drawn nothing in the pre-Cambrian era? Think carefully. Discuss this in the group so all reasons have been considered.

Time After Time (45 minutes) Teacher Notes

Outcomes

Students will be expected to

- develop a chronological model or geological time scale of major events in Earth's history (209-4, 311-6)

Assessment

Beginning (you need to come for help and try again)	It's OK if you are OK with it	Wow!
model incomplete or incorrect as outlined not all questions answered little evidence of thought or understanding of outcomes	model is complete and correct as outlined all questions answered evidence of thought and understanding of outcomes	model is complete and correct with evidence of extra attention and detail all questions answered thoroughly using detail and showing thought and understanding evidence of thought and understanding of outcomes evidence of extra creativity, detail

Question

What does a time line of the Earth look like?

Materials

4.5 metres of 8–10 cm wide paper (adding machine paper works well), metre stick, pencil and colours (markers, coloured pencils)

Background

Creating models allows students to understand large periods of time. Kinesethic and visual learners will benefit from a 'hands-on' approach. This activity also creates an art/science cross-over. If 4.5 metres is used for the paper, the scale becomes 1 metre = 1 billion years; 1 mm = 1 million years and 0.01 mm = 10 000 years.

Procedure

Using the time chart, calculate what measurements you will use to represent each time period. Hint: the Earth is 4.5 billion years old; you have 4.5 metres of paper.

- Using the metre stick and a pencil, mark off the time eras on the paper. Do not use colours until you have decided that the measurements are correct.
- Subdivide the eras into periods.
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When you are finished, you and your partner will have created a visual representation of Earth's time line.

Analysis

- From your time model, comment on the amount of time humans have been on Earth.
- When do living things appear on your model?
- What kinds of living things appear to have been the most successful at surviving on Earth? Why do you think that is so?
- Cape Breton is our coal supplier. To see the trees that are now coal, how far back in time would you have to travel? What other living things would you see?
- Amber is a fossilized resin which often has insects and plant matter trapped in it. When was this amber actual resin?
- Why would it have been scientifically impossible for Fred Flintstone to have had Dino as a pet?
- Which came first, the horse or the rider?
- Compare the length of time on Earth between dinosaurs and humans. (How many times longer were dinosaurs on Earth?)
- Why do you think you have drawn nothing in the pre-Cambrian era? Think carefully. Discuss this in the group so all reasons have been considered.

Crystal Building (45 minutes) Teacher Notes

Outcomes

Students will be expected to

- identify questions to investigate arising from the study of the rock cycle (208-2)
- use tools and apparatus safely when modeling or simulating the formation fo rock types (209-6)

Assessment

Beginning (you need to come for help and try again)	Its OK if you are OK with it	Wow!!
actions in the lab were unsafe report is incomplete report has incorrect information included	report is complete; blue or black ink used for write-up, pencil for sketches attempt has been made to explain crystal development some connections made between lab procedure and crystal formation in minerals	report is complete; added detail included in description and/or sketches explanation shows understanding of how crystals form and factors which may affect their formation connections between what happened in the lab and in nature show understanding of concepts by using examples from nature

Questions

How do crystals form? What factors affect crystal formation?

Materials Apparatus

sugar (optional), salt, alum, beakers or jars, cotton thread or string, pencil or glass rod

Background

Minerals are crystalline. Crystalline structures are characterized by an ordered internal arrangement of atoms or molecules. The external shape of a mineral may or may not reflect this ordered structure. If a mineral is in the form of a crystal its external form reflects its internal structure. Quartz is commonly found as crystals and as fractured pieces that do not have a crystal form. It is not necessary for students to understand the concept of what atoms and molecules are, but they should understand the concept of ordered structure. An analogy of stacking blocks (or some other object) in a regular pattern is useful to explain ordered structure.

Rocks are composed of mineral grains. Some sedimentary rocks contain, or are composed completely of, minerals that crystallize from concentrated seawater. These include rock gypsum and rock salt (halite). Igneous rocks are those that solidify from molten material. Grain (crystal) size in igneous rocks is controlled by rate of cooling. If a magma (molten material) cools slowly crystals will grow to a visible size resulting in the coarse-grained texture characteristic of such rocks as granite. If a magma cools quickly (at or near the surface of the earth) crystals will be quite small, resulting in the fine-grained texture of rocks such as basalt.

It is suggested that you experiment with the exercise before attempting it in a class. The alum crystals are quite easy to grow but a little experience will prevent possible fumbling. The exercise is probably best not done in a single day, but over two days. Considerable time may be saved if the seed crystals for part two of the exercise are prepared (tied on thread) beforehand. The exercise may also be modified to meet the needs of your students. You may choose simply to grow alum crystals and observe the shapes. You may modify part two of the experiment by placing a jar in a cooler of warm water to slow cooling further. You may try mixing solutions of salt and alum to see what sorts of crystals are formed and whether the crystals will segregate or grow together. It is also suggested that you construct a student lab sheet where students may list the purpose of the experiment, materials involved, the procedure, the expected outcome (a prediction), the results, and any conclusions that may be drawn.

If time is a problem, have the super saturated solutions prepared so students can observe the cooling during class time.

Safety

If sugar crystal candy is grown, care must be taken to make sure that the conditions are hygienic.

Do not us lab equipment for growing the rock candy since contamination is possible. Disposable clear plastic glasses and cooking equipment should be used for this part.

The syrup is very hot. Be careful.

Procedure

- Observe the formation of phenyl salicylate crystals. Describe in word and sketch what you saw.
- Observe salt and alum crystals. Sketch or describe what they look like (use a hand lens).
- Observe the crystals grown in the classroom. Sketch or describe these as well.
- Get some of the super-saturated alum solution from the supply cart.
- Tie the seed crystals to separate pieces of thread, each about a foot long. This is a little tricky. It may be useful to notch the crystals on opposite sides. Cast an overhand knot in the thread, insert the crystal in the loop and tighten so the thread lies in the notches. Another overhand knot will secure the crystal.

- These crystals will be suspended in clean jars by tying the free end of the thread around a pencil and propping the pencil across the top of the jar. Use the alum solution you have reserved from the observation part of the exercise and divide the solution equally between the jars. If crystals have formed in the reserved solution they will have to be dissolved by heating (allow to cool to near room temperature). Do not pour hot solution over the seed crystals or they may dissolve. Place one of the jars in a container of ice-water (a small cooler or sink would work).
- Place the other jar someplace where it will not be disturbed. Several hours are required for the crystals to form completely.
- Do you think there will be any difference in the size or shape of the crystals grown in these two different ways? Discuss completely why or why not and any differences you might see.
- When the crystals have grown sufficiently, observe and compare the size and shape of the crystals grown under different conditions and compare the results with your predictions.

Results

Part One

Students should observe that the shapes of crystals of salt and alum are quite different. The salt crystals will be cubical and most of the alum crystals will be variants of octahedrons.

The students will also notice that the salt crystals are considerably smaller than the alum crystals. This probably is a function of the kinetics of crystallization. This is probably a good point to display mineral crystals, if they are available, to demonstrate the variety of crystal shapes possible in minerals.

Part Two

This part of the exercise requires attention. Ideally the crystals grown under room temperature conditions will be larger than the crystals grown while cooling with ice water. However, if there are many nucleation points in the room temperature jar there may be many crystals that are rather small; this may result from dirt in the jar, or the jar being disturbed. Larger crystals result from greater time for crystallization to occur, as should be the case if the solution cools slowly. On the other hand, if the solution cools rapidly, less time is available for the ions to organize into large crystals, and the crystals tend to be smaller.

At this point you might discuss how such evaporate minerals as halite and gypsum form from restricted bodies of seawater that evaporate, thus concentrating the salts to the point that the minerals crystallize. Tremendous, thick deposits of halite have formed this way during the geological past at various places on Earth. Significant salt deposits can be found in Pugwash, Nova Scotia and Windsor, Ontario. Display samples of basalt and granite and explain that both are igneous rocks that formed by cooling of molten material (magma), the crystals in the granite are larger because they cooled very slowly, deep below the surface of the earth, whereas the crystals in the basalt are small because they cooled rapidly, at or near the surface of the earth.

Extension

You can grow rock candy created from sugar crystals. These take a week to grow and must not be disturbed during that time. The sugar syrup is very hot. Be careful. Since this is food, no lab equipment should be used. Use cooking equipment and clean, clear plastic glasses.

Suspend a weighted string (a clean button works well) inside a glass. A new sucker stick would work, too.

In a saucepan, heat 500 ml sugar in 250 ml of water. The sugar may not all dissolve. During heating, the water molecules move farther apart and make room for more sugar. This is called a supersaturated solution.

Cook until syrup boils. Continue cooking ***without stirring*** for 3–4 minutes.

Let syrup cool before pouring into glasses. Add food colouring if you wish.

Place the glass where you can watch it for a week. ***Do not move the glass during this time***.

If the whole glass crystalizes into a solid lump, you cooked the syrup too long or stirred it while it was boiling. Try again.

Identifying Minerals (45 minutes) Student Notes

Outcomes

Students will be expected to

- classify minerals on the basis of their physical characteristics by using a dichotomous key (210-1, 310-2a)
- identify questions to investigate arising from the study of the rock cycle (208-2)
- explain how society's needs led to developments in technologies designed to use rocks (112-3)

Assessment

Beginning (you need to come for help and try again) Level 1	Its OK if you are OK with it Level 2	Wow!! Level 3
activity equipment broken or not used for intended purpose activity procedure was incorrectly carried out activity was not completed results/conclusions were not completed	procedure for activity was followed as directed group worked as a team to complete activity group discussed results together results/conclusions were answered using complete, independent sentences connections made between activity and real world show understanding of concept	all parts of level 2 were accomplished extension activity was completed connections between activity and real world show deep understanding through discussion, examples and/or added details from research diagrams, report show extra attention, outside research or details and connections made above and beyond classroom work/discussion

Question

Can I use a key to identify mineral samples?

Materials

notes, mineral samples, hand lens, streak plate, glass, steel, penny, quartz, topaz, hydrochloric acid

Safety

Hydrochloric acid requires carefully handling. Follow instructions and safety procedures carefully.

Procedure

- You have been given some samples of minerals.
- Perform tests for each sample as outlined in your notes.
- Use the chart of characteristics of minerals to identify the mineral samples given to you.
- As a group decide on the best identification of each mineral based on your observations.

Background

Information for students

What is a Mineral?

A mineral is a natural inorganic material. It has a definite chemical composition and usually is a crystalline solid. Minerals are either elements or compounds. When two parts oxygen combine with one part silicon, the resulting mineral is quartz. Wherever quartz is found, as crystals in granite, as amethyst, or as a grain of sand, the quartz has the same composition. The particles of oxygen and silicon that comose the quartz are combined in definite proportions and packed in definite patterns. Each arrangement of particles determines its physical and chemical properties. Minerals are found in and are part of rocks. A very common rock is granite.

- Examine a piece of granite under a hand lens. How would you describe this rock?
- How many different kinds of minerals can you see?

Geologists use some tests to identify minerals.

Hardness	Test	Example
1	scratched easily with fingernail	talc
2	scratched with fingernail with extra pressure	gypsum
3	scratched by a copper penny	calcite
4	scratched by a knife	fluorite
5	scratched by a knife with extra pressure	apatite
6	not scratched by a knife; can scratch glass	feldspar
7	can scratch steel and glass	quartz
8	can scratch quartz	topaz
9	can scratch topaz	corundum
10	can scratch all other minerals	diamond

- *Lustre*–how the mineral shines. Lustre depends on absorption or reflection of light. Examples

mineral	lustre
diamond	brilliant
quartz	glassy
metallic	galena
dull	chalk

- *Colour*–due to impurities.
- *Streak test*–rub mineral against a hard surface. Use the streak plate.
- *Cleavage*–the way some minerals split along lines. Mica splits into thin sheets; feldspar at right angles
- *Specific gravity* –density of mineral calculated by comparing mass and volume D=mass/volume
- *Acid test*–Some minerals look alike but react differently with acids. Marble and gypsum look alike. Gypsum with acid. Marble fizzes in its presence.

Conclusion

- Describe how successful you were in classifying the samples. What problems did you have?
- Which minerals were easy to classify? Which ones gave you difficulty?
- Why would it be necessary to sort minerals according to hardness? Give an example of how mineral hardness can be used in tools?
- Where might cleavage properties might be useful?
- Find at least five common uses of minerals in our lives.

Extension

Create a collection of minerals found in Nova Scotia;

or

find out what minerals have commercial value in Nova Scotia;

or

interview a geologist or a gemologist to find out how minerals are important in their work.

Identifying Minerals (45 minutes) Teacher Notes

Outcomes

Students will be expected to

- classify minerals on the basis of their physical characteristics by using a dichotomous key (210-1, 310-2a)
- identify questions to investigate arising from the study of the rock cycle (208-2)
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Question

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Materials

notes, mineral samples, hand lens, streak plate, glass, steel, penny, quartz, topaz, hydrochloric acid

Safety

Hydrochloric acid requires carefully handling. Follow instructions and safety procedures carefully.

Procedure

- The following sites provide information on mineral identification.

  http://collections.ic.gc.ca/minerals/how.html

  http://collections.ic.gc.ca/minerals/collect.html
- You have been given some samples of minerals.
- Perform tests for each sample as outlined in your notes.
- Use the chart of characteristics of minerals to identify the mineral samples given to you.
- As a group decide on the best identification of each mineral based on your observations.

Background

Information for students

What is a Mineral?

A mineral is a natural inorganic material. It has a definite chemical composition and usually is a crystalline solid. Minerals are either elements or compounds. When two parts oxygen combine with one part silicon, the resulting mineral is quartz. Wherever quartz is found, as crystals in granite, as amethyst, or as a grain of sand, the quartz has the same composition. The particles of oxygen and silicon that comose the quartz are combined in definite proportions and packed in definite patterns. Each arrangement of particles determines its physical and chemical properties. Minerals are found in and are part of rocks. A very common rock is granite.

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8	can scratch quartz	topaz
9	can scratch topaz	corundum
10	can scratch all other minerals	diamond

1. *Lustre*–how the mineral shines. Lustre depends on absorption or reflection of light. Examples

mineral	lustre
diamond	brilliant
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dull	chalk

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5. *Specific gravity* –density of mineral calculated by comparing mass and volume D=mass/volume
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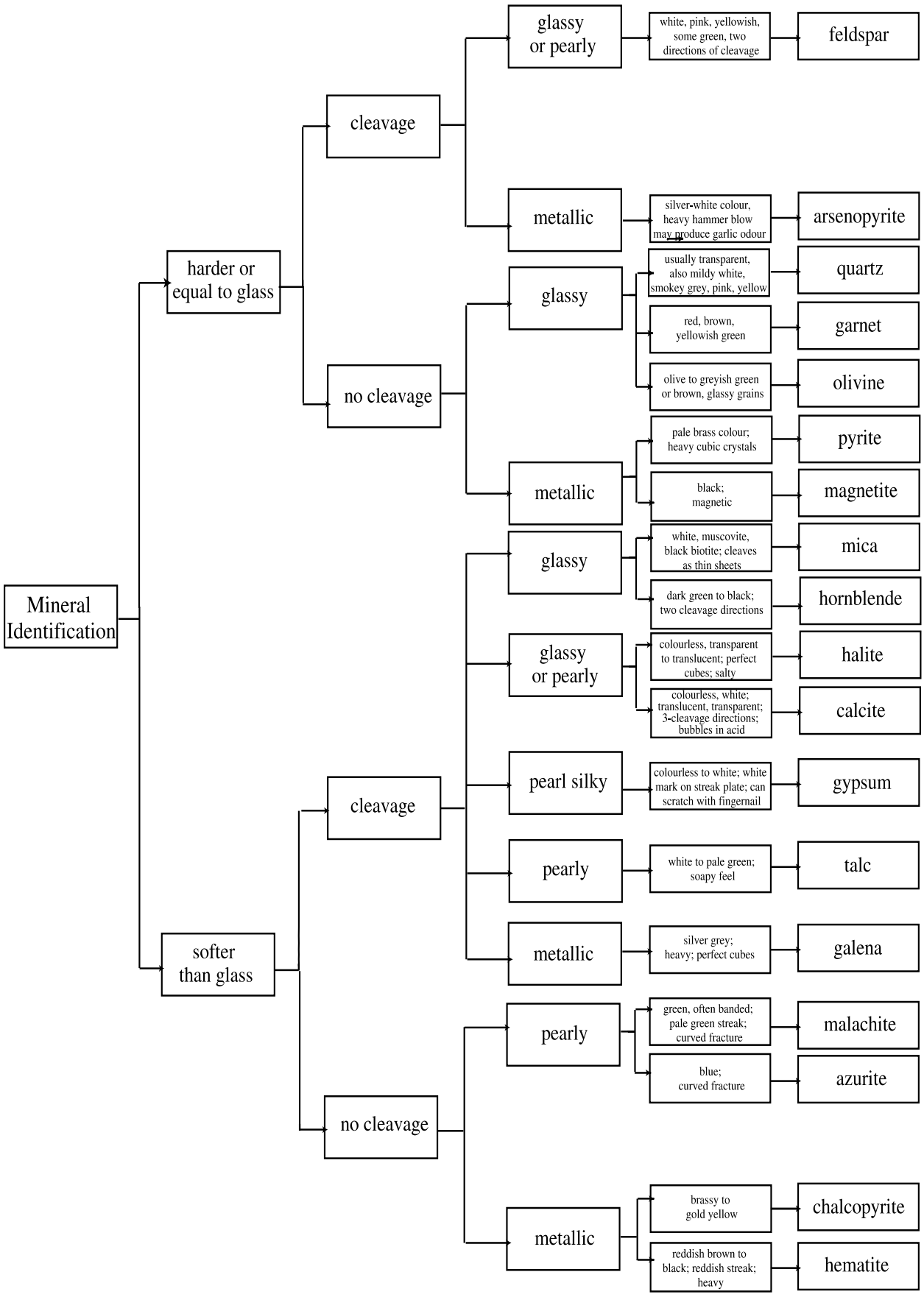
- Where might cleavage properties might be useful?
- Find at least five common uses of minerals in our lives.

Extension

- Create a collection of minerals found in Nova Scotia.
- Find out what minerals have commercial value in Nova Scotia.
- Interview a geologist or a gemologist to find out how minerals are important in their work.
- Use the Geological Map of Nova Scotia. Investigate your local mineral deposits.
  - Name the mineral deposits found in your area. Locate them on a map.
  - How are theses minerals used?
  - Compare the mineral deposits in your area with another county in Nova Scotia.
  - Which county has the greatest variety of mineral deposits?
  - Which mineral occurs most often in the province?
- Find out about mineral production in Canada.

  http://www.nrcan.gc.ca/mms/sitemap-e.htm


Mineral Identification
harder or equal to glass
softer than glass
cleavage
no cleavage
cleavage
no cleavage
glassy or pearly
metallic
glassy
metallic
glassy
glassy or pearly
pearl silky
pearly
metallic
pearly
metallic
white, pink, yellowish, some green, two directions of cleavage
feldspar
silver-white colour, heavy hammer blow may produce garlic odour
arsenopyrite
usually transparent, also mildy white, smokey grey, pink, yellow
quartz
red, brown, yellowish green
garnet
olive to greyish green or brown, glassy grains
olivine
pale brass colour; heavy cubic crystals
pyrite
black; magnetic
magnetite
white, muscovite, black biotite; cleaves as thin sheets
mica
dark green to black; two cleavage directions
hornblende
colourless, transparent to translucent; perfect cubes; salty
halite
colourless, white; translucent, transparent; 3-cleavage directions; bubbles in acid
calcite
colourless to white; white mark on streak plate; can scratch with fingernail
gypsum
white to pale green; soapy feel
talc
silver grey; heavy; perfect cubes
galena
green, often banded; pale green streak; curved fracture
malachite
blue; curved fracture
azurite
brassy to gold yellow
chalcopyrite
reddish brown to black; reddish streak; heavy
hematite

Rock Types (45 minutes) Student Notes

Outcomes

Students will be expected to

- identify questions to investigate arising from the study of the rock cycle (208-2)
- classify rocks on the basis of their characteristics and method of formation
  - sedimentary
  - igneous
  - metamorphic (310-2b)
- explain various ways in which rocks can be weathered (311-2)

Assessment

Beginning (you need to come for help and try again)	Its OK if you are OK with it	Wow!!
result paragraph is incomplete or incorrect	result paragraph shows thought and some understanding of the concepts of rock classification blue or black ink used for writing; pencil used for sketches	report shows understanding of concept by including details and thought in answering questions sketches show understanding of rock classification and attention to detail

Question

Can I sort rocks into the three major types according to their characteristics?

Materials

notes, rock samples, hand lens

Procedure

- Sort the samples of rocks found at this station. Describe how you sorted them mentioning what rules you used. Did you and the group agree? Why or why not? Mention any problems you and your group had in the sorting.
- Put the rock samples back in one pile. Using the information sheets with descriptions of how geologists classify rocks, resort your rocks. Is your sorting different? How? What characteristics do geologists use to sort rocks?

Analysis

Write a paragraph on how rocks are sorted by geologists. Include the questions found in the procedure and a sketch of each rock type from your samples.

Rock Types (45 minutes) Teacher Notes

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Question

Can I sort rocks into the three major types according to their characteristics?

Materials

notes, rock samples, hand lens

Background

Before sorting rocks, doing a sorting exercise with buttons, pasta or some items which have no formal rules for sorting will help with a discussion of how scientists decide on classifications.

For information on classifying rocks, see separate information sheets.

Procedure

- Sort the samples of rocks found at this station. Describe how you sorted them mentioning what rules you used. Did you and the group agree? Why or why not? Mention any problems you and your group had in the sorting.
- Put the rock samples back in one pile. Using the information sheets with descriptions of how geologists classify rocks, resort your rocks. Is your sorting different? How? What characteristics do geologists use to sort rocks?

Analysis

Write a paragraph on how rocks are sorted by geologists. Include the questions found in the procedure and a sketch of each rock type from your samples.

Soil, Whole Soil and Nothing But Soil (45 minutes)

Teacher Notes

Outcomes

Students will be expected to

- design and conduct a fair test of soil properties (209-1)
- classify various types of soil according to their characteristics, and investigate ways to enrich soils (310-3)
- relate various meteorological, geological, chemical, and biological processes to the formations of soils (311-3)
- identify some positive and negative effects and intended and unintended consequences of enriching soils (113-1)
- provide examples of how science and technology associated with soil enrichment affects their lives (112-7)
- suggest solutions to problems or issues related to soil use and misuse (113-7)

Assessment

Beginning (you need to come for help and try again)	Its OK if you are OK with it	Wow!!

dangerous or inappropriate use of lab and its equipment meant you had to stop your work procedure was not completed all observations are not present all questions are not answered	What are the different parts of soil? Why would I need to know what soil is made of? use of lab and its equipment was appropriate and safe procedure completed an attempt has been made to include all observations questions are answered and show some thought and understanding of outcomes report shows understanding of the importance of communication by being complete, orderly, neat blue or black pen was used for written part; pencil for sketches	use of lab and its equipment show competence and a desire to learn procedure completed carefully and within the time frame allowed observations show care, detail answers to questions show thought, connections and understanding of outcomes report is neat, carefully put together, complete and shows extra attention to care and detail blue or black pen was used for written part; pencil for sketches

Questions

Materials

Apparatus

soil mixture, latex gloves, screens of various sizes, filter paper, beakers, water, ring stand, newspaper, magnifying glass or hand lens

Safety

Unknown soil may contain contaminants harmful to you. Use the soil provided and wear gloves when handling it. Do not pour soil down the sink. It will clog the drain. To dry your parts when finished, place on several layers of newspaper to dry.

Procedure

- Read the procedure steps carefully. Assemble all your equipment and supplies before you begin.
- With the naked eye, examine your soil sample. Record all observations made with sight, touch and smell.
- Use a hand lens to gather more observations of your soil sample. Record all observations made.
- Place the largest screen on the ring stand, bending the edges slightly to make a shallow box.
- Place the soil sample on the screen. Place a large beaker under the screen. Carefully pour water over the soil. Record what you observe in words and

sketches where appropriate.

- Repeat step 5 using smaller and smaller screens until all the sample passes through. Record your observations at each step.
- When all your sample flows through the screen, arrange filter paper in a funnel in the ring stand and filter your sample. Record your observations.
- Place all parts of your sample on newspaper to dry.
- Clean your equipment, return it to its spots and clean your work area.

Results

Organize your observations and any sketches made to answer the following questions.

Conclusion

- Is soil made of only one type of material? How do you know?
- What were some of the things which made up your soil sample? How do you think these came to be in the soil?
- In nature, how is soil constructed (made)? What forces of nature are necessary?
- Why would humans need to know what soil is made of? How is soil damaged in nature? How do we damage soil? How do we preserve soil?

A Fold in Time 1 (30 minutes) Student Notes

Outcomes

Students will be expected to

- organize and analyse data on the geographical and chronological distribution of earthquakes and volcanoes to determine patterns and trends (209-4, 210-6, 311-5)
- determine how plate tectonic theory has evolved in light of new geological evidence (110-4)
- provide examples of ideas and theories used in the past to explain volcanic activity, earthquakes, and mountain building (110-1)
- explain the processes of mountain formation and the folding and faulting of the Earth's surface (311-1)
- work co-operatively with team members to plan how to determine a geological profile of a land mass by using simulated core sampling techniques (211-3)
- describe the composition of the Earth's crust and some of the technologies which have allowed scientists to study geological features in and on the Earth's crust (109-7, 111-2, 310-1)
- use tools and apparatus safely when modeling or simulating the formation of rock types (209-6)

Assessment

Beginning (you need to come for help and try again)	Its OK if you are OK with it	Wow!!
questions incorrect questions incomplete questions show some understanding but include misconceptions	all questions answered answers to questions show understanding of concepts	all questions answered answers to questions show understanding of concepts by including details and/or examples extra effort is evidence of advanced understanding of concepts

Questions

Can I explain how mountains are formed?

Can I explain folding and faulting of the Earth's crust?

Safety

The knife required for cutting this cake is large and sharp. This is best handled by the teacher.

If you are permitted to eat this cake, be aware of medical conditions such as allergies or diabetes.

Make sure you handle the cake in a hygienic manner.

A Fold in Time 1 (30 minutes) Teacher Notes

Outcomes

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- work co-operatively with team members to plan how to determine a geological profile of a land mass by using simulated core sampling techniques (211-3)
- describe the composition of the Earth's crust and some of the technologies which have allowed scientists to study geological features in and on the Earth's crust (109-7, 111-2, 310-1)
- use tools and apparatus safely when modeling or simulating the formation of rock types (209-6)

Assessment

Beginning (you need to come for help and try again)	Its OK if you are OK with it	Wow!!
questions incorrect questions incomplete questions show some understanding but include misconceptions	all questions answered answers to questions show understanding of concepts	all questions answered answers to questions show understanding of concepts by including details and/or examples extra effort is evidence of advanced understanding of concepts

Questions

Can I explain how mountains are formed?

Can I explain folding and faulting of the Earth's crust?

Safety

The knife required for cutting this cake is large and sharp. This is best handled by the teacher.

If you are permitted to eat this cake, be aware of medical conditions such as allergies or diabetes.

Make sure you handle the cake in a hygienic manner.

Procedure

- View cake and participate in class discussion. At the end of this activity you will be asked to answer two sets of questions found in the conclusion section.
- After discussion in class and having answered the first set of questions, proceed to next step.
- Place a slice of cake on a sheet of paper on a desk or table. Answer the second set of questions based on this slice of cake.

Conclusion

Answer the following questions based on demonstration and class discussion:

Set 1

- What does the cake look like from the side?
- Where on the Earth would you expect to see rock layers having this orientation?
- Which "geologic" layers are the oldest? Have any of the geologic layers been tilted?
- Predict what the inside of the cake looks like away from the edges (sides)? On what did you make your prediction?
- How might you test your prediction? What tools or "equipment" would you need?
- Is your test procedure practical for use on the real Earth? What real tools or equipment would you need?
- Try out your test procedure on the cake. Were the results what you expected?
- How many times would you have to repeat your test procedure to be sure your results applied to the entire cake?

Set 2

Answer the following questions based on your slice of cake:

- How many ways can you think of to change either the shape of your cake slice or the orientation of individual layers within?
- Do not try out any of these ideas yet, but write them all down to share with the class.
- Predict the visible changes which would be seen in the cake layers because of each of these ideas. Which ones are possible on the real Earth?
- What forces might cause such shape changes in the real Earth?
- Is there a difference in behaviour of the cake layers versus the icing layers, Why or why not?

A Fold in Time 2 (45 minutes) Student Notes

Outcomes

Students will be expected to

- organize and analyse data on the geographical and chronological distribution of earthquakes and volcanoes to determine patterns and trends (209-4, 210-6, 311-5)
- determine how plate tectonic theory has evolved in light of new geological evidence (110-4)
- provide examples of ideas and theories used in the past to explain volcanic activity, earthquakes, and mountain building (110-1)
- explain the processes of mountain formation and the folding and faulting of the Earth's surface (311-1)
- work co-operatively with team members to plan how to determine a geological profile of a land mass by using simulated core sampling techniques (211-3)
- describe the composition of the Earth's crust and some of the technologies which have allowed scientists to study geological features in and on the Earth's crust (109-7, 111-2, 310-1)
- use tools and apparatus safely when modeling or simulating the formation of rock types (209-6)

Assessment

Beginning (you need to come for help and try again) Level 1	Its OK if you are OK with it Level 2	Wow!! Level 3
activity equipment broken or not used for intended purpose activity procedure was incorrectly carried out activity was not completed results/ conclusions were not completed	procedure for activity was followed as directed group worked as a team to complete activity group discussed results together results/conclusions were answered using complete, independent sentences connections made between activity and real world show understanding of concept	all parts of level 2 were accomplished extension activity was completed connections between activity and real world questions show deep understanding through discussion, examples and/or added details from research diagrams, report show extra attention, outside research or details and connections made above and beyond classroom work/discussion

Question

Can I explain what has happened in the Earth's crust?

Materials

Plasticine™ in several colours, plastic knives, plastic straw, fine sand

Procedure

- Using Plasticine™, create an example of layers of the Earth's crust. Sketch your model in your notebook.
- Using your model, gently create a fold in the Earth's crust. Describe in your notes how you did this. Sketch what your model looks like now.
- Push your fold to its limit. Describe what happened to your model. Make a sketch.
- Recreate your original model of the Earth's crust. Use your knife to create a fault. Sketch what your model looks like now.
- Carefully insert the plastic straw through part of your model (where, is your choice). Remove the straw and fill with some sand. Describe what you have created. Sketch your model now.

Analysis

- Organize your sketches and descriptions to show what you have learned about folding, faulting, intrusions, and the formation of the Earth's crust.
- What type of rocks were formed during your model?
- What part of your model was an example of volcano action? Earthquake action? Mountain building?
- From *Procedure* above, how would geologists interpret the sample from the straw?
- How do geologists study these activities on Earth?

Extension

Create a collection of local examples (pictures, samples) of folding, faulting, etc. Be sure to label the sample with type and location;

or

interview a geologist about the work she/he does.

A Fold in Time 2 (45 minutes) Teacher Notes

Outcomes

Students will be expected to

- organize and analyse data on the geographical and chronological distribution of earthquakes and volcanoes to determine patterns and trends (209-4, 210-6, 311-5)
- determine how plate tectonic theory has evolved in light of new geological evidence (110-4)
- provide examples of ideas and theories used in the past to explain volcanic activity, earthquakes, and mountain building (110-1)
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- work co-operatively with team members to plan how to determine a geological profile of a land mass by using simulated core sampling techniques (211-3)
- describe the composition of the Earth's crust and some of the technologies which have allowed scientists to study geological features in and on the Earth's crust (109-7, 111-2, 310-1)
- use tools and apparatus safely when modeling or simulating the formation of rock types (209-6)

Assessment

Beginning (you need to come for help and try again) Level 1	Its OK if you are OK with it Level 2	Wow!! Level 3
activity equipment broken or not used for intended purpose activity procedure was incorrectly carried out activity was not completed results/ conclusions were not completed	procedure for activity was followed as directed group worked as a team to complete activity group discussed results together results/conclusions were answered using complete, independent sentences connections made between activity and real world show understanding of concept	all parts of level 2 were accomplished extension activity was completed connections between activity and real world questions show deep understanding through discussion, examples and/or added details from research diagrams, report show extra attention, outside research or details and connections made above and beyond classroom work/discussion

Question

Can I explain what has happened in the Earth's crust?

Materials

Plasticine™ in several colours, plastic knives, plastic straw, fine sand

Background

Students will need a discussion of layers of Earth's crust, folding, faulting and intrusions. This can happen as the activity evolves or this activity can be used before the discussion as exploration or after students can complete the paper sketches of Earth's crust. Then, have students design their own Earth's crust sketch or Plasticine™ model. Have students provide the key and exchange their sketches or models with others to see if they can tell what events have happened.

Massive tectonic plates beneath the Earth's surface shift, slide, and collide. These powerful effects can cause many different deformations of the Earth's crust. Faulting, folding, and jointing are the three different kinds of common structural features that can be found.

Fault–A crack or fracture in the earth's surface. Movement along the fault can cause earthquakes or-—in the process of mountain-building—-can release underlying magma and permit it to rise to the surface.

Extrusion–The emission of magmatic material at the Earth's surface. Also, the structure or form produced by the process (e.g., a lava flow, volcanic dome, or certain pyroclastic rocks).

Intrusion–The process of emplacement of magma in pre-existing rock. Also, the term refers to igneous rock mass so formed within the surrounding rock.

Folding has several terms.

Syncline–A syncline is a feature that is formed by the folding of the Earth's crust, usually associate with compressional tectonic forces. Synclines are features created when those compressional forces cause layers of rock to bend down. Synclines can have a dip of a few metres or several kilometres.

Anticline–An anticline is another deformational folding feature akin to synclines. Instead of the layer of rock bending in a downward arc, the layers of rock are bent in an upward arc. Like synclines, anticlines form as a result from compressional forces. These compressional forces can be the result of wide scale plate tectonic activity or a regional intrusion of lava that folds the overlying beds.

Some Web sites used for this activity could be the following:

Web sites change frequently so check before sending students to these sites.

http://quake.wr.usgs.gov/research/structure/CrustalStructure/

http://www.ecoworld.com/Earth/EcoWorld_Earth_Home.cfm

http://geology.er.usgs.gov/eastern/tectonic.html

http://volcano.und.nodak.edu/vwdocs/glossary.html

http://www.maroon.com/bigbend/struct/index.html

Procedure

- Using Plasticine™, create an example of layers of the Earth's crust. Sketch your model in your notebook.
- Using your model, gently create a fold in the Earth's crust. Describe in your notes how you did this. Sketch what your model looks like now.
- Push your fold to its limit. Describe what happened to your model. Make a sketch.
- Recreate your original model of the Earth's crust. Use your knife to create a fault. Sketch what your model looks like now.
- Carefully insert the plastic straw through part of your model (where, is your choice). Remove the straw and fill with some sand. Describe what you have created. Sketch your model now.

Analysis

- Organize your sketches and descriptions to show what you have learned about folding, faulting, intrusions, and the formation of the Earth's crust.
- What type of rocks were formed during your model?
- What part of your model was an example of volcano action? Earthquake action? Mountain building?
- From *Procedure* above, how would geologists interpret the sample from the straw?
- How do geologists study these activities on Earth?

Extension

Create a collection of local examples (pictures, samples) of folding, faulting, etc. Be sure to label the sample with type and location;

or

interview a geologist about the work she/he does.

Physical Science: Mixtures and Solutions Appendix

Sorting Things Out (2x45 minutes) Student Notes

Outcomes

Students will be expected to

- safely use tools and apparatus, identify and separate the components of a variety of mixtures, using
  - mechanical sorting
  - filtration
  - evaporation
  - distillation
  - paper chromatography (209-6, 307-2)
- identify new questions and problems about mixtures that arise from what is learned (210-16)
- describe the science underlying a distillation apparatus (111-5)
- provide examples of how science and technology, related to mixtures and solutions, affect our lives (112-7)
- identify some positive and negative effects and intended and
- unintended consequences of a particular scientific or technological development related to mixtures and solutions (113-1)
- provide examples showing the evolution of refining and separation techniques (109-4)

Assessment

Beginning (you need to come for help and try again) Level 1	Its OK if you are OK with it Level 2	Wow!! Level 3
activity equipment broken or not used for intended purpose activity procedure was incorrectly carried out activity was not completed results/ conclusions were not completed	procedure for activity was followed as directed group worked as a team to complete activity group discussed results together results/conclusions were answered using complete, independent sentences connections made between activity and real world show understanding of concept	all parts of level 2 were accomplished extension activity was completed connections between activity and real world questions show deep understanding through discussion, examples and/or added details from research diagrams, report show extra attention, outside research or details and connections made above and beyond classroom work/discussion

Safety

Some methods involve heat. Work carefully around heating apparatus and hot liquids. Use tongs or hot mitts to move heated equipment.

Materials Apparatus

Materials are grouped at the front. Your group must read an activity carefully, discuss what must be done and come up with a plan. When your group has a plan, send a representative to the front to discuss what you need to test your idea.

Activity I

- Obtain a sample for Activity I. (peas/rice)
- As a group, decide at least three ways you could separate this mixture.
- After looking at the available equipment, separate this mixture into its components in the most efficient manner.
- Describe what your group did, how successful you were and why your group chose this method over other ideas you had.

Activity II

- Obtain a sample for Activity II. (sand and water)
- As a group, decide at least three ways you could separate this mixture.
- After looking at the available equipment, separate this mixture into its components in the most efficient manner.
- Describe what your group did, how successful you were and why your group chose this method over other ideas you had.

Activity III

- Obtain a sample for Activity II. [salt and water]
- As a group, decide at least three ways you could recover the salt from this mixture.
- After looking at the available equipment, separate this mixture into its components in the most efficient manner.
- Describe what your group did, how successful you were and why your group chose this method over other ideas you had.

Activity IV

Obtain a sample for Activity II. [salt and water]
As a group, decide at least three ways you could recover fresh water from this mixture.
After looking at the available equipment, separate this mixture into its components in the most efficient manner.
Describe what your group did, how successful you were and why your group chose this method over other ideas you had.

Activity V

- Obtain a marker from the front equipment table.
- As a group, decide at least three ways you could discover what colours made up in the ink in the marker.
- After looking at the available equipment, separate this marker into its components in the most efficient manner.
- Describe what your group did, how successful you were and why your group chose this method over other ideas you had.

Analysis

Define mechanical sorting, filtration, evaporation, distillation, chromatography.

- In each of the activities, your group discussed several ways to separate the mixtures. In each case, there was one method which was more efficient than the others. For each activity, identify the method of separation and why that method was most efficient using the particle model and your researched definitions.
- As a group, discuss how these methods of separation are used in our lives. Give practical examples of each method. A chart would be a good way to organize your ideas.

Mixture Separated	Method of Separation	How Separation Works	Example from our Lives of Separation Method

- Draw a diagram of the distillation process you used.

Extension

Choose one of the practical examples of separation to investigate in depth. This could be done by building a working model, researching/interviewing a working example of a method or by examining some cutting edge methods of separation being investigated but not yet in use.

A video, powerpoint or hyperstudio could be used as a method of reporting.

Sorting Things Out (2x45 minutes) Teacher Notes

Outcomes

Students will be expected to

- safely use tools and apparatus, identify and separate the components of a variety of mixtures, using
  - mechanical sorting
  - filtration
  - evaporation
  - distillation
  - paper chromatography (209-6, 307-2)
- identify new questions and problems about mixtures that arise from what is learned (210-16)
- describe the science underlying a distillation apparatus (111-5)
- provide examples of how science and technology, related to mixtures and solutions, affect our lives (112-7)
- identify some positive and negative effects and intended and
- unintended consequences of a particular scientific or technological development related to mixtures and solutions (113-1)
- provide examples showing the evolution of refining and separation techniques (109-4)

Assessment

Beginning (you need to come for help and try again) Level 1	Its OK if you are OK with it Level 2	Wow!! Level 3
activity equipment broken or not used for intended purpose activity procedure was incorrectly carried out activity was not completed results/ conclusions were not completed	procedure for activity was followed as directed group worked as a team to complete activity group discussed results together results/conclusions were answered using complete, independent sentences connections made between activity and real world show understanding of concept	all parts of level 2 were accomplished extension activity was completed connections between activity and real world questions show deep understanding through discussion, examples and/or added details from research diagrams, report show extra attention, outside research or details and connections made above and beyond classroom work/discussion

Safety

Some methods involve heat. Work carefully around heating apparatus and hot liquids. Use tongs or hot mitts to move heated equipment.

Background

The arrangement of materials and apparatus at the front, allows students to decide among themselves what method they might use to separate mixtures. Monitoring their decisions for safety will need to be done. Guide those students who have the general idea but may need some refinement. Students may especially need help is setting up a distillation process.

Materials Apparatus

ring stands	hot plates	fine sand
coffee filters	coarse sieve	cork for flask with hole
whole dried peas	250 ml beakers	funnels
ice	marker	Erlenmyer flask
clamp for tube	rice	salt
tubing		

Activity I

- Obtain a sample for Activity I. (peas/rice)
- As a group, decide at least three ways you could separate this mixture.
- After looking at the available equipment, separate this mixture into its components in the most efficient manner.
- Describe what your group did, how successful you were and why your group chose this method over other ideas you had.

Activity II

- Obtain a sample for Activity II. (sand and water)
- As a group, decide at least three ways you could separate this mixture.
- After looking at the available equipment, separate this mixture into its components in the most efficient manner.
- Describe what your group did, how successful you were and why your group chose this method over other ideas you had.

Activity III

- Obtain a sample for Activity II. (salt and water)
- As a group, decide at least three ways you could recover the salt from this mixture.
- After looking at the available equipment, separate this mixture into its components in the most efficient manner.
- Describe what your group did, how successful you were and why your group chose this method over other ideas you had.

Activity IV

Obtain a sample for Activity II. (salt and water)
As a group, decide at least three ways you could recover fresh water from this mixture.
After looking at the available equipment, separate this mixture into its components in the most efficient manner.
Describe what your group did, how successful you were and why your group chose this method over other ideas you had.

Activity V

- Obtain a marker from the front equipment table.
- As a group, decide at least three ways you could discover what colours made up in the ink in the marker.
- After looking at the available equipment, separate this marker into its components in the most efficient manner.
- Describe what your group did, how successful you were and why your group chose this method over other ideas you had.

Analysis

- Define mechanical sorting, filtration, evaporation, distillation, chromatography.
- In each of the activities, your group discussed several ways to separate the mixtures. In each case, there was one method which was more efficient than the others. For each activity, identify the method of separation and why that method was most efficient using the particle model and your researched definitions.
- As a group, discuss how these methods of separation are used in our lives. Give practical examples of each method. A chart would be a good way to organize your ideas.

Mixture Separated	Method of Separation	How Separation Works	Example from our Lives of Separation Method

- Draw a diagram of the distillation process you used.

Extension

Choose one of the practical examples of separation to investigate in depth. This could be done by building a working model, researching/interviewing a working example of a method or by examining some cutting edge methods of separation being investigated but not yet in use.

A video, powerpoint or hyperstudio could be used as a method of reporting.

Concentration (20 minutes) Student Notes

Outcomes

Students will be expected to

- relate the formation and separation of everyday mixtures and solutions to disciplines such as chemistry and engineering (109-10)
- demonstrate a knowledge of WHMIS standards by recognizing and following warning labels symbols (209-7)
- identify different ways that concentrations can be demonstrated for various substance (109-7)
- describe the concentrations of solutions qualitatively (307-4)
- use a commercial or student-made hydrometer effectively and accurately for collecting data (209-3)

Assessment

Beginning (you need to come for help and try again) Level 1	Its OK if you are OK with it Level 2	Wow!! Level 3
activity equipment broken or not used for intended purpose activity procedure was incorrectly carried out activity was not completed results/ conclusions were not completed	procedure for activity was followed as directed group worked as a team to complete activity group discussed results together results/conclusions were answered using complete, independent sentences connections made between activity and real world show understanding of concept	all parts of level 2 were accomplished extension activity was completed connections between activity and real world questions show deep understanding through discussion, examples and/or added details from research diagrams, report show extra attention, outside research or details and connections made above and beyond classroom work/discussion

Materials Apparatus

table salt (NaCl)	test tubes	test tube racks
250 ml beakers	source of heat	thermometers
ice	hydrometer	test tube holder/tongs
metric measuring spoons		

Procedure

Examine the packaging of the items used for safety symbols.

Activity I

- Fill a 250 ml beaker two-thirds full of crushed ice.
- Add water until it too fills the beaker two-thirds full.
- Stir well.
- Measure and record the temperature.
- Add 5 g salt (NaCl, sodium chloride) to the ice water mixture and
- stir well to dissolve the salt. (Use a stir stick or glass rod. DO NOT STIR WITH THE THERMOMETER!!!)
- Measure and record the temperature.
- Predict the temperature that will result when a second 5 g of salt is added.
- Add 5 g salt. (Total salt is now 10 g.)
- Stir to dissolve. Measure and record the temperature.
- Predict the temperature that will result when a third 5 g of salt is added. Add 5 g more salt. (Total salt is now 15 g.)
- Stir to dissolve. Measure and record the temperature.

Activity II

- Get five test tubes.
- In test tube #2, put 1 ml of salt.
- In test tube #3, put 2 ml of salt.
- In test tube #4, put 4 ml of salt.
- In test tube #5, put 5 ml of salt.
- Add water to all 5 test tubes to within 6 mm of the top.
- Carefully stir to dissolve as much salt as you can.
- Float a hydrometer in each test tube. Record your results.
- Heat each test tube to boiling. Record the temperature of boiling.

Analysis

Activity I

- On graph paper, plot ml of salt vs. temperature. Alternatively the data can be entered into the TI-82 and plotted. and temperature?
- What does the graph tell us about the amount of salt?
- Predict the temperature if we added another 5 ml of salt.
- How much salt is needed to obtain a temperature of –10°C?
- What would be the benefits of the addition of salt to icy roads? Would there be environmental consequences?
- Why is salt used in freezing homemade ice cream?
- How do you think an automobile antifreeze works? Is antifreeze beneficial in an area where the winters are mild and the summers are hot?

Activity II

- What did the hydrometer readings tell you about the concentration of each test tube?
- Graph the ml of salt vs temperature of boiling. What does the graph tell you about concentration and boiling point?
- Looking at your data, hypothesize why a person would add salt to cooking water when cooking vegetables or pasta?
- Hydrometers are used in making beer or wine. What would the hydrometer tell the brew master?

Extension

What if we dissolved a salt other than NaCl? Would the effect on temperature be the same? Repeat the experiment above using another salt, e.g. calcium chloride.

Concentration (20 minutes) Teacher Notes

Outcomes

Students will be expected to

- relate the formation and separation of everyday mixtures and solutions to disciplines such as chemistry and engineering (109-10)
- demonstrate a knowledge of WHMIS standards by recognizing and following warning labels symbols (209-7)
- identify different ways that concentrations can be demonstrated for various substance (109-7)
- describe the concentrations of solutions qualitatively (307-4)
- use a commercial or student-made hydrometer effectively and accurately for collecting data (209-3)

Assessment

Beginning (you need to come for help and try again) Level 1	Its OK if you are OK with it Level 2	Wow!! Level 3
activity equipment broken or not used for intended purpose activity procedure was incorrectly carried out activity was not completed results/ conclusions were not completed	procedure for activity was followed as directed group worked as a team to complete activity group discussed results together results/conclusions were answered using complete, independent sentences connections made between activity and real world show understanding of concept	all parts of level 2 were accomplished extension activity was completed connections between activity and real world questions show deep understanding through discussion, examples and/or added details from research diagrams, report show extra attention, outside research or details and connections made above and beyond classroom work/discussion

Materials Apparatus

table salt (NaCl)	test tubes	test tube racks
250 ml beakers	source of heat	thermometers
ice	hydrometer	test tube holder/tongs
metric measuring spoons		

Background

Calcium chloride is an alternative de-salter found in hardware stores during the winter months.

In this activity, students should be encouraged to read warning labels as a reinforcement of safety in the lab.

The plotting of data acquired in activity one is a good place to use the TI graphing calculators if students are familiar with them.

NaCl has a maximum solubility in cold water of approximately 35 grams per 100 grams of water.

Adding salt to roads lowers the freezing point of water, so roads can be wet, not icy, at lower temperatures. High concentrations of salt promote rusting of automobiles.

Auto antifreeze, usually glycols, similarly alters the interaction of water molecules with one another making the formation of ice crystals more difficult. It effectively lowers the freezing point of water. The mixture of glycols and water has a much higher boiling point than water alone, so antifreeze is also anti-boil: it prevents overheating in hot weather.

Mixtures are formed simply by blending two or more substances together in some random proportion without chemically changing the individual substances in the mixture. Mixtures can then be broken down into homogeneous and heterogeneous.

A homogeneous mixture is called a solution: salt or sugar and water, air (solution of gases). These have a constant composition throughout the solution. A heterogeneous mixture would be: salt with sugar (no water), water with gasoline or oil, salt with sand. These have areas with differing compositions (you could usually see the separation of the two things).

Using salt in making ice cream allows the temperature surrounding the ice cream mixture to be lowered, thus promoting freezing of the mixture. Auto antifreeze, usually glycols, similarly alters the interaction of water molecules with one another making the formation of ice crystals more....?

Procedure

Examine the packaging of the items used for safety symbols.

Activity I

- Fill a 250 ml beaker two-thirds full of crushed ice.
- Add water until it too fills the beaker two-thirds full.
- Stir well.
- Measure and record the temperature.
- Add 5 g salt (NaCl, sodium chloride) to the ice water mixture and
- stir well to dissolve the salt. (Use a stir stick or glass rod. DO NOT STIR WITH THE THERMOMETER!!!)
- Measure and record the temperature.
- Predict the temperature that will result when a second 5 g of salt is added.
- Add 5 g salt. (Total salt is now 10 g.)
- Stir to dissolve. Measure and record the temperature.
- Predict the temperature that will result when a third 5 g of salt is added. Add 5 g more salt. (Total salt is now 15 g.)
- Stir to dissolve. Measure and record the temperature.

Activity II

- Get five test tubes.
- In test tube #2, put 1 ml of salt.
- In test tube #3, put 2 ml of salt.
- In test tube #4, put 4 ml of salt.
- In test tube #5, put 5 ml of salt.
- Add water to all 5 test tubes to within 6 mm of the top.
- Carefully stir to dissolve as much salt as you can.
- Float a hydrometer in each test tube. Record your results.
- Heat each test tube to boiling. Record the temperature of boiling.

Analysis

Activity I

- On graph paper, plot ml of salt vs. temperature. Alternatively the data can be entered into the TI-82 and plotted. and temperature?
- What does the graph tell us about the amount of salt?
- Predict the temperature if we added another 5 ml of salt.
- How much salt is needed to obtain a temperature of –10°C?
- What would be the benefits of the addition of salt to icy roads? Would there be environmental consequences?
- Why is salt used in freezing homemade ice cream?
- How do you think an automobile antifreeze works? Is antifreeze beneficial in an area where the winters are mild and the summers are hot?

Activity II

- What did the hydrometer readings tell you about the concentration of each test tube?
- Graph the ml of salt vs temperature of boiling. What does the graph tell you about concentration and boiling point?
- Looking at your data, hypothesize why a person would add salt to cooking water when cooking vegetables or pasta?
- Hydrometers are used in making beer or wine. What would the hydrometer tell the brew master?

Extension

What if we dissolved a salt other than NaCl? Would the effect on temperature be the same? Repeat the experiment above using another salt, e.g. calcium chloride.

Dissolving (45 minutes)

Outcomes

Students will be expected to

- Describe the characteristics of solutions using the particle model of matter (307-3)
- Carry out procedures controlling the major variables (209-1)
- Use tools and apparatus safely. (209-6)
- Identify and suggest explanations for discrepancies in data. (210-7)

Assessment

Beginning (you need to come for help and try again)	It's OK if you are OK with it	Wow!
dangerous or inappropriate use of lab and its equipment meant you had to stop your work procedure was not completed all observations are not present all questions are not answered	use of lab and its equipment was appropriate and safe procedure completed an attempt has been made to include all observations questions are answered and show some thought and understanding of outcomes report shows understanding of the importance of communication by being complete, orderly, neat blue or black pen was used for written part; pencil for sketches	use of lab and its equipment show competence and a desire to learn procedure completed carefully and within the time frame allowed observations show care, detail answers to questions show thought, connections and understanding of outcomes report is neat, carefully put together, complete and shows extra attention to care and detail blue or black pen was used for written part; pencil for sketches

Questions

What happens to drink crystals when you place it in water? How can the particle model of matter be used to explain this?

Materials Apparatus

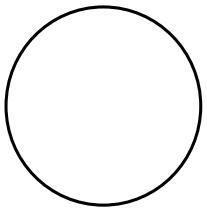
drink crystals, water, binocular microscope, three petrie dishes

Safety

Do not put anything in your mouth in during science activities.
Dispose of all materials in a safe manner.

Procedure

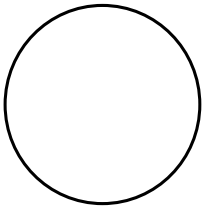
Follow the procedure outlined below.
Suppose we could see the drink crystals through a "mega-microscope*"—a microscope so powerful it could see the individual particles that make up the drink crystals. Draw what we might expect the drink crystals to look like.



Are all the particles exactly the same?

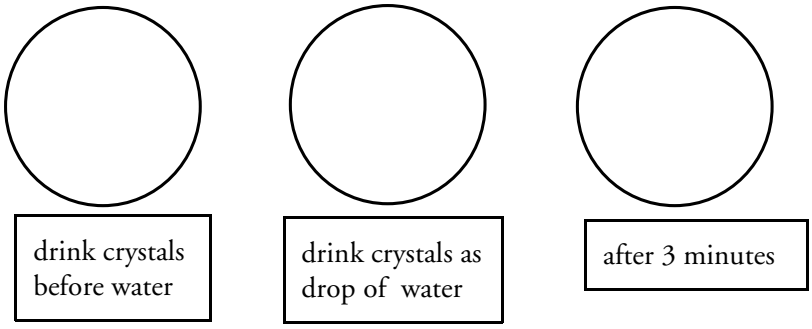
*By the way, a "mega-microscope" doesn't exist yet.

If we could also see the individual particles of water in the dish, draw what they might look like. Are the water particles are all the same? Are the water particles different from the drink crystals particles?



Observations

Put these models together to see if you can show what happens to the drink crystals when you put the water on it. Make sure you distinguish between the water and the drink crystals particles in your drawings Place a few crystals of drink crystals on a petri dish under the microscope. Focus on the crystals. While you are observing, have another member of your group place a few drops of water on the drink crystals.



Draw a diagram of what you saw and record some observations.
Answer the questions posed at the beginning of the lab using examples from your explorations.

- What happens to drink crystals when you place it in water?
- How can the particle model of matter be used to explain this?
- Drop a bit of food colouring into a cup of water and watch what happens.
- How can you explain your observations?

Conclusion

Find the definitions to dissolve, solvent, solute. Use them in discussing what you have done in this activity. Items to put in your discussion:

- particle model
- drink crystals particles before water was added
- drink crystals particles as water was added
- drink crystals and water particles after 3 minutes
- dissolve, solvent, solute

Ice Cream, You Scream, We All Scream for Ice Cream (45 minutes)
Student Notes

Outcomes

Students will be expected to

- relate the formation and separation of everyday mixtures and solutions to disciplines such as chemistry and engineering (109-10)
- identify new questions and problems about mixtures that arise from what is learned (210-16)
- provide examples of how science and technology, related to mixtures and solutions, affect our lives (112-7)

Assessment

Beginning (you need to come for help and try again) Level 1	Its OK if you are OK with it Level 2	Wow!! Level 3
activity equipment broken or not used for intended purpose activity procedure was incorrectly carried out activity was not completed results/ conclusions were not completed	procedure for activity was followed as directed group worked as a team to complete activity group discussed results together results/conclusions were answered using complete, independent sentences connections made between activity and real world show understanding of concept	all parts of level 2 were accomplished extension activity was completed connections between activity and real world questions show deep understanding through discussion, examples and/or added details from research diagrams, report show extra attention, outside research or details and connections made above and beyond classroom work/discussion

Question

How do mixtures and solutions occur in everyday life?

Safety

Be aware of food sensitivities you have before doing this activity. It is not advisable to use fresh eggs for this activity because of contamination from raw eggs. The egg replacements are actual eggs but have been pasturized.

Materials
Apparatus

2 packages of egg replacement	500 ml sugar	1 L half and half
10 ml vanilla	2 L milk	clean 4 L jug with cap
1 bag ice, crushed	50 ml table salt	spoons and cups

large re-sealable plastic bag (1 for each 2 students)
small re-sealable plastic bag (1 for each 2 students)

Procedure

- Crush ice.
- Predict how long it will take for your mixture to turn to ice cream.
- Get a small re-sealable bag. Pour approximately 250 ml ice cream mixture in each bag. Seal well.
- Get a large re-sealable bag half filled with ice.
- Add a small handful (about 50 ml) of salt to the ice.
- Place the ice cream filled bag into the bag of ice. Seal the large bags.
- Take turns or work together to "churn" the ice cream turning the bag over and over. The ice should be continually moved around the ice cream mixture.
- When the ice cream is frozen, remove it from the bags, place in individual cups and enjoy your ice cream!
- Compare predictions to the actual time it took the ice cream to freeze.

Analysis

- How did your predictions compare to the actual time needed to make ice cream?
- Was the time the same for all groups? Why do you suppose this is so?
- What was the purpose of adding the salt to the ice?
- Would twice as much ice cause it to freeze twice as fast?
- At the particle level, describe what was happening to the mixture.
- How would the absence of salt affect the freezing time?

Extension

Investigate why Nova Scotia uses salt on its roads in the winter. Using what you discovered in the activity above, answer the following questions:

- What is happening to the ice/snow on the roads when salt is applied? Make sure you discuss the particles and not just generally.
- The Prairie provinces do not use salt on their roads in the winter. Why is it not effective in these provinces?

Ice Cream, You Scream, We All Scream for Ice Cream (45 minutes)
Teacher Notes

Outcomes

Students will be expected to

- relate the formation and separation of everyday mixtures and solutions to disciplines such as chemistry and engineering (109-10)
- identify new questions and problems about mixtures that arise from what is learned (210-16)
- provide examples of how science and technology, related to mixtures and solutions, affect our lives (112-7)

Assessment

Beginning (you need to come for help and try again) Level 1	Its OK if you are OK with it Level 2	Wow!! Level 3
activity equipment broken or not used for intended purpose activity procedure was incorrectly carried out activity was not completed results/ conclusions were not completed	procedure for activity was followed as directed group worked as a team to complete activity group discussed results together results/conclusions were answered using complete, independent sentences connections made between activity and real world show understanding of concept	all parts of level 2 were accomplished extension activity was completed connections between activity and real world questions show deep understanding through discussion, examples and/or added details from research diagrams, report show extra attention, outside research or details and connections made above and beyond classroom work/discussion

Question

How do mixtures and solutions occur in everyday life?

Safety

Be aware of food sensitivities you have before doing this activity. It is not advisable to use fresh eggs for this activity because of contamination from raw eggs. The egg replacements are actual eggs but have been pasturized.

Background

The egg replacements can be found in small cartons in the refrigerator section of the grocery store with the milks and cheeses. Coarse salt (pickling salt) can be used with the ice instead of table salt to lower the temperature. Additional salt may be added to decrease freezing time. The teacher might make a bag of ice cream using no salt on the ice to demonstrate the purpose of the salt. Crushing the ice is a good student job since it is noisy and requires lots of energy.

Adding salt to roads lowers the freezing point of water, so roads can be wet, not icy, at lower temperatures. High concentrations of salt promote rusting of automobiles.

Using salt in making ice cream allows the temperature surrounding the ice cream mixture to be lowered, thus promoting freezing of the mixture.

Materials Apparatus

2 packages of egg replacement	500 ml sugar	1 L half and half
10 ml vanilla	2 L milk	clean 4 L jug with cap
1 bag ice, crushed	50 ml table salt	spoons and cups

large re-sealable plastic bag (1 for each 2 students)
small re-sealable plastic bag (1 for each 2 students)

Procedure

- Crush ice.
- Predict how long it will take for your mixture to turn to ice cream.
- Place the egg replacement, sugar, half and half, vanilla, and salt in the clean 4 L jug. Add milk until the jug is almost full. Place the cap on the jug and shake well to mix all the ingredients.
- Give each pair of students a small re-sealable bag. Pour approximately 250 ml ice cream mixture in each bag. Seal well.
- Give each pair of students a large re-sealable bag half filled with ice.
- Add a small handful (about 50 ml) of salt to the ice.
- Have the students place the ice cream filled bag into the bag of ice. Seal the large bags.
- Students can take turns or work together to "churn" the ice cream turning the bag over and over. The ice should be continually moved around the ice cream mixture.
- When the ice cream is frozen, remove it from the bags, place in individual cups and enjoy their ice cream!
- Compare predictions to the actual time it took the ice cream to freeze.

Analysis

- What was the purpose of adding the salt to the ice?
- Why did some bags of ice cream freeze faster than others?
- Would twice as much ice cause it to freeze twice as fast?
- How would the absence of salt affect the freezing time?

Extension

Investigate why Nova Scotia uses salt on its roads in the winter. Using what you discovered in the activity above, answer the following questions:

- What is happening to the ice/snow on the roads when salt is applied? Make sure you discuss the particles and not just generally.
- The Prairie provinces do not use salt on their roads in the winter. Why is it not effective in these provinces?

Solubility–Too (45 minutes) Student Notes

Outcomes

Students will be expected to

- describe qualitatively the factors that affect solubility. (307-5)
- identify and suggest explanations for discrepancies in data (210-7)
- identify some positive and negative effects and intended and unintended consequences of a particular scientific or technological development (113- 1)
- relate personal activities in formal and informal settings to specific science disciplines (109-10)
- identify new questions and problems that arise form what was learned (210- 16)

Assessment

Beginning (you need to come for help and try again) Level 1	Its OK if you are OK with it Level 2	Wow!! Level 3
activity equipment broken or not used for intended purpose activity procedure was incorrectly carried out activity was not completed results/ conclusions were not completed	procedure for activity was followed as directed group worked as a team to complete activity group discussed results together results/conclusions were answered using complete, independent sentences connections made between activity and real world show understanding of concept	all parts of level 2 were accomplished extension activity was completed connections between activity and real world questions show deep understanding through discussion, examples and/or added details from research diagrams, report show extra attention, outside research or details and connections made above and beyond classroom work/discussion

Questions

What does "soluble" mean?
What does “insoluble” mean?
Is it possible for a substance to be soluble in one solvent and insoluble in another?

Material Apparatus

2 sugar cubes	2 covered jars	2 cubes shortening
alcohol	water	markers
2 (100 mL) beakers	filter paper	

Safety

- Wear safety glasses.
- Do not put anything in your mouth during science activities.
- Dispose of all materials in a safe manner.

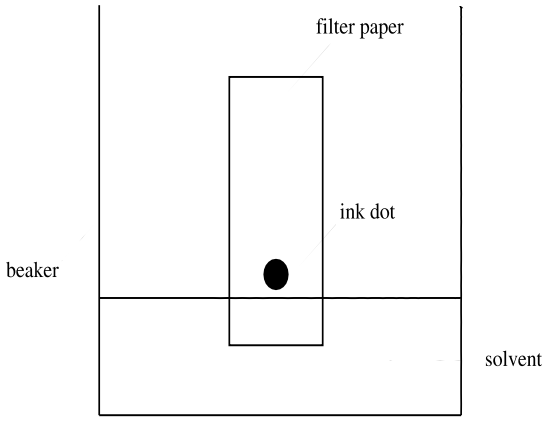
Procedure

Part I

- Place a sugar cube in each jar.
- Cover tightly and shake.
- Record your observations

Part II

- Make an ink dot on a strip of filter paper with a marker. Make sure the dot is about 1 cm from the end of the paper.
- Dip the end of the paper in one of the solvents. Make sure the dot doesn't touch the solvent.
- Observe. Save the results and tape it to your worksheet.
- Now use the same pen and repeat the test using another piece of paper and the other solvent. Make your observations and save the paper again.



Conclusion

Show your understanding of what you have observed in these two activities by completely answering these questions.

- Is it possible for a substance to be soluble in one solvent and insoluble in another?
- How do you explain the differences you observed between the sugar cubes in the two jars?
- How do you explain the differences you observed between the markers?
- Define soluble, insoluble, pigment, solvent, solute, chromatography and relate them to what you did in these activities.

Extension

Where in our lives would some of these concepts be used?

Find some occupations, careers or technology related to what you have just done in these activities? Report your findings by interviewing people in these positions and reporting by video, audio tape or in a written or electronic presentation.

Solubility–Too (45 minutes) Teacher Notes

Outcomes

Students will be expected to

- describe qualitatively the factors that affect solubility. (307-5)
- identify and suggest explanations for discrepancies in data (210-7)
- identify some positive and negative effects and intended and unintended consequences of a particular scientific or technological development (113- 1)
- relate personal activities in formal and informal settings to specific science disciplines (109-10)
- identify new questions and problems that arise form what was learned (210- 16)

Assessment

Beginning (you need to come for help and try again) Level 1	Its OK if you are OK with it Level 2	Wow!! Level 3
activity equipment broken or not used for intended purpose activity procedure was incorrectly carried out activity was not completed results/ conclusions were not completed	procedure for activity was followed as directed group worked as a team to complete activity group discussed results together results/conclusions were answered using complete, independent sentences connections made between activity and real world show understanding of concept	all parts of level 2 were accomplished extension activity was completed connections between activity and real world questions show deep understanding through discussion, examples and/or added details from research diagrams, report show extra attention, outside research or details and connections made above and beyond classroom work/discussion

Questions

What does "soluble" mean?
What does “insoluble” mean?
Is it possible for a substance to be soluble in one solvent and insoluble in another?

Material Apparatus

2 sugar cubes
alcohol
2 (100 mL) beakers
4 covered jars
water
filter paper
2 cubes shortening
markers

Safety

- Wear safety glasses.
- Do not put anything in your mouth during science activities.
- Dispose of all materials in a safe manner.

Procedure

Part I

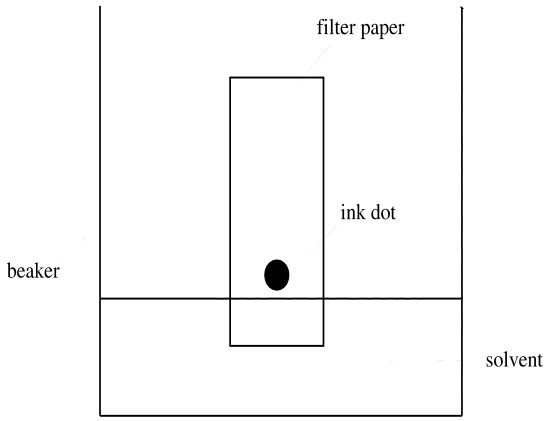
- Place a sugar cube in each jar.
- Cover tightly and shake.
- Record your observations

Part II

- Make an ink dot on a strip of filter paper with a marker. Make sure the dot is about 1 cm from the end of the paper.
- Dip the end of the paper in one of the solvents. Make sure the dot doesn't touch the solvent.
- Observe. Save the results and tape it to your worksheet.
- Now use the same pen and repeat the test using another piece of paper and the other solvent. Make your observations and save the paper again.

Conclusion

Show your understanding of what you have observed in these two activities by completely answering these questions.



- Is it possible for a substance to be soluble in one solvent and insoluble in another?
- How do you explain the differences you observed between the sugar cubes in the two jars?
- How do you explain the differences you observed between the markers?
- Define soluble, insoluble, pigment, solvent, solute, chromatography and relate them to what you did in these activities.

Extension

Where in our lives would some of these concepts be used?

Find some occupations, careers or technology related to what you have just done in these activities? Report your findings by interviewing people in these positions and reporting by video, audio tape or in a written or electronic presentation.

Solubilities–Effect of Temperature (45 minutes) Teacher Notes

Outcomes

Students will be expected to

- describe the concentrations of solutions qualitatively (307-4)
- identify different was that concentrations can be demonstrated for various substances (109-7)
- calculate concentrations of solutions in g/L (210-9)
- rephrase questions related to solubility in a testable form and clearly define practical problems (208-1)
- design and carry out procedures to study the effect of temperature on solubility (208-6, 209-1)
- identify and suggest explanations for discrepancies in data after carrying out procedures designed to study the effect of temperature on solubility (210-7)
- predict the solubility of a solute by interpolating or extrapolating from graphical data (210-40)
- describe qualitatively the factors that affect solubility (307-5)

Assessment

Beginning (you need to come for help and try again)	It's OK if you are OK with it	Wow!
dangerous or inappropriate use of lab and its equipment meant you had to stop your work procedure was not completed all observations are not present all questions are not answered	use of lab and its equipment was appropriate and safe procedure completed an attempt has been made to include all observations questions are answered and show some thought and understanding of outcomes report shows understanding of the importance of communication by being complete, orderly, neat blue or black pen was used for written part; pencil for sketches	use of lab and its equipment show competence and a desire to learn procedure completed carefully and within the time frame allowed observations show care, detail answers to questions show thought, connections and understanding of outcomes report is neat, carefully put together, complete and shows extra attention to care and detail blue or black pen was used for written part; pencil for sketches

Questions

What does saturated mean?
How do I think temperature will affect the solubility of a solid?
Do I think it will affect the solubility of a gas in the same way?

Material Apparatus

Alum, salt, sugar	150 ml Erlenmeyer flasks
hot plate	water
400 ml beaker	corks for flasks
2 test tubes	plastic straw
hot plate	2 beakers

Safety

- Wear safety glasses.
- Be careful when handling the hot water. Wear hot mitts or use tongs.
- Do not put anything in your mouth in science class.

Procedure

Activity I

- Place 100 ml of cold tap water in each flask.
- Make a hot water bath by heating water in beaker.
- Place one of the flasks in a hot water bath until it warms up to 10°C more than the cold water.
- Measure and record the temperature of each flask of water.
- Carefully measure 5 ml of alum (salt or sugar) in each flask.
- Cork and swirl flask until all alum dissolves (you may have to return the flask to the hot water bath). Raise the temperature another 10°C in the hot water.
- Once the alum is dissolved, add 5 ml more.
- Repeat the last two steps until you have reached 50°C and can get no more to dissolve. Make sure you record how much alum each flask can hold and the temperatures.

Activity II

- Fill each test tube 2/3 full of cold tap water.
- Using the straw, gently blow air into the water for a few seconds. This will
- ensure that the water has lots of gas dissolved in it.
- Place one of the test tubes in a warm water bath, the other in a cold water bath for a few minutes.
- Record what you observe.

Analysis

- Define saturated, solubility, supersaturated. Identify where these terms fit
- into your activity.
- Create a line graph of temperature versus amount of solute.
- Predict how much solute could be added at 60°C.
- What do you think might happen at 10°C?
- How did temperature affect solubility of a solid?
- Did temperature affect the solubility of a gas in the same way? Explain.

- What problems might fish in an aquarium have if the water is left at too high
- a temperature?
- Calculate what the concentration of each solution in Activity I.
- Show you understand of the concepts in these activities by reading, discussing the attached article.

Solutions–A Special Kind of Mixture (45 minutes) Student Notes

Outcomes

Students will be expected to

- distinguish between pure substances and mixtures, using the particle theory of matter (307-1)
- demonstrate a knowledge of WHMIS standards by recognizing and following warning labels symbols (209-7)

Assessment

Beginning (you need to come for help and try again)	It's OK if you are OK with it	Wow!
dangerous or inappropriate use of lab and its equipment meant you had to stop your work procedure was not completed all observations are not present all questions are not answered	use of lab and its equipment was appropriate and safe procedure completed an attempt has been made to include all observations questions are answered and show some thought and understanding of outcomes report shows understanding of the importance of communication by being complete, orderly, neat blue or black pen was used for written part; pencil for sketches	use of lab and its equipment show competence and a desire to learn procedure completed carefully and within the time frame allowed observations show care, detail answers to questions show thought, connections and understanding of outcomes report is neat, carefully put together, complete and shows extra attention to care and detail blue or black pen was used for written part; pencil for sketches

Question

Can I tell the difference between a solution and a non-solution?

Material Apparatus

sugar	drink crystals	alcohol
salt	sand	milk
film canisters	clear plastic glasses	oil
water		

Procedure

- Examine the packaging for the substances used for safety precautions.
- Get six mixtures in film containers.
- Three of the mixtures (sugar/water, drink crystals/water, alcohol/water) are solutions. The other three (salt/sand, milk/water, water/oil) are non-solutions.
- Carefully pour each mixture into a clear plastic cup so you can observe it better.
- Determine, by observations, how solutions are different from non-solutions.
- Use the attached chart to complete your observations.

Analysis

- Define solution, alloy. Use these words in describing what you have learned from this activity.
- How is a solution different from a non-solution?
- What are the properties of a solution?
- What is the one property an alloy has that is different from other solutions?

Extension

Find examples of alloys and their uses in our lives;
or
interview a person who works with alloys. Report on what their job is, how the alloy is obtained, where the alloy comes from, what it is used for.

Observations

Ingredients	Solution/non-solution	description	diagram
sugar and water			
alcohol and water			
drink crystals and water			
salt and sand			
milk and water			
oil and water			

Solutions–A Special Kind of Mixture (45 minutes) Teacher Notes

Outcomes

Students will be expected to

- distinguish between pure substances and mixtures, using the particle theory of matter (307-1)
- demonstrate a knowledge of WHMIS standards by recognizing and following warning labels symbols (209-7)

Assessment

Beginning (you need to come for help and try again)	It's OK if you are OK with it	Wow!
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Question

Can I tell the difference between a solution and a non-solution?

Background

Mixtures are formed simply by blending two or more substances together in some random proportion without chemically changing the individual substances in the mixture. Mixtures can then be broken down into homogeneous and heterogeneous.

A homogeneous mixture is called a solution: salt or sugar and water, air (solution of gases). These have a constant composition throughout the solution.

A heterogeneous mixture would be: salt with sugar (no water), water with gasoline or oil, salt with sand. These have areas with differing compositions (you could easily see the separation of the two things).

Material Apparatus

sugar	drink crystals	alcohol
salt	sand	milk
film canisters	clear plastic glasses	oil
water		

Procedure

- Examine the packaging for the substances used for safety precautions.
- Get six mixtures in film containers.
- Three of the mixtures (sugar/water, drink crystals/water, alcohol/water) are solutions. The other three (salt/sand, milk/water, water/oil) are non-solutions.
- Carefully pour each mixture into a clear plastic cup so you can observe it better.
- Determine, by observations, how solutions are different from non-solutions.
- Use the attached chart to complete your observations.

Analysis

- Define solution, alloy. Use these words in describing what you have learned from this activity.
- How is a solution different from a non-solution?
- What are the properties of a solution?
- What is the one property an alloy has that is different from other solutions?

Extension

Find examples of alloys and their uses in our lives;
or
interview a person who works with alloys. Report on what their job is, how the alloy is obtained, where the alloy comes from, what it is used for.

Observations

Ingredients	Solution/non-solution	description	diagram
sugar and water	solution		
alcohol and water	solution		
drink crystals and water	solution		
salt and sand	non-solution		
milk and water	non-solution		
oil and water	non-solution		

Tyndall Effect (15 minutes) Student Notes

Outcomes

Students will be expected to

- identify new questions and problems about mixtures that arise form what is learned (210-16)
- distinguish between pure substances and mixtures, using the particle theory of matter (307-1)

Assessment

Beginning (you need to come for help and try again)	It's OK if you are OK with it	Wow!
dangerous or inappropriate use of lab and its equipment meant you had to stop your work procedure was not completed all observations are not present all questions are not answered	use of lab and its equipment was appropriate and safe procedure completed an attempt has been made to include all observations questions are answered and show some thought and understanding of outcomes report shows understanding of the importance of communication by being complete, orderly, neat blue or black pen was used for written part; pencil for sketches	use of lab and its equipment show competence and a desire to learn procedure completed carefully and within the time frame allowed observations show care, detail answers to questions show thought, connections and understanding of outcomes report is neat, carefully put together, complete and shows extra attention to care and detail blue or black pen was used for written part; pencil for sketches

Question

How does the Tyndall effect show the difference between solutions and non-solutions?

Safety

- Wear safety glasses.
- Do not put anything in your mouth in science class.
- Dispose of all materials in a safe manner.

Material
Apparatus

distilled water
tap water
clear, disposable glasses
flashlight
cornstarch
drink crystals
milk

Procedure

- Fill your cup approximately 2/3 full of distilled water.
- Shine a flashlight through the cup.
- You can see the light as it leaves the flashlight and perhaps as it falls on something on the other side of the cup, but can you see the beam of light passing through the water?
- Add a bit of drink crystals to the water and stir until it has disappeared. Can you see the beam now?
- Add some cornstarch and repeat your observations.
- Clean your cup and repeat steps 2–6 using tap water.
- Clean your cup and try step 2–3 with milk
- Complete the chart using your observations.

Analysis

- Define Tyndall effect, solution, non-solution, transparent, translucent, opaque. Use these words and definitions in your discussion or what happened.
- How can the Tyndall effect be used to identify a solution?
- Which of your experiments were solutions? Which were non-solutions?

Observation

liquid	liquid alone	liquid + drink crystals	liquid + drink crystals + cornstarch
distilled water			
tap water			
milk			

Tyndall Effect (15 minutes) Teacher Notes

Outcomes

Students will be expected to

- identify new questions and problems about mixtures that arise form what is learned (210-16)
- distinguish between pure substances and mixtures, using the particle theory of matter (307-1)

Assessment

Beginning (you need to come for help and try again)	It's OK if you are OK with it	Wow!
dangerous or inappropriate use of lab and its equipment meant you had to stop your work procedure was not completed all observations are not present all questions are not answered	use of lab and its equipment was appropriate and safe procedure completed an attempt has been made to include all observations questions are answered and show some thought and understanding of outcomes report shows understanding of the importance of communication by being complete, orderly, neat blue or black pen was used for written part; pencil for sketches	use of lab and its equipment show competence and a desire to learn procedure completed carefully and within the time frame allowed observations show care, detail answers to questions show thought, connections and understanding of outcomes report is neat, carefully put together, complete and shows extra attention to care and detail blue or black pen was used for written part; pencil for sketches

Question

How does the Tyndall effect show the difference between solutions and non-solutions?

Background

If you can see the beam of light passing through he mixture, that means there are particles in the liquid that are large enough to scatter light. That means the mixture is not a solution since the solute is not totally dissolved. The scattering of light caused by the particles is called the Tyndall effect.

Mixtures are formed simply by blending two or more substances together in some random proportion without chemically changing the individual substances in the mixture. Mixtures can then be broken down into homogeneous and heterogeneous.

A homogeneous mixture is called a solution: salt or sugar and water, air (solution of gases). These have a constant composition throughout the solution. A heterogeneous mixture would be: salt with sugar (no water), water with gasoline or oil, salt with sand. These have areas with differing compositions (you could usually see the separation of the two things).

A clear glass with coloured jelly made ahead of time (so it is gelled) can be used as a class demonstration of the Tyndall effect without spills.

Safety

- Wear safety glasses.
- Do not put anything in your mouth in science class.
- Dispose of all materials in a safe manner.

Material Apparatus

distilled water	flashlight	drink crystals
tap water	cornstarch	milk
clear, disposable glasses		

Procedure

- Fill your cup approximately 2/3 full of distilled water.
- Shine a flashlight through the cup.
- You can see the light as it leaves the flashlight and perhaps as it falls on something on the other side of the cup, but can you see the beam of light passing through the water?
- Add a bit of drink crystals to the water and stir until it has disappeared. Can you see the beam now?
- Add some cornstarch and repeat your observations.
- Clean your cup and repeat steps 2–6 using tap water.
- Clean your cup and try steps 2–3 with milk
- Complete the chart using your observations.

Analysis

- Define Tyndall effect, solution, non-solution, transparent, translucent, opaque. Use these words and definitions in your discussion or what happened.
- How can the Tyndall effect be used to identify a solution?
- Which of your experiments were solutions? Which were non-solutions?

Observation

liquid	liquid alone	liquid + drink crystals	liquid + drink crystals + cornstarch
distilled water			
tap water			
milk			

Life Science:
Interactions Within Ecosystems
Appendix

A Town Meeting (45 minutes) Student Notes

Outcomes

Students will be expected to

- propose and defend a course of action to protect the local habitat of a particular organism (113-11, 211-5)
- provide examples of problems that arise in the environment that cannot be solved using scientific or technological knowledge (113-10)
- use various print and electronic sources to research individuals or groups in Canada interested in protecting the environment (112-4, 112-8, 209-5)

Assessment

Beginning (you need to come for help and try again) Level 1	Its OK if you are OK with it Level 2	Wow!! Level 3
activity equipment broken or not used for intended purpose activity procedure was incorrectly carried out activity was not completed results/ conclusions were not completed	procedure for activity was followed as directed group worked as a team to complete activity group discussed results together results/conclusions were answered using complete, independent sentences connections made between activity and real world show understanding of concept	all parts of level 2 were accomplished extension activity was completed connections between activity and real world questions show deep understanding through discussion, examples and/or added details from research diagrams, report show extra attention, outside research or details and connections made above and beyond classroom work/discussion

Background

It is hoped that as students assume character roles, they will come to realize that environmental issues need sensitive decision making. There is no ‘right’ answer to this dilemma. Assessment should be based on the depth of research, the ability to think clearly 'on one's feet' as the debate takes place and the trueness to character. As with most environmental issues, humans need to balance the preservation of habitat for other species with development for humans.

Students should come to see that a compromise is necessary. Therefore, the final question put by the mayor may need to be reworded to reflect the compromises agreed to by the townspeople. The names chosen for characters were deliberately chosen to be gender neutral. The character of the person can be filled by either a male or female.

Material

A copy of character cards for participants.
A copy of the issue.

Procedure

- Read and discuss the issue with the class first. Review what has been learned about food webs, interdependence, niche, habitat, ecosystems.
- Each person who wishes may draw for a character. That person should have one or two others for coaches.
- In those small groups, spend 15–20 minutes discussing how the character would act, the ideas and opinions on the issue of that character and what position that character might take about the issue. Research may be done at this point using text, notes and/or Internet sites.
- After 20 minutes, the meeting begins and continues until the mayor calls for the vote; or
- research time may be allowed and the meeting scheduled for another class. This would also allow for characters to develop props such as maps, charts, diagrams if you felt it was true to character. Check with your teacher about the time allowed.

Results Analysis

- Do you personally feel the results of the vote were right? Why or why not?
- During the debate, what other issues did you hear raised which a real town would have to deal with?
- If you could have been any character, which one would you have chosen? Why?
- If you hadn't been in character, what would your 'real' feelings be about this issue?
- Is there a current issue in the media (either locally, nationally or internationally) that is similar to the issue debated in class?

Extension

Find out information about a Canadian group or individual interested in protecting the environment. Give some background on the group or individual (history, ideals, etc.). Describe the work done by the group or individual;

or

pick a current environmental issue to research. Find out what the issue is, who is on what side, what has been proposed to date. What do you think a solution to the issue could be? How close do you think the sides are to solving the problem? Is there a solution?

A Town Meeting (45 minutes) Teacher Notes

Outcomes

Students will be expected to

- propose and defend a course of action to protect the local habitat of a particular organism (113-11, 211-5)
- provide examples of problems that arise in the environment that cannot be solved using scientific or technological knowledge (113-10)
- use various print and electronic sources to research individuals or groups in Canada interested in protecting the environment (112-4, 112-8, 209-5)

Assessment

Beginning (you need to come for help and try again) Level 1	Its OK if you are OK with it Level 2	Wow!! Level 3
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Background

It is hoped that as students assume character roles, they will come to realize that environmental issues need sensitive decision making. There is no ‘right’ answer to this dilemma. Assessment should be based on the depth of research, the ability to think clearly 'on one's feet' as the debate takes place and the trueness to character. As with most environmental issues, humans need to balance the preservation of habitat for other species with development for humans.

Students should come to see that a compromise is necessary. Therefore, the final question put by the mayor may need to be reworded to reflect the compromises agreed to by the townspeople. The names chosen for characters were deliberately chosen to be gender neutral. The character of the person can be filled by either a male or female.

Material

A copy of character cards for participants.
A copy of the issue.

Procedure

- Read and discuss the issue with the class first. Review what has been learned about food webs, interdependence, niche, habitat, ecosystems.
- Each person who wishes may draw for a character. That person should have one or two others for coaches.
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Extension

Find out information about a Canadian group or individual interested in protecting the environment. Give some background on the group or individual (history, ideals, etc.). Describe the work done by the group or individual;

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pick a current environmental issue to research. Find out what the issue is, who is on what side, what has been proposed to date. What do you think a solution to the issue could be? How close do you think the sides are to solving the problem? Is there a solution?

Town Meeting

The Issue

Application has been made to build an access road into the town of Smallville. The proposed route will take the highway through a wetlands area known as Spruce Meadows. The land here is unused and consists of privately and publically owned land. In years past, Smallville was a prosperous lumber town. There was a strong Main Street with a bakery, a restaurant, a grocer, a butcher, a library, a general store, a garage, a hardware store, a barber shop and a pharmacy. The town boasted a school, four churches, a local fire brigade.

Ever since the highway was built, people have been able to bypass the town. With the slow-down in the lumber industry and the bypassing of the town, Main Street has slowly declined to one convenience store and a museum. There is only one church still operating regularly. The school is open but has only 125 students from primary to grade 12. There is talk of closing the school and busing the children to the next town. Young people find it hard to stay in the town because employment opportunities are limited.

This town meeting is to decide whether to approve the building of an access road or not. Several people have made petitions to speak at the meeting. The counsellors will add their opinions then ask the general public for their comments. In the end, a vote will be taken on a motion put to the floor by the mayor.

The Mayor

The Mayor will maintain order during the meeting and control the speakers. When discussion is finished, the mayor will put forward the motion—"Be it resolved that the town of Smallville will approve the construction of an access road from Highway 103." There is the possibility that the wording may be revised depending on the suggestions from the speakers.

Terry

Terry is a young entrepreneur who has recently opened a new water park. Terry wants the new road so tourists will detour off the highway to visit the town. Terry doesn't want to upset those in the town but feels that the highway will have little impact on the swamp.

Kim

Kim is an environmental activist who does not want the wetlands tampered with in any way. Recently, Kim has taken an inventory of the plants and animals in the wetlands and has found several rare species of orchids.

Aayu

Aayu is the town engineer who will be responsible for the planning of the new highway. Aayu has 30 years experience in town planning and feels that there must be a way to have easy access to the town and do no damage to the wetlands.

Casey and Pat

Casey and Pat are owners of the land adjacent to the wetlands on either end of the proposed road. Selling this land to the town will be financially beneficial.

Pat and Casey do not understand what the fuss is about. That swamp has been ignored for years.

Darcey

Darcey is a new resident to the townwho moved here for the peace and quiet. Darcey is unwilling to have any of the charm and ambienceof the town changed by water parks or influxes of tourists.

Jean and Forrest

Jean and Forrest have been residents of the town for 50 and 80 years. Jean and Forrest feel that the 'young people'of the town are making an undue fuss over a stinky piece of swamp. This swamp only contains disgusting insects, snake, frogs. It stinks in the summer and is a nuisance in the winter since it doesn't freeze solid. For years, Forrest and Jean have been dumping garbage in the end closest to their places and feel that the swamp would be best filled in and paved over. Part of each of their properties could be sold to make part of the highway.

Counsellors 1–5

The counsellors want the access road into the town. Projections show that the economics of the town could improve by 25% in the first year alone. Because these politicians are elected, they must be careful not to offend voters but overall support an access road because of short-term employment opportunities and long-term tourism prospects.

Rene

Rene owns the local construction company. Work on the access road would be a boom to the company. Rene has always liked the wetlands area, has many pleasant memories of childhood explorations, looks forward to sharing these experiences with future grand children.

Bobby

Bobby works as a guide during the hunting season. The wetlands are home to migratory birds such as geese and ducks. An increased tourist base at other times of the year would help round out Bobby's income, making it less seasonal.

Stacey

Stacey is founder and curator of the local museum. Increased tourism would help keep the museum solvent. The discovery and conservation of rare plants in the wetlands would mean increased status and importance to the museum.

Concerned citizens

There is a wide variety of people attending the meeting who are strongly for the access road at any cost, strongly opposed to the road in any way and some who can see reasons for and against. Some of these people own the businesses remaining along Main Street. Others have owned businesses in the past which have closed as the town could no longer support them. These people need to be identified and need to take a stand on the issue based on their attachment to church, school, business (past or present) or fire brigade. Reasons can be economic, environmental, or purely selfish.

How Does Your Garden Grow? (5 days) Student Notes

Outcomes

Students will be expected to

- describe conditions essential to the growth and reproduction of plants and microorganisms in an ecosystem, and relate these conditions to various aspects of the human food supply
  - air
  - temperature
  - light
  - moisture (304-3)
- describe interactions between biotic and abiotic factors in an ecosystem (306-3)
- organize and record data collected in an investigation of an ecosystem (209-4)

Assessment

Beginning (you need to come for help and try again) Level 1	Its OK if you are OK with it Level 2	Wow!! Level 3
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Material

10 potted plants
thermometer
plastic straws
water
window
twist ties/elastics
2 large baggies
grow light

Procedure

- Get two potted plants. As a group, carefully observe the plant. Record your observations. Gather data such as number of leaves, height, mass, etc.
- Set up the plants in the variable your group is testing. Keep all other variables the same for all plants.
- For air:
  - put one plant in a plastic bag. With a straw suck as much air out of the bag. Blow the bag back up by exhaling into the bag. Seal the bag.
  - put the other plant in another bag. With a straw suck as much air out of the bag. Seal the bag before air leaks back in.
- For temperature:
  - put one plant in a spot (5–10°C) cooler. This could be near a window if it is winter
  - put one plant in a spot (5–10°C). This could be near a heater or you could train a lamp on the plant in the bag.
- For moisture:
  - for one plant this will be the last water it gets for the duration of the activity.
  - water the other plant every day
- For light:
  - place one plant in a southern exposure window or under a grow lamp
  - place the other plant in a dark cupboard
- The control plants will be placed in a sunny window where the temperature is about 25°C. These plants will be watered as they need it. Most plants need to be slightly dry before adding more water. Check the plants daily but only add water when the top soil feels dry. The control plants are important because they will indicate what the plants do under normal light, moisture, temperature, and air conditions.
- When the time period is up, place your plants at your group's table. Visit other groups to see what has happened to their plants.
- Record the results of all the variables in this activity.
- Return to you group to discuss the analysis questions.

Analysis

- What was the purpose of the control plants?
- Does temperature affect the growth of plants? What did you discover about the temperature needs for this type of plant? Would the needs be different for other types of plants?
- What did you discover about water needs for this plant? Would the needs differ for another type? Give some examples of plants you know that have different water needs.
- Does the amount of light affect plant growth? How? Why do you suppose the instructions suggested a southern exposure for the light? Do some research to find out if the direction of the light affects the growth of plants?
- What happened in the air part of this activity? Find out how the process of photosynthesis works in plants. What was the purposeof blowing into the bag? What kind of ‘air’ was blown in? What happened in the bag with most of the air removed? Why?

Conclusion

Using what you have learned about growth of plants, answer the following:

- What problems are created for farmers in years of drought?
- In growing years where the temperature is above average from May to October, what might farmers experience in their crops?
- Why are most greenhouses built to catch southern or western light?

Extension

Visit a working greenhouse to interview the operators. Describe what is grown in the greenhouse. What growing conditions are carefully controlled? Why? How?

How Does Your Garden Grow? (5 days) Teacher Notes

Outcomes

Students will be expected to

- describe conditions essential to the growth and reproduction of plants and microorganisms in an ecosystem, and relate these conditions to various aspects of the human food supply
  - air
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Material

10 potted plants
thermometer
plastic straws
water
window
twist ties/elastics
2 large baggies
grow light

Background

It is suggested that five groups of students be responsible for one part of this activity. Four groups will alter either air, temperature, light or moisture variable. The fifth group will look after the control plants. One will remain in normal light, temperature, air, moisture conditions; one will remain in those same conditions in a bag. This activity offers the opportunity to discuss variables, controls, and the importance of record keeping. The plants need to be identical. Geraniums work well as do coleus and spider plants. All plants should have the same amount of water, light and be at the same temperature to begin the activity.

Procedure

- Get two potted plants. As a group, carefully observe the plant. Record your observations. Gather data such as number of leaves, height, mass, etc.
- Set up the plants in the variable your group is testing. Keep all other variables the same for all plants.
- For air:
  - put one plant in a plastic bag. With a straw suck as much air out of the bag. Blow the bag back up by exhaling into the bag. Seal the bag.
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- For moisture:
  - for one plant this will be the last water it gets for the duration of the activity.
  - water the other plant every day
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- When the time period is up, place your plants at your group's table. Visit other groups to see what has happened to their plants.
- Record the results of all the variables in this activity.
- Return to you group to discuss the analysis questions.

Analysis

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- Why are most greenhouses built to catch southern or western light?

Extension

Visit a working greenhouse to interview the operators. Describe what is grown in the greenhouse. What growing conditions are carefully controlled? Why? How?

Living or Not (45 minutes) Student Notes

Outcomes

Students will be expected to

- explain how biological classification takes into account the diversity of life on Earth, using the terms producer, consumer, and decomposer (304-1)
- explain that observations and identification of similar characteristics enables classification in an ecosystem (109-1)
- classify organisms as producers, consumer, and decomposers (210-1)
- organize and record data collected in an investigation of an ecosystem (209-4)
- describe interactions between biotic and abiotic factors in an ecosystem (306-3)

Assessment

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Material

You will need a collection of pictures which includes abiotic factors such as air, water, sun, rocks, etc. and biotic factors from all groups—plants, animals (mammals, insects, birds, reptiles, amphibians), fungi and yeast and protozoa.

Procedure Observation Analysis

- In groups of five, get a handful of pictures from the collection.
- As a group, sort your pictures as you see them fitting together. Be sure you can defend you sort in scientific terms.
- Present your system to your teacher. Explain your reasons for your classifications.
- As a group, in your notes, define the terms biotic and abiotic.
- Re-examine your system of pictures. In a chart, list the biotic and abiotic factors.
- As a group, in your notes, define the terms producers, consumers, and decomposers. In chart form, list all the producers, consumers and decomposers in your system.
- In your notes identify some food chains or pyramids you can form among producers, consumers and decomposers. Add any abiotic factors to surround the pyramid layer they influence.
- Pick two pyramids formed in your notes. What would happen to the pyramid if you removed either the producer, the consumer or the decomposer? What would happen if the abiotic factor changed or disappeared? Be complete in your answer.
- As a group, define ecosystem. In your notes, explain the importance of all the parts of an ecosystem and the dependence of the parts on the whole system.
- Present your report with all parts, definitions, sketches and charts for assessment.

Extension

Research an example of an ecosystem changed by the removal or addition of a biotic or abiotic factor to that system. Describe what the system was like originally, what was changed and how and the consequences of the change. Was the change beneficial? Why or why not? Can the change be reversed? Should it be reversed? Include diagrams, sketches or pictures with your report. Present your report to the class.

Or

Build a model of an ecosystem such that you can manipulate (add or remove) the parts within it so the model then reflects the changes to the whole system. Present your model to the class.

Or

Create a skit where each person in the group is a biotic or abiotic factor in a system. Your skit should show how the parts of the system interact with each other and what happens if something is added or removed.

Living or Not (45 minutes) Teacher Notes

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Background

Ecology is the study of the interactions between living things and their environments. Ecology comes from the Greek word oikos, which means home. The word ecosystem refers to the system of interactions between living and non-living things.

An ecosystem is the minimum system of interacting species and their abiotic resources in an area necessary to sustain life. Normally, an ecosystem must have some kind of producers, consumers, and decomposers. The presentation of the final report could be in group form in which case.

In your notes, define the terms producers, consumers, and decomposers. Presentation skills can be added to the assessment or as individual reports handed in to be read by the teacher.

Material

You will need a collection of pictures which includes abiotic factors such as air, water, sun, rocks, etc. and biotic factors from all groups—plants, animals (mammals, insects, birds, reptiles, amphibians), fungi and yeast and protozoa. From this large collection, make smaller collections for each group making sure you have some biotic and some abiotic factors in the collections.

Procedure Observation Analysis

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- As a group, sort your pictures as you see them fitting together. Be sure you can defend you sort in scientific terms.
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- As a group, define ecosystem. In your notes, explain the importance of all the parts of an ecosystem and the dependence of the parts on the whole system.
- Present your report with all parts, definitions, sketches and charts for assessment.

Extension

Research an example of an ecosystem changed by the removal or addition of a biotic or abiotic factor to that system. Describe what the system was like originally, what was changed and how and the consequences of the change. Was the change beneficial? Why or why not? Can the change be reversed? Should it be reversed? Include diagrams, sketches or pictures with your report. Present your report to the class.

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Or

Create a skit where each person in the group is a biotic or abiotic factor in a system. Your skit should show how the parts of the system interact with each other and what happens if something is added or removed.

New Again (10-30 days) — Student Notes

Outcomes

Students will be expected to

- describe how matter is recycled in an ecosystem through interactions among plants, animals, fungi, and microorganisms (306-2)
- identify and evaluate potential applications for the recycling of matter in an ecosystem (210-12)
- distinguish between the following scientific terms:
  - consumer
  - decomposer
  - producer
  - ecosystem
  - habitat
  - photosynthesis (109-12)
- demonstrate the importance of choosing words that are scientifically appropriate by using these words in context:
  - niche
  - habitat
  - population
  - community
  - ecosystem (109-13)

Assessment

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Question

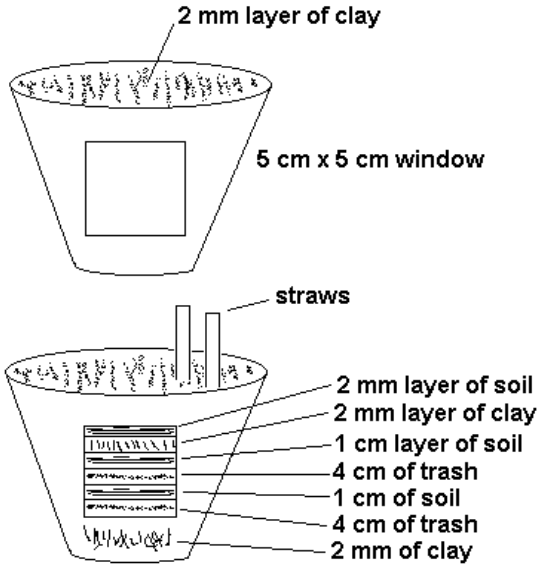
What happens to discarded items in an ecosystem?

Material

plastic cups (10 oz)	clay	trash
metric rulers	plastic trash bags	soil
straws		

Procedure

- Line a plastic cup with approximately 2 mm of clay. Be sure to leave 5 cm x 5cm window covered by clay.
- Cut a piece of the trash bag to fit over the clay (leave the window uncovered). Place about 4 cm of trash in the cup. Use a combination of biodegradable (peelings, leaves, apple cores, small pieces of paper, etc.) and non-biodegradable (plastic, Styrofoam™, metal, etc.) items.
- Insert a straw, straight up and down, inside the trash layer.
- Cover the layer of trash with 1 cm of soil and compact.
- Add a bit of water.
- Make a second layer of trash repeating steps 4, 5, and 6.
- Cover the upper layer of soil with 2 mm of clay.
- Cover the clay with 2 mm of soil.
- Place the cup in a sunny window or some other warm area.
- Record observations of the 'landfill.'
- Use your observations to answer the questions in the analysis section.



Analysis

- What happened to the items you put in your landfill?
- Why are decomposers an important part of any ecosystem?
- In a landfill what roles do the clay, plastic trash bag, and soil play?
- Why is the top layer soil?
- What does a municipality do when a landfill is full?
- Why did the instructions say to put the landfill somewhere warm?
- What are some things a municipality needs to consider when choosing a landfill site?
- What can people do to help extend the life of existing landfills?

Extension

Find out how trash is processed in your municipality? Is there more than one site for trash? What divisions are made in the trash? How does your municipality get rid of materials such as paint, insecticides, etc?

Or

What careers opportunities are involved in the processing and care of trash? (Name at least eight; describe three in detail—education, job responsibilities, etc.).

New Again (10-30 days) — Student Notes

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Question

What happens to discarded items in an ecosystem?

Background

A discussion of the carbon cycle can be useful as you begin this activity. This activity could be used at the beginning of the unit. Have the activity run throughout the unit checking on the progress and discussing what is happening using the terminology of the unit will reinforce concepts discussed in other activities

Composting is a natural process whereby micro-organisms transform organic waste materials into a soil-like product called humus. Kitchen scraps, leaves and yard waste, paper, wood, food-processing wastes, as well as agricultural crop wastes and animal manures, are excellent organic waste materials that can be composted. Composting helps complete the carbon cycle by returning the carbon to the non-living environment by decomposing plant and animal matter. Composting has two benefits: it helps to reduce the amount of waste going to landfills and to recover a valuable resource. It is estimated that about 40 to 60 percent of the total waste stream could be composted!

Organic wastes are broken down through a combination of biological and chemical processes. Biological agents like worms, insects, fungi, bacteria and other micro-organisms "chew up" the materials, which are further transformed by oxidation (exposure to air), reduction and hydrolysis (exposure to water).

The most common microorganisms in the bio-degradation of wastes are bacteria and fungi. These organisms act in concert to bio-degrade organic wastes to stable end products. The end products include CO_2+H_2O. The stabilized organic matter is more commonly known as compost.

Bacteria

Bacteria are single-celled organisms that can be spheres, rod shaped, or spirals. They vary in size from 0.5 mm (spheres) up to 10 mm. Because of their small size, bacteria have a high surface area to volume ratio and are thus very efficient at transferring oxygen and nutrients. Typically 80 to 90 percent of the microorganisms in a compost system are bacteria. Although most bacteria are harmless, the potential for the growth of harmful, disease causing pathogenic bacteria exists, particularly when waste water treatment plant bio-solids are part of the compost waste stream. The control of pathogenic bacteria by high temperature operation will be discussed later in this section.

Fungi

Fungi are multicellular microorganisms that are somewhat larger than typical bacteria, being up to 50 mm wide. Many species form long tubular, filamentous structures called hyphae. Fungi can tolerate lower moisture and require lower nitrogen levels than bacteria, so they compete with bacteria during some parts of the compost cycle.

For successful composting, you need:

- the right amount of water and air to keep the biological and chemical processes functioning
- the right temperature. Ever notice how quickly things go 'bad' in warm-weather? For the purposes of composting, the warmer it gets, the better. In a cool environment, the composting process slows down. The internal temperature of a compost pile is also important. When the process of

- decomposition is at its peak, the compost will tend to generate quite a bit of heat. In a sense it's 'cooking'.
- the right carbon to nitrogen (C:N) ratio will affect the speed of decomposition. Ideally, your C:N ratio should be thirty to one. Grass clippings, plant trimmings and kitchen scraps are high in nitrogen. Sawdust, straw, woodchips and dry leaves are in carbon. A mixture of kitchen and yard waste should give you close to the ideal ratio.
- the right container.

Material

plastic cups (10 oz)	clay	trash
metric rulers	plastic trash bags	soil
straws		

Procedure

- Line a plastic cup with approximately 2 mm of clay. Be sure to leave 5 cm x 5cm window covered by clay.
- Cut a piece of the trash bag to fit over the clay (leave the window uncovered). Place about 4 cm of trash in the cup. Use a combination of biodegradable (peelings, leaves, apple cores, small pieces of paper, etc.) and non-biodegradable (plastic, Styrofoam™, metal, etc.) items.
- Insert a straw, straight up and down, inside the trash layer.
- Cover the layer of trash with 1 cm of soil and compact.
- Add a bit of water.
- Make a second layer of trash repeating steps 4, 5, and 6.
- Cover the upper layer of soil with 2 mm of clay.
- Cover the clay with 2 mm of soil.
- Place the cup in a sunny window or some other warm area.
- Record observations of the 'landfill.'
- Use your observations to answer the questions in the analysis section.

Analysis

- What happened to the items you put in your landfill?
- Why are decomposers an important part of any ecosystem?
- In a landfill what roles do the clay, plastic trash bag, and soil play?
- Why is the top layer soil?
- What does a municipality do when a landfill is full?
- Why did the instructions say to put the landfill somewhere warm?
- What are some things a municipality needs to consider when choosing a landfill site?
- What can people do to help extend the life of existing landfills?

Extension

Find out how trash is processed in your municipality? Is there more than one site for trash? What divisions are made in the trash? How does your municipality get rid of materials such as paint, insecticides, etc?
Or
What careers opportunities are involved in the processing and care of trash? (Name at least eight; describe three in detail—education, job responsibilities, etc.).

A Tangled Web (45 minutes) Student Notes

Outcomes

Students will be expected to

- describe interactions between biotic and abiotic factors in an ecosystem (306-3)
- identify the roles of producers, consumers, and decomposers in a local ecosystem and describe both their diversity and their interactions (304-2)
- prepare a chart that describes how energy is supplied to and how it flows through a food web (210-2, 306-1)
- identify the strengths and weaknesses of a diagram showing the flow of energy in an ecosystem (210-3)
- apply the concept of a food web as a tool for interpreting the structure and interactions of a natural system (111-6)

Assessment

Beginning (you need to come for help and try again) Level 1	Its OK if you are OK with it Level 2	Wow!! Level 3
activity equipment broken or not used for intended purpose activity procedure was incorrectly carried out activity was not completed results/ conclusions were not completed	procedure for activity was followed as directed group worked as a team to complete activity group discussed results together results/conclusions were answered using complete, independent sentences connections made between activity and real world show understanding of concept	all parts of level 2 were accomplished extension activity was completed connections between activity and real world questions show deep understanding through discussion, examples and/or added details from research diagrams, report show extra attention, outside research or details and connections made above and beyond classroom work/discussion

Material

Cards with biotic and abiotic parts of an ecosystem.
Ball of yarn or string

Procedure

- Draw a card from the pack.
- Form a circle holding your card in front so everyone can see.
- One person starts with the ball of yarn. That person passes the ball of yarn to someone naming the connection between them while holding the end.
- The second person takes the ball of yarn and finds a connection, passing the ball of yarn while holding a string and naming the connection.
- The web continues until there is no more yarn.
- Do not hold the yarn too tightly or too loosely.
- When the web is finished, each person in the circle should take one small step into the centre to let some tension from the threads.
- The group then gently lays the web on the floor. At the point where you were standing (where all your threads are), place the card you represented.
- Complete this activity by discussing and answering the analysis questions.

Analysis

- Sketch the web. Place all the card names on a circle on a piece of paper. Draw all the lines connecting the card names.
- Were there any cards with more than one line going to or from it? Why would this be?
- Was there any card which had all the lines going to it? Why, do you suppose?
- Pick a card to remove from your ecosystem. If that card was not there, describe what would happen to the system. Be complete. Take time to think about all the changes that could happen.
- In this system, where does the energy come from? Find at least three things connected in this web. Describe the flow of energy from one item to another by answering bullet #7 completely.
- Where does the energy come from at each level? What is the energy used for at each level? Be complete.
- Identify the producers, consumers and decomposers in the web.
- Identify the abiotic factors in your web.
- Look out your classroom window. Using what you see, create a small web of connections in this ecosystem.

A Tangled Web (45 minutes) Student Notes

Outcomes

Students will be expected to

- describe interactions between biotic and abiotic factors in an ecosystem (306-3)
- identify the roles of producers, consumers, and decomposers in a local ecosystem and describe both their diversity and their interactions (304-2)
- prepare a chart that describes how energy is supplied to and how it flows through a food web (210-2, 306-1)
- identify the strengths and weaknesses of a diagram showing the flow of energy in an ecosystem (210-3)
- apply the concept of a food web as a tool for interpreting the structure and interactions of a natural system (111-6)

Assessment

Beginning (you need to come for help and try again) Level 1	Its OK if you are OK with it Level 2	Wow!! Level 3
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Background

The connections made in the web show flows of energy. There is often more than one connection between parts of the ecosystem so some may hold more than one string. The organisms in a community must interact in some way to be considered part of the same community. The interactions can be direct (a predator consuming prey) or indirect (a predator prey's is out-competed by another animal, so that both the predator and prey populations are affected.) An ecosystem is the minimum system of interacting species and their abiotic resources in an area necessary to sustain life. Normally, an ecosystem must have some kind of producers, consumers, and decomposers. Students should come to realize, through discussion, that the ultimate energy source is the sun.

Material

Cards with biotic and abiotic parts of an ecosystem. Some examples could be:

mushroom	fungi	bacteria	robin
worm	earth	sun	waterair
cat	dog	human	grass
rock	tree	rain	alder
snake	hawk	mouse	acorn
squirrel	wheat	grapevine	grapes
bee	moose	deer	wolf
rabbit	coyote	frog	salamander
rose	blueberry	ladybug	aphid
duck	turtle	partridge	

Ball of yarn or string

Procedure

- Draw a card from the pack.
- Form a circle holding your card in front so everyone can see.
- One person starts with the ball of yarn. That person passes the ball of yarn to someone naming the connection between them while holding the end.
- The second person takes the ball of yarn and finds a connection, passing the ball of yarn while holding a string and naming the connection.
- The web continues until there is no more yarn.
- Do not hold the yarn too tightly or too loosely.
- When the web is finished, each person in the circle should take one small step into the centre to let some tension from the threads.
- The group then gently lays the web on the floor. At the point where you were standing (where all your threads are), place the card you represented.
- Complete this activity by discussing and answering the analysis questions.

Analysis

- Sketch the web. Place all the card names on a circle on a piece of paper. Draw all the lines connecting the card names.
- Were there any cards with more than one line going to or from it? Why would this be?
- Were there any cards connected to more than one other card? Why?
- Was there any card which had all the lines going to it? Why, do you suppose?
- Pick a card to remove from your ecosystem. If that card was not there, describe what would happen to the system. Be complete. Take time to think about all the changes that could happen.

- In this system, where does the energy come from? Find at least three things connected in this web. Describe the flow of energy from one item to another by answering bullet #7 completely.
- Where does the energy come from at each level? What is the energy used for at each level? Be complete.
- Identify the producers, consumers and decomposers in the web.
- Identify the abiotic factors in your web.
- Look out your classroom window. Using what you see, create a small web of connections in this ecosystem.

Making it Last (2 days) — Student Notes

Outcomes

Students will be expected to

- provide examples of how knowledge of microorganisms has resulted in the development of food production and preservation techniques (111-1)

Assessment

Beginning (you need to come for help and try again) Level 1	Its OK if you are OK with it Level 2	Wow!! Level 3
activity equipment broken or not used for intended purpose activity procedure was incorrectly carried out activity was not completed results/ conclusions were not completed	procedure for activity was followed as directed group worked as a team to complete activity group discussed results together results/conclusions were answered using complete, independent sentences connections made between activity and real world show understanding of concept	all parts of level 2 were accomplished extension activity was completed connections between activity and real world questions show deep understanding through discussion, examples and/or added details from research diagrams, report show extra attention, outside research or details and connections made above and beyond classroom work/discussion

Question

How can I prevent food spoilage from microbial action?

Safety

- Be aware of food allergies and sensitivities before proceeding with this activity.
- NEVER taste anything or put anything in their mouths during a science activity.
- All decaying food should be kept sealed in the plastic bag.

Material

UHT milk (250 ml)
canned milk (250 ml)
fresh milk(250 ml)
fresh fish
canned fish
salt fish
fresh bread (2 slices)
self-closing plastic bags (4)
clean petrie dish
clean 100 ml beaker
5 grapes
5 raisins

Background

A good way to organize your observations for this activity is a chart. Your chart could be set up like this:

Item	Prediction	Observed
fresh milk		
canned milk		
UHT milk		
fresh fish		
salt fish		
canned fish		
fresh bread		
frozen bread		
grape		

Procedure

- Place 50 ml of fresh milk in a clean beaker.
- Place the beaker of milk, the UNOPENED UHT milk package and the UNOPENED can of milk on a shelf until next science class.
- Predict what you will observe from each milk sample next class.
- Place a small piece of fresh fish in a plastic bag. Close tightly.
- Place a piece of salt fish in another bag. Close tightly.
- Place the two bags of fish and the UNOPENED can of fish on a shelf until next science class.
- Predict what you will observe from each fish sample next science class.
- Place one slice of bread in each of two plastic bags. Seal each tightly.
- Place on slice of bread on a shelf. Place the other slice of bread in the freezer.
- Predict what you will observe from each bread sample next science class.
- Place one grape on a clean Petrie dish.
- Place the petrie dish on a shelf until next science class.
- Predict what you will observe about the grape next science class.

Observation Analysis

- Complete the chart you started with your observations.
- What happened to the milk in the beaker? Open the UHT and canned milk? Pour 50 ml of each into clean 100 ml beakers. Are there differences between these samples and the fresh milk? Why? What happened to the fresh milk? How does this occur?
- What does UHT mean? How does this preserved milk? How does canning preserve milk?
- Would your fresh milk sample be safe to consume? What would it taste like? DO NOT TASTE.
- Can you link what you observe about the fresh milk sample to milk foods that we do consume that are similar?

- Why are these safe to consume?
- What happened to the fresh fish sample? Open the canned fish.
- Compare the fresh, salt and canned samples. Which would be safe to consume? DO NOT TASTE. Why?
- How does salting and canning preserve fish?
- Compare the fresh and frozen bread samples? Why does freezing preserve bread?
- What happened to the grape? Compare the grape to a raisin. How are they similar?
- How does dehydration preserve food?
- Settlers often hung slices of apples on strings in their attics. Why would they do this? What was the science behind this act?
- A traditional German dish is made by thinly slicing cabbage. This was placed in layers in a crock with layers of salt in between. What were they making? What was the purpose of the salt?

Extension

Research some of the methods settlers used to preserve food. Some possibilities could be canning, making jams and jellies, drying foods, smoking, etc. Find a few different methods or recipes and tell how the food remained safe for humans to eat.

Or

Prepare a sample of food preservation such as canning, dehydration or smoking. You should be prepared to describe the steps taken and have a sample of your finished product. Discuss any difficulties you had and how effective you were in preserving your chosen food.

Making it Last (2 days) — Teacher Notes

Outcomes

Students will be expected to

- provide examples of how knowledge of microorganisms has resulted in the development of food production and preservation techniques (111-1)

Assessment

Beginning (you need to come for help and try again) Level 1	Its OK if you are OK with it Level 2	Wow!! Level 3
activity equipment broken or not used for intended purpose activity procedure was incorrectly carried out activity was not completed results/ conclusions were not completed	procedure for activity was followed as directed group worked as a team to complete activity group discussed results together results/conclusions were answered using complete, independent sentences connections made between activity and real world show understanding of concept	all parts of level 2 were accomplished extension activity was completed connections between activity and real world questions show deep understanding through discussion, examples and/or added details from research diagrams, report show extra attention, outside research or details and connections made above and beyond classroom work/discussion

Question

How can I prevent food spoilage from microbial action?

Safety

- Be aware of food allergies and sensitivities before proceeding with this activity.
- Students should NEVER taste anything or put anything in their mouths during a science activity.
- All decaying food should be kept sealed in the plastic bag.

Material

UHT milk (250 ml)
canned milk (250 ml)
fresh milk(250 ml)
fresh fish
canned fish
salt fish
fresh bread (2 slices)
self-closing plastic bags (4)
clean petrie dish
clean 100 ml beaker
5 grapes
5 raisins

Background

See notes below on food preservation.

There should be at least one day between the set up and the completion of this activity to allow for decomposition time. Bakers or homemade bread have no preservatives and will show moulding faster than commercial bagged bread.

Students should be encouraged to discuss what they already know about food preservation and food safety. This activity is a good science/social studies cross-over. Additional items such as cheese, yogurt, jams/jellies and dried items such as fruit leathers, dried blueberries, cranberries, raisins and plums add to students knowledge of food preservation.

A good way to organize your observations for this activity is a chart. Your chart could be set up like this:

Item	Prediction	Observed
fresh milk		
canned milk		
UHT milk		
fresh fish		
salt fish		
canned fish		
fresh bread		
frozen bread		
grape		

Procedure

- Place 50 ml of fresh milk in a clean beaker.
- Place the beaker of milk, the UNOPENED UHT milk package and the UNOPENED can of milk on a shelf until next science class.
- Predict what you will observe from each milk sample next class.
- Place a small piece of fresh fish in a plastic bag. Close tightly.
- Place a piece of salt fish in another bag. Close tightly.
- Place the two bags of fish and the UNOPENED can of fish on a shelf until next science class.
- Predict what you will observe from each fish sample next science class.
- Place one slice of bread in each of two plastic bags. Seal each tightly.
- Place on slice of bread on a shelf. Place the other slice of bread in the freezer.
- Predict what you will observe from each bread sample next science class.
- Place one grape on a clean Petrie dish.
- Place the petrie dish on a shelf until next science class.
- Predict what you will observe about the grape next science class.

Observation Analysis

- Complete the chart you started with your observations.
- What happened to the milk in the beaker? Open the UHT and canned milk? Pour 50 ml of each into clean 100 ml beakers. Are there differences between these samples and the fresh milk? Why? What happened to the fresh milk? How does this occur?
- What does UHT mean? How does this preserved milk? How does canning preserve milk?
- Would your fresh milk sample be safe to consume? What would it taste like? DO NOT TASTE.
- Can you link what you observe about the fresh milk sample to milk foods that we do consume that are similar?
- Why are these safe to consume?
- What happened to the fresh fish sample? Open the canned fish.
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- A traditional German dish is made by thinly slicing cabbage. This was placed in layers in a crock with layers of salt in between. What were they making? What was the purpose of the salt?

Extension

Research some of the methods settlers used to preserve food. Some possibilities could be canning, making jams and jellies, drying foods, smoking, etc. Find a few different methods or recipes and tell how the food remained safe for humans to eat.

Or

Prepare a sample of food preservation such as canning, dehydration or smoking. You should be prepared to describe the steps taken and have a sample of your finished product. Discuss any difficulties you had and how effective you were in preserving your chosen food.

Drying: General Information

For thousands of years, people have dried many foods to preserve them for leaner times. Preserving seasonal foods by drying is still useful and convenient, and it has the added advantage of conserving storage space. Successful home food dehydration is dependent on three basic principles:

- heat: controlled temperature high enough to force out moisture, but not hot enough to cook the food
- dry air: to absorb the released moisture
- air circulation: to carry the moisture away.

When food is dehydrated, 80 to 95 percent of the moisture is removed, inactivating the growth of bacteria and other spoilage microorganisms, making

it a useful method of preparation. In hot, dry climates, food will be reduced in a few days to a moisture level that preserves them. In any climate, however,

you can create satisfactory drying conditions at a moderate expense by using artificial heat and circulating air over the food. You can do this:

- in your own kitchen oven (equipment needed: drying trays, an oven thermometer and a small fan)
- in a homemade or commercial portable vegetable dehydrator

Drying is the oldest method of preserving food. Throughout history, the sun, the wind, and a smoky fire were used to remove water from fruits, meats, grains, and herbs.

By definition, food dehydration is the process of removing water from food by circulating hot air through it, which prohibits the growth of enzymes and bacteria.

Benefits of Dried Food

Dried foods are tasty, nutritious, lightweight, easy-to-prepare, and easy-to-store and use. The energy input is less than what is needed to freeze or can, and the storage space is minimal compared with that needed for canning jars and freezer containers.

The nutritional value of food is only minimally affected by drying. Vitamin A is retained during drying; however, because vitamin A is light sensitive, food containing it should be stored in dark places. Yellow and dark green vegetables, such as peppers, carrots, winter squash, and sweet potatoes, have high vitamin A content. Vitamin C is destroyed by exposure to heat, although pre-treating foods with lemon, orange, or pineapple juice increases vitamin C content.

Dried foods are high in fibre and carbohydrates and low in fat, making them healthy food choices. Dried foods that are not completely dried are susceptible to mould.

Microorganisms are effectively killed when the internal temperature of food reaches 145°F (Fahrenheit).

Solar Food Drying

The art of drying food using solar energy is a little more complicated than you might think. We have tried to gather some practical information and to provide links to other resources. Although dried food is popular with campers, backpackers, etc., this page is driven by the need for solar dryers in areas where fruit is plentiful in summer months, but because there is no simple and economic method to preserve it, much of it is left to rot, while in the winter there is hunger.

Solar food drying can be used in most areas but how quickly the food dries is affected by many variables, especially the amount of sunlight and relative humidity. There are some basic guidelines to drying food. Most of the resources we researched recommend pre-treatment of the food, such as blanching, (boiling/steaming). Many experienced users do not pre-treat food.

Wash fresh fruits and ripe vegetables thoroughly. Effective drying is accomplished with a combination of heat and air movement. Remove 80–90% of moisture from the food. Typical drying times range from 1 to 3 days, again depending on sun, air movement, humidity, and type of food. Once the drying process has started it should not be interrupted, do not allow to freeze. Direct sunlight is not recommended.

Temperature ranges of 100°–160° will effectively kill bacteria and inactivate enzymes, although temperatures around 110° are recommended for solar dryers. Too much heat, especially early in the process, will prevent complete drying.

Food should be cut into thin slices, less than ½" thick and spread out on trays to allow free air movement. Rotate trays 180° daily for uniform drying. Move dryer food to bottom racks. Safe tray materials include stainless steel rack, wood slats, cheesecloth, Teflon™, Teflon™ coated fiberglass, nylon, and food grade plastics.

Allow food to cool completely before storing. Store food in air tight jars or plastic containers, and do not expose dried food to air, light or moisture. Most fruits taste great dried including apples, apricots, bananas, grapes, etc. Vegetables are best reconstituted by covering with cold water until they are near original size. They can be added in their dry form to soups or stews. Vegetables can also be ground into powders and used for instant soups or flavouring. http://frugalliving.about.com/gi/dynamic/offsite.htm?site=http%3A%2F%2Fwww.txses.org%2Fepsea%2Fdry.html

Pickling: General Information

Pickled vegetables or fruits are preserved by acid. Because pickles are high in acid, they may be safely processed in a water bath canner. Pickle flavours reach their peak after six or more weeks in the jar. In fresh-pack pickles, acetic acid is added to vegetables or fruits in the form of vinegar. Examples of fresh-pack pickle products are fresh-pack dill pickles, pickled zucchini, watermelon pickles and corn relish.

Fermented pickles, also known as brine pickles, contain lactic acid produced by bacterial fermentation. They are submerged in a brine solution to ferment for about three weeks. Brine dill pickles, deli-style dill pickles and sauerkraut are all fermented pickle products.

Fruit pickles are usually prepared from whole fruits and simmered in a spicy, sweet-sour syrup. They are bright in colour, of uniform size, and tender and firm without being watery. Pears and watermelon rind are prepared this way.

Relishes are prepared from fruits and vegetables which are chopped, seasoned and then cooked to desired consistency. Bright colour and uniformity in size of pieces make an attractive product. Relishes accent the flavours of other foods. They may be quite hot and spicy. Relishes include piccalilli, pepper onion, tomato-apple chutney, tomato-pear chutney, horseradish, corn relish, and chili sauce.

How Canning Preserves Foods

The high percentage of water in most fresh foods makes them very perishable. They spoil or lose their quality for several reasons:

- growth of undesirable microorganisms--bacteria, moulds, and yeasts
- activity of food enzymes
- reactions with oxygen
- moisture loss

Microorganisms live and multiply quickly on the surfaces of fresh food and on the inside of bruised, insect-damaged, and diseased food. Oxygen and enzymes are present throughout fresh food tissues.

Proper canning practices include:

- carefully selecting and washing fresh food.
- peeling some fresh foods
- hot packing many foods
- adding acids (lemon juice or vinegar) to some foods
- using acceptable jars and self-sealing lids
- processing jars in a boiling-water or pressure canner for the correct period of time.

Collectively, these practices remove oxygen; destroy enzymes; prevent the growth of undesirable bacteria, yeasts, and moulds; and help form a high vacuum in jars. Good vacuums form tight seals which keep liquid in and air and microorganisms out. Even though sugar has a preservative action in jams and jellies, moulds can still grow and spoil these products. Mould growth causes product to be lost when it occurs. In addition, some research indicates that mould growth on fruit products may not always be as completely harmless as believed in the past. USDA and the Cooperative Extension Service are endorsing a boiling water canning process for jams and jellies which will make the potential for mould spoilage as small as possible. The cost of ingredients is high enough to make any preventable loss unacceptable.

Paraffin or wax sealing of jars is no longer considered an equally acceptable choice for any sweet spread, including jellies. Any pinholes, shrinkage or cracks in the wax paraffin allow airborne moulds to contaminate and grow on the product. In addition, leaks or holes in the paraffin can allow product to seep out during storage and once on the surface, it will provide nutrients for moulds to grow on the surface and enter into the jam or jelly in the jar.

Ensuring Safe Canned Foods

Growth of the bacterium CLOSTRIDIUM BOTULINUM in canned food may cause botulism, a deadly form of food poisoning. These bacteria exist either as spores or as vegetative cells. The spores, which are comparable to plant seeds, can survive harmlessly in soil and water for many years. When ideal conditions exist for growth, the spores produce vegetative cells which multiply rapidly and may produce a deadly toxin within three to four days of growth in an environment consisting of:

- a moist, low-acid food
- a temperature between 40–120°F
- less than 2% oxygen

Botulinum spores are on most fresh food surfaces. Because they grow only in the absence of air, they are harmless on fresh foods.

Most bacteria, yeasts and moulds are difficult to remove from food surfaces. Washing fresh food reduces their numbers only slightly. Peeling root crops, underground stem crops, and tomatoes reduces their numbers greatly. Blanching also helps, but the vital controls are the method of canning and making sure the recommended research-based process times are used.

The recommended processing times ensure destruction of the largest expected number of heat-resistant microorganisms in home-canned foods. Properly sterilized canned food will be free of spoilage if lids seal and jars are stored below 95°F. Storing jars at 50–70° Fahrenheit enhances retention of quality.

Freezing: General Information

Freezing is not necessarily the preferred way for preserving all vegetable and fruit products. What to freeze is determined on the basis of family needs and desires, on freezer space and cost of freezer storage, and on other storage facilities available.

It may be more economical, for instance, to store some fruits and vegetables in a vegetable cellar than to freeze them. Freezing may be worth the extra cost because of the convenience of having products prepared so they can be readied quickly for serving.

Costs of owning and operating a home freezer vary with the electricity used, costs of packaging materials, repairs and the original price of the freezer. Some varieties of fruits and vegetables freeze better than others. Because growing conditions differ widely throughout the country and different varieties of fruits and vegetables are available in different localities. Contact the Extension office for information on local varieties that give highest quality when frozen. Fruits and vegetables that do not make satisfactory products when frozen include green onions, lettuce and other salad greens, radishes and tomatoes (except as juice or cooked).

Freezing Basics

Freezing is the easiest, most convenient, and least time-consuming method of preserving foods. Freezing does not sterilize foods or destroy the organisms that cause spoilage; the extreme cold simply slows the growth of microorganisms and the chemical changes that affect quality or cause spoilage.

Enzymes are complex proteins, present in all living tissue, that help organisms ripen and mature. During freezing, enzyme action is slowed but not stopped. If not inactivated, these enzymes can cause colour and flavour changes and loss of nutrients during freezer storage.

Blanching vegetables before freezing inactivates the enzymes. During blanching, the vegetable is exposed to boiling water or steam for a brief period. The vegetable is then rapidly cooled in ice water to prevent cooking. The use of microwave ovens for blanching has become popular. However, microwave blanching produces uneven results because of varied heat patterns within an oven and from one oven to another. Microwave blanching requires working with only small quantities at a time; there is no time saving when working with large quantities of vegetables. Blanching also helps destroy microorganisms on the surface of the vegetables. When blanched, vegetables such as broccoli and spinach become more compact. Following the recommended times for blanching each vegetable is important. Over-blanching results in a cooked product and loss of flavour, colour, and nutrients. Under-blanching stimulates enzyme activity and is worse than no blanching at all.

Enzymes in fruits can cause browning and loss of Vitamin C. Fruits, however, are not usually blanched. Instead, ascorbic acid (Vitamin C) is used to control enzymes in frozen fruits. Commercial mixtures of ascorbic acid are available for home use. Citric acid or lemon juice also may be used to prevent darkening of fruits, but they are not as effective as ascorbic acid. Packing fruit in sugar or sugar syrup also will control browning.

Smoking Fish

Wood smoke has little, if any, preservative action. Smoking merely adds flavour and colour and removes some water. Smoked fish are almost as perishable as fresh fish.

Home processors would do well to heed the Michigan state law that applies to commercial smokers. Smoked fish should be kept at temperatures under 36°F and used within 14 days. If smoked fish is to be kept longer than 14 days, it should be frozen immediately after smoking. Freezing old fish only further reduces the quality of an already deteriorating product. AT THIS TIME, SAFE METHODS FOR CANNING SMOKED FISH ARE STILL BEING TESTED. PLEASE CHECK WITH YOUR PROVINCIAL HOME ECONOMIST FOR UP TO DATE INSTRUCTIONS.

The four basic steps in smoking fish are cleaning, curing, drying and smoking.

Cleaning

Clean fish as soon as possible after taking them from the water. Scale fish and remove viscera, including the kidney, which is the dark streak along the backbone. The head may also be removed from larger fish, but the collarbone should remain to provide shape. Fillet or steak large fish.

Curing

Cure the fish in salt, either dry or in a brine. If dry curing fish, follow the procedure for salting. Dry salted fish will have a high salt concentration and will need to be freshened before smoking.

The goal of brining is to produce a thoroughly and uniformly salted product. A basic brine consists of 1 cup salt to each gallon of cold water (30 salimeter). Sugar, spices, and saltpetre are often added to the brine. Here is one recommended sugar spice brine: 1 gallon cold water; 1 cup salt; ½ cup sugar; 1 teaspoon saltpetre (optional); cloves, bay leaves, pickling spices, and sage are optional. Use a mixture of spices at the rate of 1 tablespoon per gallon of water.

Another spice formula is 1 tablespoon whole cloves and 1 teaspoon bay leaves per gallon of water. Saltpetre may or may not be added, according to personal preference, but it does provide a margin of safety against botulism.

Place fish in a large nonmetal container so they lie flat. Cover with brine. use one gallon for each 4–5 pounds of fish. Use a plate or cover to weight down fish enough to submerge them without packing them together. Allow fish to cure in the coldest part of the refrigerator (34–38°F) for the appropriate time. There is no one time which is right for all fish under all conditions. Brining times vary because brine concentration and amount, and fish condition and size affect how quickly and how much salt will be absorbed.

Table of Brining Times

For a brine of 30 salimeter, 2 parts brine to 1 part fish

Size	Condition		
	Fresh	Refrigerated	Thawed
½ to 1 inch thick, fillets or split fish	18–24 hours	16 hours	12–14 hours
large whole fish 10 pounds or larger	48–72 hours	36–60 hours	24–48 hours

Salt Concentration

The stronger or more concentrated the brine, the shorter the brining time required. However, short (more concentrated brine) brining times will not salt fish as uniformly as slow (less concentrated brine) times.

A brine concentration of 30 to 40 salimeter is recommended. This is about 1 or 1 1/4 cups salt for each gallon cold water.

Amount of Brine to Fish

The amount of brine to the amount of fish affects how uniformly and thoroughly the fish will be salted. A good ratio is 2 parts brine to 1 part fish. One gallon of brine weighs about 9 pounds. This means you would need 20 pounds (about 2 gallons brine) for each 10 pounds of fish.

Rate of Brining

Muscle fibres of freshly caught fish are still intact. Intact muscle fibres absorb salt slowly. Freshly caught fish will require about 18 to 24 hours of brining. Fish held in the refrigerator for 24 hours will absorb salt faster (about 16 hours). Thawed fish absorb salt still faster and will be thoroughly brined in 12 to 14 hours.

Use these times with brine concentrations of 30to 40 salimeter.

Size

Brining times are affected by the thickness of the fish pieces. Fresh pieces ½ to 1 inch thick require 14 to 16 hours of brining. A large, whole fish such as salmon, requires 48 to 72 hours of brining. For such large fish, the concentration of the brine should not exceed 30 salimeter.

Drying

When fish are cured, remove from brine and rinse thoroughly. Fish may be dried in the smokehouse or in a protected area with heat and air circulation. Place fish on smokehouse hangers or racks wiped with vegetable oil, and allow surface to dry. A shiny skin-like pellicle will form on the fish surface. The pellicle seals the surface and prevents loss of natural juices during smoking.

Fish require approximately ½ hour of drying at 70–80°F before smoking. Air circulation and humidity will affect the time. A fan will speed the drying process.

Storage of Smoked Fish

Smoked fish should be kept in the refrigerator below 36°F and consumed within 14 days after smoking. For longer storage, the fish may be frozen immediately after smoking. Store smoked fish in the freezer for no longer than 2 to 3 months.

Dry Salting Fish

Fill a dish pan or shallow box with dry salt. Sprinkle a thin layer of salt on the bottom of the brining container. Dredge each piece of fish in salt, then place skin-side down in the container. Place large pieces with the backbone next to the container wall. An extra piece may be placed in the middle to level each layer. Overlap pieces as little as possible. Pack small fish in a ring with tips of heads touching container walls. You may need to put one or two fish across the centre to keep the layer level. Stagger successive layers so that each fish rests on two fish in the layer below. Scatter a thin coat of salt between each layer.

Pack the top layer of fish, both large and small pieces, skin-side up. The amount of salt used depends on the season of year, fish size and length of preservation desired. A general rule is to use one part salt to three parts fish.

Pasteurization

Heating of a specific food enough to destroy the most heat-resistant pathogenic or disease-causing microorganism known to be associated with that food. Commonly used to preserve the freshness and safety of milk.

A Brief History of Cheesemaking

The art of cheesemaking goes back centuries. A Greek historian named Xenophon, born in 349 BC, wrote about a goat cheese that had been known for centuries in Peloponnesus. As the centre of civilization moved westward to Rome, the art of cheesemaking was carried along. The Romans refined techniques, added herbs and spices, and discovered how to make smoked cheese.

Many varieties were made in those times and the Romans feasted on curd cheeses, Limburger-type, soft cheeses, smoked and salted cheeses. They exported their hard cheeses and experimented with a cheese made from a mixture of sheep's and goat's milks. They learned to use different curdling agents in addition to the rennet they extracted from the stomach of a weaning goat or sheep.

Thistle flowers, safflower seeds, or fig bark were soaked in water to make extracts that would set a curd. Baskets and nets and moulds were devised to shape their cheeses. When Julius Caesar sent his soldiers out to conquer Gaul, they packed rations of cheese for the long marches. Wherever they went and conquered and settled, the savage, northern tribesmen quickly learned to copy their captors' delicious food. Finally far up in the Alps, back in the fifteenth century, Swiss farmers milked their cows out in the fields and brought the milk back to the farms to make their Emmenthaler (Swiss) cheese.

It wasn't until about 1800 that they realized they could make cheese down in the valleys, as well as high in the hills. The first cheese factory was opened there in the valley, at Bern, in 1815. It was such a successful venture that in the next twenty-five years, 120 cheese factories sprouted up, with the number growing to 750 by the end of the century. There are a wide variety of soft cheeses. What differentiates one soft cheese from another is mostly the method of persuasion used on the curds.

Basically, there are two ways to get the curds to do their thing: raise the acid level of the milk until the solids simply give up the ghost and clump together (i.e. curdle) add an animal derivative called rennet to the milk. The rennet contains an enzyme called rennin that does the curd-making deed often, one uses some combination of acid-induced and rennet-induced coagulation to produce a particular cheese.

Within the realm of acid-induced coagulation, there are two primary options to choose from add a highly acidic substance such as lemon juice or vinegar to the milk. add a carefully chosen strain of lactose-loving bacteria to the milk and allow them to reproduce like mad. One byproduct of this bacteriological feeding frenzy will be lactic acid. Soon (typically within a few hours) the bacteria will produce enough lactic acid to make the milk curdle. Bacterially-induced coagulation is also used to produce yogurt. Adding an acidic fluid produces essentially instant coagulation.

A Metre of Ecosystem (45 minutes) Student Notes

Outcomes

Students will be expected to

- identify, delimit and investigate questions related to a local ecosystem such as "What types of species live in a particular ecosystem?" (208-2, 208-3)
- use instruments effectively and accurately to investigate components of an ecosystem (209-3)
- distinguish between the following scientific terms:
  - consumer
  - decomposer
  - producer
  - ecosystem
  - habitat
  - photosynthesis (109-12)
- demonstrate the importance of choosing words that are scientifically appropriate by using these words in context:
  - niche
  - habitat
  - population
  - community
  - ecosystem (109-13)

Assessment

Beginning (you need to come for help and try again) Level 1	Its OK if you are OK with it Level 2	Wow!! Level 3
activity equipment broken or not used for intended purpose activity procedure was incorrectly carried out activity was not completed results/ conclusions were not completed	procedure for activity was followed as directed group worked as a team to complete activity group discussed results together results/conclusions were answered using complete, independent sentences connections made between activity and real world show understanding of concept	all parts of level 2 were accomplished extension activity was completed connections between activity and real world questions show deep understanding through discussion, examples and/or added details from research diagrams, report show extra attention, outside research or details and connections made above and beyond classroom work/discussion

Background

When observing nature you are to respect the environment you are observing. Plants and animals should be left in the environment as they were found. All organisms found within an ecosystem have a role to play. By adding or removing organisms, the balance of the ecosystem can be upset.

Material

4 m long piece of string or yarn
hand lens

Procedure

- Pick an unpaved part of the school yard to observe.
- With a partner, form a square on your chosen spot using the piece of string.
- Carefully observe and record all the different things you find in your square. These can be sights, sounds, smells, things you feel. Do not put anything in your mouth during a science activity.
- Sit quietly beside your square for 3-5 minutes without moving or making noise.
- Record what happens within your square and above it as you observe.
- When you have finished observing, collect your string. Pick up any evidence of humans which does not belong in your square.
- Show your understanding of the outcomes by carefully and completely answering the questions found in the Analysis section.

Results Analysis

- In a chart form, divide your observations into plant, animal, and evidence of humans. Which column has the most entries? Why is this so?
- In your square was there evidence of humans? Was this beneficial or not to the ecosystem in your square?
- Define the following terms:
  - consumer
  - ecosystem
  - niche
  - photosynthesis
  - habitat
  - population
  - producer
  - community
  - decomposer
- Demonstrate your understanding of the terms by using them correctly in answering the following questions.
- Describe the communities you observed within your ecosystem. Do you think there are organisms present that you did not observe? Name some. Why do you think they were not observed?
- Divide the populations you observed into producers and consumers.
- By what process do producers get their energy? What larger group do producers belong to?
- How do consumers get their energy? What larger group do consumers belong to?
- Pick several organisms to describe their niche in the observed ecosystem.

- What would happen if one of these organisms disappeared from your ecosystem?
- Did you observe any decomposers in your ecosystem? What role do decomposers play in an ecosystem? Is it an important role? Why or why not?

Extension

- Create a diary/inventory of a broader ecosystem near you.
- Identify as many producers, consumers and decomposers as you can. Include sketches, photographs or video samples of each.
- Is this ecosystem being infringed upon by outside organisms or abiotic factors?
- Describe what is happening within and on the edges of this ecosystem.
- Predict what the ecosystem will be like when you are in high school.

A Metre of Ecosystem (45 minutes) Teacher Notes

Outcomes

Students will be expected to

- identify, delimit and investigate questions related to a local ecosystem such as "What types of species live in a particular ecosystem?" (208-2, 208-3)
- use instruments effectively and accurately to investigate components of an ecosystem (209-3)
- distinguish between the following scientific terms:
  - consumer
  - decomposer
  - producer
  - ecosystem
  - habitat
  - photosynthesis (109-12)
- demonstrate the importance of choosing words that are scientifically appropriate by using these words in context:
  - niche
  - habitat
  - population
  - community
  - ecosystem (109-13)

Assessment

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Background

Students should be encouraged to respect the environment they are observing. Plants and animals should be left in the environment as they were found. Discussion of interactions and interdependence on organisms in their ecosystems will reinforce the need to leave nature as we find it.

Material

4 m long piece of string or yarn
hand lens

Procedure

- Pick an unpaved part of the school yard to observe.
- With a partner, form a square on your chosen spot using the piece of string.
- Carefully observe and record all the different things you find in your square. These can be sights, sounds, smells, things you feel. Do not put anything in your mouth during a science activity.
- Sit quietly beside your square for 3-5 minutes without moving or making noise.
- Record what happens within your square and above it as you observe.
- When you have finished observing, collect your string. Pick up any evidence of humans which does not belong in your square.
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Results Analysis

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  - population
  - producer
  - community
  - decomposer
- Demonstrate your understanding of the terms by using them correctly in answering the following questions.
- Describe the communities you observed within your ecosystem. Do you think there are organisms present that you did not observe? Name some. Why do you think they were not observed?
- Divide the populations you observed into producers and consumers.
- By what process do producers get their energy? What larger group do producers belong to?
- How do consumers get their energy? What larger group do consumers belong to?
- Pick several organisms to describe their niche in the observed ecosystem.

- What would happen if one of these organisms disappeared from your ecosystem?
- Did you observe any decomposers in your ecosystem? What role do decomposers play in an ecosystem? Is it an important role? Why or why not?

Extension

- Create a diary/inventory of a broader ecosystem near you.
- Identify as many producers, consumers and decomposers as you can. Include sketches, photographs or video samples of each.
- Is this ecosystem being infringed upon by outside organisms or abiotic factors?
- Describe what is happening within and on the edges of this ecosystem.
- Predict what the ecosystem will be like when you are in high school.

Succession in a Bottle (10–30 days) Student Notes

Outcomes

Students will be expected to

- identify signs of ecological succession in a local ecosystem
  - pioneer species
  - climax community
  - primary succession
  - secondary succession (306-4)
- predict what an ecosystem will look like in the future on the basis of the characteristics of the area and the long-term changes (succession) observed in the site (208-5)

Assessment

Beginning (you need to come for help and try again) Level 1	Its OK if you are OK with it Level 2	Wow!! Level 3
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Material

large glass container
water
soil
seeds

Procedure

- Day 1– place water in the jar so it is 1/4 full. Record observations.
- Day 2 – add two handfuls of soil or enough to create a 5 cm depth. Record observations.
- Day 3 – add 5 seeds. Record observations.
- Day 4 – add 5 seeds. Record observations.
- Day 5 – add 5 seeds. Record observations.
- Day 6 – add 5 seeds. Record observations.
- Day 7 – add 5 seeds. Record observations.
- Day 8 – add 5 seeds. Record observations.
- Day 9 – add 5 seeds. Record observations.
- Day 10 – Record observations.
- Continue recording observations each day for 5-20 more days.
- When observations are complete, discuss the questions found in the Analysis section as a group. Create a written report using the questions as a guide to discussion.

Analysis

- Write a paragraph describing what happened in the bottle over the days you observed it. Be detailed. Describe what happened to all components in the bottle.
- If fish had lived in the pond, what would have happened? When? Before the pond dried completely, describe the other problems or dangers the fish would have experienced.
- What changes would the land animals have experienced as the pond dried up?
- What animals would live near this spot now? Remember: animals are not just mammals.
- What plants will come next? How will this change the animal life?
- Imagine taking your grandchildren to visit this pond site. What will they see? What will you tell them about your visit when you were their age?

Extension

Choose a spot near your home or school which shows succession. Prepare a visual report (video, digital camera pictures, sketches) which show the area in various stages of succession. The report should have an audio component to accompany the visual either tapes or delivered by you showing your understanding of succession. Name as many of the plants as you can and where they stand in the stages of succession.

Succession in a Bottle (10–30 days) Teacher Notes

Outcomes

Students will be expected to

- identify signs of ecological succession in a local ecosystem
  - pioneer species
  - climax community
  - primary succession
  - secondary succession (306-4)
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Material

A large (restaurant size) glass mayonnaise or pickle jar works well. Equally, a small aquarium or large fish bowl will work. Radishes are recommended because they sprout quickly. Any quick-sprouting seed such as mung bean or alfalfa will do. Bird seed adds many different kinds of seeds and therefore a mixture of success in sprouting as in the real world.

Background

In predicting the future, students may choose to describe the spot as developed rather than following a more natural succession.

An alternate to the large jar is to have pairs or small groups of students follow the procedure in their own smaller jar or large beaker (600 ml would work well).

At the stage where some soil is no longer under water, a bit of moss sprinkles onto the soil will produce moss growth under the proper conditions.

Procedure

- Day 1– place water in the jar so it is 1/4 full. Record observations.
- Day 2 – add two handfuls of soil or enough to create a 5 cm depth. Record observations.
- Day 3 – add 5 seeds. Record observations.
- Day 4 – add 5 seeds. Record observations.
- Day 5 – add 5 seeds. Record observations.
- Day 6 – add 5 seeds. Record observations.
- Day 7 – add 5 seeds. Record observations.
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- Day 10 – Record observations.
- Continue recording observations each day for 5-20 more days.
- When observations are complete, discuss the questions found in the Analysis section as a group. Create a written report using the questions as a guide to discussion.

Analysis

- Write a paragraph describing what happened in the bottle over the days you observed it. Be detailed. Describe what happened to all components in the bottle.
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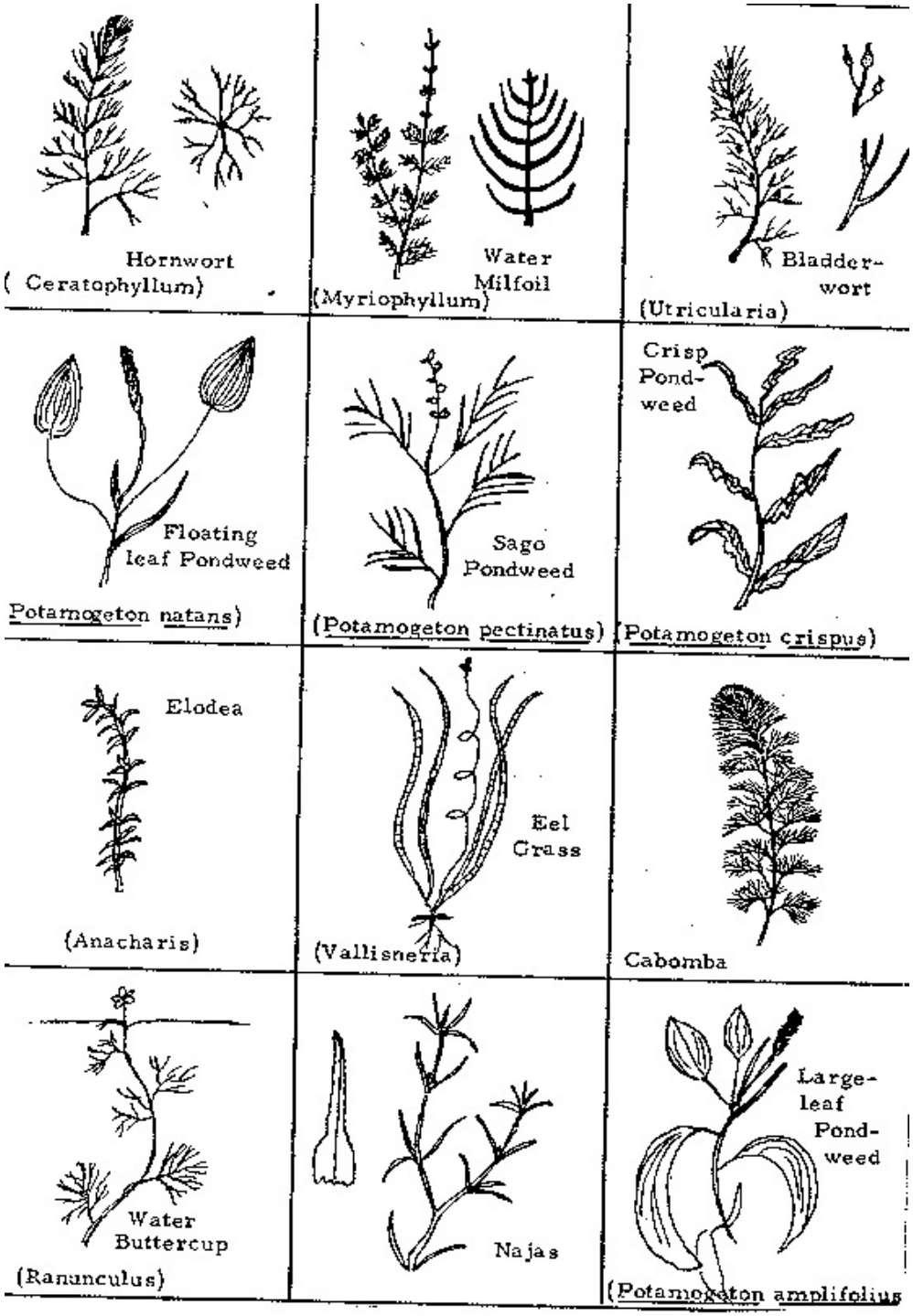
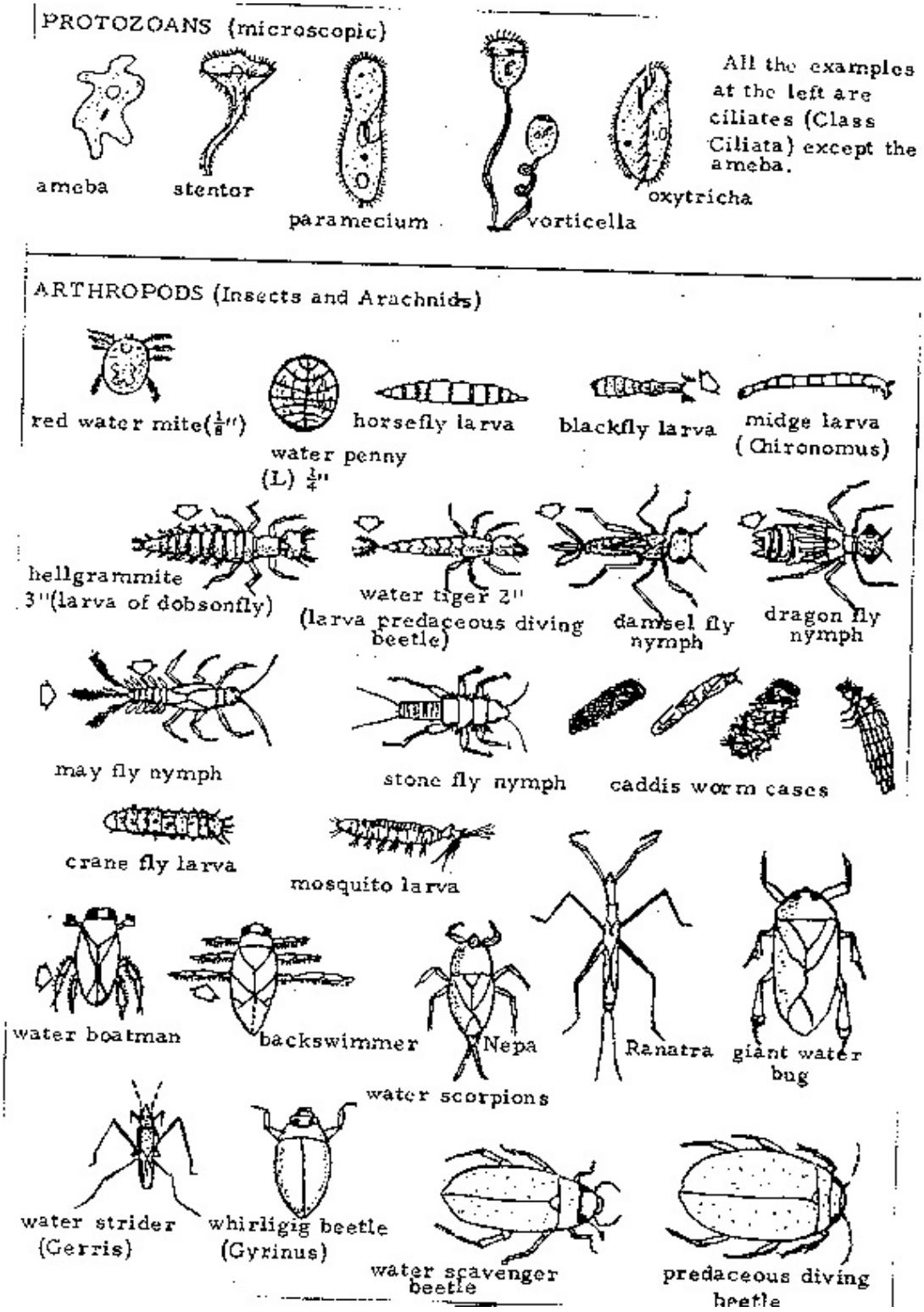
Extension

Choose a spot near your home or school which shows succession. Prepare a visual report (video, digital camera pictures, sketches) which show the area in various stages of succession. The report should have an audio component to accompany the visual either tapes or delivered by you showing your understanding of succession. Name as many of the plants as you can and where they stand in the stages of succession.

Some common aquatic plants



Some common aquatic animal life.



Physical Science: Heat
Appendix

The State of Matter (45 minutes) Student Notes

Outcomes

Students will be expected to

- explain how each state of matter reacts to changes in temperature (308-3)
- explain changes of state, using the particle model of matter (308-4)
- explain temperature, using the concept of kinetic energy and the particle model of matter (308-2)

Assessment

Beginning (you need to come for help and try again) Level 1	Its OK if you are OK with it Level 2	Wow!! Level 3
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Question

How does the particle model explain particle behaviour at different states?

Material Apparatus

hot plate 250 mL beaker thermometer
2 ice cubes

Safety

Handle hot water and heated equipment with care to prevent burns.

Procedure

- Place two ice cubes in a beaker.
- Put thermometer in and wait one minute. Record temperature.
- Place beaker on a hot plate. Turn on heat medium. Record temperature every 15 seconds until water has been boiling for one minute.
- Be sure to make observations about the contents of the beaker as you do this activity.
- Graph your data.

Conclusion

- What picture does the graph make for you?
- Describe what the particles are doing at each part of the graph using the particle model. This could be in words or pictures.

Current Thought? (45 minutes) Student Notes

Outcomes

Students will be expected to

- explain temperature, using the concept of kinetic energy and the particle model of matter (308-2)
- compare transmission of heat by conduction, convection, and radiation (308-5)
- describe the science underlying heat transfer in solar heating systems and central heating systems in houses (111-5)
- describe how a technology associated with heat has affected lives (113-4)

Assessment

Beginning (you need to come for help and try again) Level 1	Its OK if you are OK with it Level 2	Wow!! Level 3
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Question

How do I explain conduction, convection and radiation of heat?

Safety

- Boiling water can burn you. Pour the boiling water carefully.
- Handle the beaker of hot water with care.
- Never put anything in your mouth when conducting science activities.

Material Apparatus

boiling water
tap water
2 (250 mL) beakers
food colouring

Procedure

This activity can be done individually or in small groups.

- Put 150 mL tap water in a beaker. Carefully pour 150 mL boiling water into the other beaker.
- Answer the following questions for each beaker. Keep the beakers on the table.
  - Place your hand 3 cm from the beaker near the bottom of the beakers. What do you feel?
  - Touch the top of each beaker. What do you feel?
  - Now gently place a drop of colour in each beaker and carefully observe the reaction. Do not stir.

Results/Conclusion

- Define conduction, convection and radiant heat using your text or other resource.
- Match the parts of this activity to each definition.
- Explain how parts of this activity are like the technologies of heating our homes using hot water heat, radiators and radiant heat flooring.
- Explain how parts of this activity can be linked to how a convection oven cooks food.

Extension

Investigate how a solar oven can cook your food when you are camping. Draw a detailed diagram or build a working model of a solar oven.

Forming Clouds (15 minutes) Student Notes

Outcomes

Students will be expected to

- explain how each state of matter reacts to changes in temperature (308-3)
- explain changes of state, using the particle model of matter (308-4)

Assessment

Beginning (you need to come for help and try again) Level 1	Its OK if you are OK with it Level 2	Wow!! Level 3
activity equipment broken or not used for intended purpose activity procedure was incorrectly carried out activity was not completed results/ conclusions were not completed	procedure for activity was followed as directed group worked as a team to complete activity group discussed results together results/conclusions were answered using complete, independent sentences connections made between activity and real world show understanding of concept	all parts of level 2 were accomplished extension activity was completed connections between activity and real world questions show deep understanding through discussion, examples and/or added details from research diagrams, report show extra attention, outside research or details and connections made above and beyond classroom work/discussion

Question

How do clouds form?

Material Apparatus

2 clear narrow mouthed bottles
2 ice cubes
hot and cold water

Procedure

- Fill a bottle with very hot water and let it sit for a few minutes.
- Pour out most of the water, leaving 2 cm of water in the bottom of the bottle.
- As a control, set up an identical bottle with an equal amount of cold water.
- Place an ice cube on the top of each of the bottles.
- The ice cubes should be large enough to "cover" the top of the bottles.
- Observe and record notes.

Results/ Conclusion

- What do you see happening in each bottle?
- What do we call what you see in the hot water bottle?
- Discuss in detail what is happening to the water particles. How does this fit into the particle theory of matter?
- Why do you think clouds or fog formed in the bottle with hot water and not in the cold water?
- How do clouds form in nature?

The Heat is On (45 minutes) Student Notes

Outcomes

Students will be expected to

- compare various instruments used to measure temperature (308-1)
- compile and display data collected in the test of the design of an air thermometer (210-2)
- compare, in qualitative terms, the heat capacities of some common materials (308-7)
- use and read a thermometer safely and properly (209-3)

Assessment

Beginning (you need to come for help and try again) Level 1	Its OK if you are OK with it Level 2	Wow!! Level 3
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Question

Does the amount of a material or the type of material affect heat capacity?

Material Apparatus

4 (400 ml) beakers	cornstarch	oil
water	thermometers	heat probes
hot plates	oven mitts/tongs	

Safety

- Handle the hot liquids carefully.
- Have some cold water or ice handy in case skin comes in contact with the hot liquids.
- Oil can catch fire if heated too much. Monitor the heating of oil carefully.

Procedure

- Measure 50 ml of water into a 250 ml beaker.
- Place beaker over a heat source. Add probe or thermometer.
- Record the temperature every 10 seconds for two minutes.
- Carefully remove from heat source to a safe place to cool.
- Repeat procedure with 100 mL then 150 mL of water.
- Repeat with other liquids.
- Graph your results.

Results/ Observations

- Did the amount of liquid make a difference in the rise in temperature? Comment on each amount.
- Did the type of liquid make a difference in the rise in temperature? Comment on each type of liquid.
- Compare the data gathered by thermometers with that gathered by the data probes.

Conclusion

- The radiator is a car has a liquid (water with antifreeze) in it. Why do you think this is so? How would it work?
- A refrigerator pumps a gas through tubes in the walls in the back and sides of the fridge. How does a refrigerator cool food?

Extension

Find other examples of heat transfer technology that uses the concept above to heat or cool things in our lives.

Insulators (45 minutes) Student Notes

Outcomes

Students will be expected to

- describe how our needs related to heat can lead to developments in science and technology (112-1)
- identify examples of science-and technology-based careers that are associated with heat and temperature (112-9)
- provide examples of insulating technologies used in the past that were developed through trial and error (109-4)

Assessment

Beginning (you need to come for help and try again) Level 1	Its OK if you are OK with it Level 2	Wow!! Level 3
activity equipment broken or not used for intended purpose activity procedure was incorrectly carried out activity was not completed results/ conclusions were not completed	procedure for activity was followed as directed group worked as a team to complete activity group discussed results together results/conclusions were answered using complete, independent sentences connections made between activity and real world show understanding of concept	all parts of level 2 were accomplished extension activity was completed connections between activity and real world questions show deep understanding through discussion, examples and/or added details from research diagrams, report show extra attention, outside research or details and connections made above and beyond classroom work/discussion

Question

Do different materials have different insulating qualities?

Material Apparatus

ice cubes	container with a lid	aluminum foil
sand	sawdust	paper
fabric (wool and cotton)	popcorn	Styrofoam™
coffee beans	pea gravel	marbles

Procedure

- Put an ice cube in a container. Cover the container with a lid.
- Time how long it takes for the ice cube to melt completely.
- Record your results. This will be the control. While you are waiting for the first ice cube to melt, begin melting a second ice cube.
- Each group will select insulators to test depending on the number of containers from the list below:
  - aluminum foil
  - dirt
  - sand
  - clay
  - sawdust
  - paper
  - fabric (cotton or wool)
  - popcorn
  - Styrofoam™
  - coffee beans
  - pea gravel
  - marbles
- Each insulator will need a container with a lid and one of the materials selected. Select one of the materials to pack around their individual ice cube. The material should be packed to enclose the ice cube. Handle the ice cube as little as possible.
- Predict the time it will take for your ice cube to melt. Record the time it takes for the ice to melt.
- Record any other changes observed.
- Analyse the results and rank the materials according to how successful the insulators were.

Analysis

- Rate the materials from the longest melting time to the shortest melting time. 1 is the longest time; 5 is the shortest time.
- What was the purpose of timing a melting ice cube with no insulators? What do scientists call this? Why?
- Which material was the best at keeping the ice cubes from melting?
- Which material(s) hardly worked at all?
- Would the insulation work as well with warm materials as it did with cold materials?
- Would the size of the ice cube make a difference?

Extension

Find examples of insulation used in buildings. Comment on why there is more than one insulator used in buildings. What determines what kind of insulation is put in a building?

Insulators (45 minutes) Teacher Notes

Outcomes

Students will be expected to

- describe how our needs related to heat can lead to developments in science and technology (112-1)
- identify examples of science-and technology-based careers that are associated with heat and temperature (112-9)
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Question

Do different materials have different insulating qualities?

Material Apparatus

ice cubes
sand
fabric (wool and cotton)
coffee beans
container with a lid
sawdust
popcorn
pea gravel
aluminum foil
paper
Styrofoam™
marbles

Background

To do this activity you will have to prepare in advance, a supply of ice cubes. The best way to provide ice cubes that are uniform in size and shape is to freeze 10-20 mL of water in the bottom of a medicine cup. Small coffee cans, nut tins, small Pringles™ tins or film canisters work well as containers.

Procedure

- Put an ice cube in a container. Cover the container with a lid.
- Time how long it takes for the ice cube to melt completely.
- Record your results. This will be the control. While you are waiting for the first ice cube to melt, begin melting a second ice cube.
- Each group will select insulators to test depending on the number of containers from the list below:
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- Would the insulation work as well with warm materials as it did with cold materials?
- Would the size of the ice cube make a difference?

Extension

Find examples of insulation used in buildings. Comment on why there is more than one insulator used in buildings. What determines what kind of insulation is put in a building?

Effects of Colour on Solar Energy (45 minutes) Student Notes

Outcomes

Students will be expected to

- describe the science underlying heat transfer in solar heating systems and central heating systems in houses (111-5)
- describe how a technology associated with heat has affected lives (113-4)
- carry out a procedure to investigate how various surfaces absorb radiant heat and control major variables (209-1)
- identify potential sources of error in data while investigating how various surfaces absorb radiant heat (210-10)
- identify, evaluate and draw a conclusion about the relationship between colour and heat absorption in materials (210-11, 210-12)
- communicate results of experiments and/or investigations related to colour and heat absorption by using language and a variety of tables, charts, and/or graphs (211-2)

Assessment

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Question

Does colour affect the absorption of solar energy?

Material Apparatus

2 light coloured balloons 2 dark coloured balloons 22 cm length of string
30 cm length of string

Safety

Be careful not when inflating the balloon that it does not explode in your mouth or near your eyes.

Procedure

- Pick several different balloons of different colors. Choose a few with dark colors, such as black, dark blue, or purple, and a few with light colors such as white, yellow, or pink.
- In a cool location, inflate the balloons so that they are of nearly equal size. This can be accomplished by looping a string around the balloons as they are being inflated to measure their circumference. Make a mark of 1 cm in from each end to hold the string. Balloon will be inflated to 20 cm.
- Next, take the balloons outside to a bright, sunny location and allow the sun to heat them up.
- Then record the circumference of the balloons using the longer length of string.
- Gather data from each of the groups in order to create an average increase/decrease in circumference.
- Graph group data.

Conclusion

- Is there any difference between the original, cool circumference and the warm circumference?
- Graph group data. What does this example reveal about volume and temperature relationships?
- Was there a difference between the light and dark balloons? What implications does this have in designs for solar heating?

Extension

Use various materials such as brick, stone, bark, etc. and/or different colours to build a model of a house heated using passive solar heat technology.

What is a Thermometer? (30 minutes over several days, if desired)

Student Notes

Outcomes

Students will be expected to

- use and read a thermometer safely and properly (209-3)
- select appropriate methods and tools in order to construct and test an air thermometer (208-8, 210-13)

Assessment

Beginning (you need to come for help and try again) Level 1	Its OK if you are OK with it Level 2	Wow!! Level 3
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Question

What is a thermometer?

Safety

Treat rubbing alcohol with respect. Rubbing alcohol is not edible. Keep it away from your face. Avoid spilling it on your hands. It could damage some types of clothing.

Food colouring does not come out of some types of clothing.

Material Apparatus

clear narrow drinking straw
small vial/medicine bottle
cold water or rubbing alcohol
7.5 cm x 12.5 cm index card
scissors
red food colouring
modelling clay
tape

Procedure

This activity can be done individually or in small groups.

- Put 2.5 cm of cold water or rubbing alcohol into the small vial.
- Add several drops of red food coloring.
- Cut the end of the drinking straw off on a slight angle. (Use a very narrow straw.) Put the straw into the vial and completely seal the top of the vial with modeling clay, making sure it is airtight. You will have captured some of the liquid in the straw.
- Tape the 7.3 cm x 12.5 cm card to the drinking straw
- Mark the level of the coloured water and the time.
- Note that air pressure and evaporation may affect your thermometer. To prevent this, put a few drops of oil into the top of the straw or seal the straw with modeling clay.
- Place the thermometer(s) in a warmer spot or in a pan of warm water.
- Observe, and mark the new height of liquid in the drinking straw.
- Now place the thermometer in a pan of cold water.

This activity may be continued over a few days, taking and noting the observations. Also, thermometers may be placed in different areas of the room.

After one day of recording data, students may predict the next day's readings, or compare the highest reading with the lower reading.

Results

Record data by drawing a picture of what happened.

- Explain what might happen to the coloured water in the drinking straw if you put the thermometer in a warmer spot; colder spot.
- Explain why the colored water moved up/down the straw.
- Using the particle theory, explain what is happening to the liquid contained in the vial.

Extension

Calibrate the thermometer scale by using known temperatures such as freezing and boiling point of water and body temperature.

What is a Thermometer? (30 minutes over several days, if desired)

Teacher Notes

Outcomes

Students will be expected to

- use and read a thermometer safely and properly (209-3)
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Question

What is a thermometer?

Background

Thermal energy (heat) gives increased energy to molecules, causing them to exert more pressure or expand the space between them. Warm temperatures make things expand more than do cold temperatures. An instrument that measures changes in temperature is called a thermometer (thermo=heat and meter=to measure).

When heated, liquid expands and moves up the tube. We say the temperature goes up. Conversely, when cooled, liquid contracts and moves down the tube. We say the temperature goes down. This interrelationship between expansion and contraction of molecular space and temperature, or the amount of molecular motion should be connected and explained using the particle theory.

Students may develop their own list of situations in which thermometers are used.

Safety

Treat rubbing alcohol with respect. Rubbing alcohol is not edible. Keep it away from your face. Avoid spilling it on your hands. It could damage some types of clothing.

Food colouring does not come out of some types of clothing.

Material Apparatus

clear narrow drinking straw
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Calibrate the thermometer scale by using known temperatures such as freezing and boiling point of water and body temperature.