Earth and Space Science: Water Systems on Earth

What's Down There (3–4 classes)
Student Notes

Outcomes

Students will be expected to

- select and integrate information from various print and electronic sources to provide examples of technologies that have enabled scientific research involving ocean basins (111-3, 209-5)
- provide examples of how technologies used to investigate the ocean floor have improved over time (110-8)
- identify some strengths and weaknesses of technologies used to investigate the ocean floor (210-3)
- provide examples of public and private Canadian institutions that support scientific and technological research involving the oceans (112-5)
- describe some positive and negative effects of marine technologies in the ocean (113-2)
- provide examples of problems related to the oceans that cannot be resolved using scientific and technological knowledge (113-10)

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 scientists know what the ocean floor is like?

Materials

- air dry clay or plaster of Paris
- metric ruler
- bamboo skewers
- shoe box
- tape
- pencil
- cardboard
- marker

Procedure

Activity I

Use the clay or plaster of Paris to create a model of the ocean floor in the bottom of the shoe box. Include features such as guyot, trench, continental ridge, etc.

On the lid of the box, make a grid. Points on the grid should be 4 cm apart.

Using a math compass, punch holes in the marks through the cardboard box.

Put the lid back on the box.

Insert the bamboo skewers into the holes on the grid and read the highs and lows of the ocean.

Plot their data on a graph. Label the ocean features on the graph.

Activity II

As a group, find out how scientists map the ocean floor. The Bedford Institute of Oceanography has a very useful site. A key word search of Sable gas, Hibernia oil will take you to sites which will answer the questions listed below. The Federal Government site also has excellent links.

As a group, plan who will be responsible for which parts of the search. Divide the work, make a plan and decide how your group will report your findings.

The search:

Find at least three different methods of mapping the ocean floor. Describe how each method gathers information on the ocean floor.

Give and example of how this information is displayed.

Include some limitations (problems) experienced by each method.

Who is using each method? Why?

Include some Canadian institutions involved in mapping our ocean bottom.

Results

The report:

Your report needs to be accurate, complete and have clear examples. The format of your report needs to be discussed with your teacher. Some suggestions could be a Hyperstudio or PowerPoint presentation, a group (shared) report with maps, diagrams, a brilliant idea of your own (check to see how brilliant you are).

What's Down There (3–4 classes)
Teacher Notes

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Question

How do scientists know what the ocean floor is like?

Background

See attached notes on ocean floor.

The outcomes state that students should be researching. Activity I is meant to be a jump-off point to open discussion on how people investigate the ocean floor. Knowing the terms down there is not necessary.

Key words to search are Sable Gas, Hibernia oil, ocean floor mapping. In addition, the Bedford Institute of Oceanography and the Federal Government Web site have excellent links for student investigation.

Materials

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Procedure

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The Major Ocean Basins and Their Features

The Archaean Earth (3.5–2.5 billion years ago) was composed of a loose assemblage of continents surrounded by a vast ocean known as Panthallassa. As the supercontinent Pangaea drifted apart (most recently) about 280 million years ago, the beginnings of the Atlantic and Indian Oceans were formed in a body of water known as the Tethys Ocean. The split up of Pangaea into Gondwanaland and Laurasia, and eventually the six major continents as we know them, led to the formation of the three major oceans, the Pacific, the Atlantic, and the Indian.

The oceans (and adjacent seas) cover approximately 71% of the Earth's surface. Yet the distribution of this water across the planet is not equal; the Southern Hemisphere contains most of the water. The largest ocean on Earth, the Pacific

Ocean, covers about 32% (one-third) of the Earth's surface. The Atlantic and Indian Oceans are about half the size of the Pacific Ocean, covering about 16% and 14%, respectively. Interestingly, the average depth of these oceans is about the same, roughly 3700 metres deep.

There are also differences in the shapes of the basins and where they are located. The Pacific Ocean basin appears as one big round ocean, stretched across both hemispheres. Because of its shape, some scientists believe that the Pacific Ocean basin gave rise to the moon as the result of an impact with a large asteroid (or small planet!), which spilled the lighter contents of the Earth's molten crust into outer space.

On the other side of the globe, the Atlantic Ocean basin looks pinched in the middle, where the western bulge of Africa reaches out towards the eastern bulge of South America. Then we have the Indian Ocean basins, which rests for the most part in the Southern Hemisphere, with only a very small portion extending above the equator. While the Atlantic Ocean basin and the Indian Ocean basin hold nearly the same volume of water, that of the Atlantic has been stretched across the globe while that of the Indian is confined to the southern half of the globe.

Despite these differences, ocean basins have many features in common that are useful to know. In general, ocean basins can be divided into two parts, the continental margins and the deep-ocean basins. The continental margins include the continental shelf and the continental slope. The deep-ocean basins comprise the "floor" of the sea, though it is hardly flat! As we shall see, the ocean floor consists of the oceanic ridges, submarine trenches, abyssal plains, guyots, island arcs, and a few other interesting geological features.

The continental shelf is the part of the continental margin nearest the shore, often flat and quite gentle in slope. These are actually parts of the continent and have been exposed and submerged throughout geological time depending on the sea level. This is where you stand when you are at the beach. The width of the continental shelf is highly variable, depending on whether it is on the leading edge of a continent, the edge, which moves towards an ocean basin, or the trailing edge, the edge that moves away from the ocean basin. On leading edges, continents are colliding and overriding the oceanic plates, leading to narrow continental shelves such as are found along the Pacific coast. Trailing edges are regions from which the continent moved away, leaving a wide swath of sediments behind it. This is typical of the continental shelf along the Atlantic coast.

The continental slope is the part of the margin where the slope drops sharply at a steep angle (about 4 degrees), in a region called the shelf break. The slope marks

the region where the continental and oceanic crust meet. Continental slopes, being steep, give rise to avalanches of sediments called turbidity currents. When large accumulations of sediments are deposited on the shelf, they suddenly give way like an avalanche. These turbidity currents may cut into the sides of the slope, forming underwater canyons called submarine canyons (don't confuse these with submarine trenches, which are tectonic). One famous submarine canyon is the Monterey Submarine Canyon, which is as deep and steep as the Grand Canyon. Also, we should note that as these sediments descend to the ocean floor, they spread out forming alluvial fans and fan valleys, such as what you see at the mouths of rivers.
The continental rise is this is a region beyond the continental slope, which slowly descends into the oceanic basin. It is largely composed of sediments, which have flowed down the continental slope onto the oceanic basin. Because these sediments are often deposited by turbidity currents, they have been called turbidite deposits. One feature of turbidite deposits is that they are graded. That means that the heavier rocks and sands are found at the bottom and the finer sediments are on top. Where several turbidite deposits have been deposited, this pattern will repeat itself over and over again.

The ocean floor is the bottom of the ocean, beyond the continental margins. The ocean floor is not flat and the composition of rocks here is distinctly different than that of the continents. Though we may not realize it, the ocean floor covers more of the Earth's surface than the continents. In fact, in many places, the ocean floor has large expanses that are absolutely flat, flatter than anywhere on land. These regions are known as the abyssal plains.

The ocean floor is home to many other interesting geologic features. There are several regions along the ocean floor, which are, elevated a mile or so from the rest of the ocean floor. These are called oceanic plateaus. They are typically thicker and more "buoyant" than oceanic crustal material. It is thought that these may be fragments of continental crustal materials floating within the plates, or some may be the result of volcanic activity. Whatever their origin their distribution is widespread.

In some spots, ocean basins are covered with hills, called abyssal hills. Larger "hills", called sea mounts, may also be present. These are formed by volcanic activity where "hot-spots" occur. While the source of these hot spots is not known, there appear to be particular locations anchored in the mantle which push magma through the oceanic crust towards the surface. These hot spots give rise to undersea volcanoes, which sometimes rise to the surface and form islands.

Another feature attributed to hot spots are island arcs. These arcs appear as a series of volcanic islands in close association with each other. The Hawaiian Islands are a good example.

If the volcano remains submerged, they become known as sea mounts. Sea mounts are present in many of the ocean basins. If the volcanoes break the surface of the ocean, they become islands. The weight of these volcanoes on the crust causes the plate to sink. Oftentimes, the tops of these volcanoes are weathered by wind and waves, and the tops become flat. When these flat-topped volcanoes submerge completely, they become known as guyots ("ghee-oats"). Eventually, the Hawaiian Islands, which are slowly sinking, will be completely submerged and turn into guyots.

Geological activity is not the only type of activity that creates structures on the ocean floor. Biological activity may contribute as well. Among the best known are the coral reefs, such as the Great Barrier Reef in Australia.

The most famous "marine carpenters" are the corals. Corals, which are related to sea anemones, remove calcium from the seawater to form intricate and often massive calcified skeletons. Corals consist of colonies of individuals, known as polyps, each of which contains a number of symbiotic microscopic plant cells, called zooxanthellae. The zooxanthellae, which are photo synthetic, provide some of the energy and biochemical building blocks, which help the polyps, build their coral skeletons.

Some of the best-known structures built by corals are the fringing reefs. Fringing reefs are most typical around islands, but also may be formed along coastlines. They usually occur where the depth of the seawater is great enough that they don't dry out and shallow enough that light penetrates to their zooxanthellae. Oftentimes, the actions of these organisms may be substantial enough to build barrier reefs, which form a barrier between the shoreline and the ocean. The most famous of these is the Great Barrier Reef in Australia.

Another curiosity which can be attributed to corals are atolls. Atolls are small ring-shaped reefs, which occur in the middle of the ocean. The processes, which form atolls, were discovered by Darwin, who correctly postulated and later confirmed that atolls were formed as volcanoes sank back into the sea. The reefs, which formed around the ring of the volcano, were able to grow as fast as the volcano sank thus creating a ring of coral, which stayed at the surface of the ocean. Because conditions at the other edges of the atoll, i.e. the side facing the ocean, are better for coral growth than along the inner edge, the ring also grows outward, thus forming the familiar ring-shape structure of the atoll.

Convection Currents (15 minutes)

Student Notes

Outcomes

Students will be expected to

- carry out procedures in order to investigate how temperature difference in water causes current (209-1)
- state a conclusion based on experimental data about the formation of water currents (209-4, 210-11)

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 are water currents in the oceans and air currents in the atmosphere created?

Materials

- 3 shallow metal pans
- candle
- matches
- food colouring

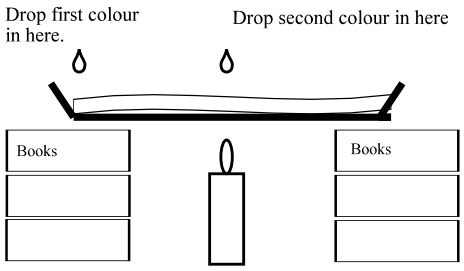
- sand
- water
- heat lamp
- thermometer

Procedure

Activity I

Make two equal piles of books high enough for the candle to fit safely under the pan.

Place the pan so it balances on the books.
Fill with water.



Carefully light the candle.

Add a couple of drops of food colouring to the tray, along the outside near the edge.
Record your observations.

Try a couple drops of a different colour in the middle tray above the flame.

Record your observations.

Activity II

Put sand in one tray and water in the other. Measure and record their temperatures.

Place both trays under a heat lamp. After 5 minutes, record their temperatures.

Turn off the heat lamp. After 5 minutes, record the temperatures of heat tray.

Analysis

What made the difference in the movement of the two colours of food colouring?

What is similar in the make-up of our oceans?
Did the pan of sand or water heat more quickly?

Which cooled more quickly?

If you could put see the air moving above the sand and water, how would they compare?

In the daytime, the breeze at the beach is blowing off the water and onto you. Why?

At night, the breeze is blowing off the land and onto the water. Why?

In Nova Scotia, on the Atlantic side of the province, the best swimming is late August, early September. Why is the water warmest at that time?

Extension

Research El Nino, La Nina, Gulf Stream. Tell what they are, how they affect us on land. A map showing their location would be help with your explanation.

Convection Currents (15 minutes)
Teacher Notes

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Question

How are water currents in the oceans and air currents in the atmosphere created?

Background

On hot summer days the sun can cause an on-shore wind.

As the land is warmed up by the sun, bubbles of hot air form over things like car parks and wheat fields. (Car parks because the tarmac heats up and crops in fields because the air between the stalks heats up). Other things have the same effect. Flat roofs of buildings, airport runways, empty roads.

These bubbles of heated air eventually break free of the ground and rise upwards, often in a doughnut shape. As they rise, the air under them has to move inwards to fill the gap left and this is often felt as a localised breeze offering a brief cool moment on an otherwise hot day.

Eventually, this bubble of hot air reaches the colder air at 500 feet or more above the ground and reveals itself to the eye as a patch of white condensation, or, as we call it from down below, a cloud. When a few of these bubbles get together they form cumulus clouds, the white fluffy type you see over the land on hot days.

Near the coast this cold air moving in to fill the space under the thermal bubbles comes from the sea and by the end of a long hot day there are so many thermals rising that there is often a strong on-shore breeze. This we can utilize, of course, even though it might be a flat calm five or six miles inland.

The tides also have an effect on winds. As the water level rises, the air is pushed upwards. It has to go somewhere and on even a slightly warm day with no obvious thermal activity it often moves inland, giving again an on-shore breeze. As the tide goes out (water level goes down) the reverse can happen and any on-shore winds can be turned off just as if someone threw a switch.

Thermal forcing resulting from the contrast between land and sea leads to localized circulations that vary diurnally and seasonally. Land/sea breezes occur by lakes or in coastal regions. During the day the air over land heats up and rises. Aloft it moves over the ocean or lake where it sinks over the relatively cool ocean or lake. To complete the flow air moves onshore from the lake to land and this is referred to as an "on-shore" breeze. At night the reverse conditions apply and we get an "off-shore" breeze, air moving from land to sea or lake. On a much larger scale, both spatially and temporally, this circulation can apply to large coastlines. When this occurs it is referred to as a monsoon. The land/sea contrast in this case occurs seasonally. In the summer months the land is considerably warmer inducing an on shore breeze, in the winter the opposite. The onshore breeze is laden with moisture and results in precipitation on land as the air rises. Thus the monsoon is associated with heavy rain events.

Although North America has a mild monsoon, it best known to occur in Asia, particularly India and surrounding countries. Mountain breezes are thermally induced winds. Along the mountain slope the surface cools faster than the surrounding air, thus at any given altitude the surface air is colder and denser

than the neighbouring air at that height. Thus there is a tendency for the air to sink downslope. During the day the opposite conditions apply and there is an upslope wind. A chinook is a wind that travels over a mountain. On the windward side of the mountain the moisture-laden air forms clouds and precipitates. On the leeward side the dry air flows down the mountain. Dry air warms faster than moist air and so at the base of the mountain, the air is very dry and considerably warmer than when it started its ascent up the windward side of the mountain. This is a feature of the climate of Calgary and other communities on the leeward side of a mountain.

Materials

- 3 shallow metal pans
- candle
- matches
- food colouring
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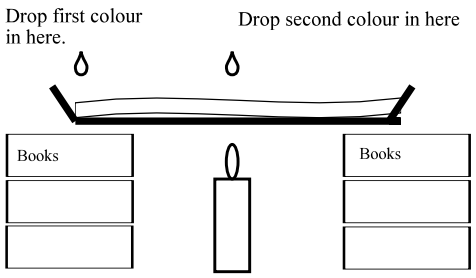
Procedure

Activity I

Make two equal piles of books high enough for the candle to fit safely under the pan.



Place the pan so it balances on the books. Fill with water.

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Extension

Research El Nino, La Nina, Gulf Stream. Tell what they are, how they affect us on land. A map showing their location would be help with your explanation.

Shapes of the Land (2–3 classes)
Student Notes

Outcomes

Students will be expected to

- describe factors that affect glaciers and polar icecaps, and describe their consequent effects on the environment (311-12)
- identify new questions that arise from the study of glaciers and polar icecaps (210-16)

Assessment

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Question

How do changes in glaciers and the polar icecaps affect our environment?

Safety

Research on the Internet requires supervision. Not all sites are appropriate. Check with your teacher before using sites not mentioned in class.

Procedure

Complete a K-W-L worksheet on glaciers and the Arctic polar cap. The 'L' will be the independent part of your report so ask good questions. Each group will need an historian, a geologist, a water specialist, an environmentalist, and a reporter at large. Each has a special job in the group.

Historian—research how glaciers and icecaps have moved over Canada in the past

Geologist—research on how glacial movement affected land formation in Canada

Water Specialist—research on how glaciers and icecaps influence our water supply on land and in our ocean

Environmentalist—research on how events in our environment have affected the glaciers and icecaps

Reporter at large—writes the introduction and conclusion to the group report and includes the answers to the 'L' column of K-W- L sheet where they belong in the report. In the conclusion, include the group's prediction for the future.

Results

The report can take many forms. A choice of a formal written report with diagrams and illustrations, a write-up with poster diagrams, maps, illustrations, a PowerPoint presentation including graphics, an oral report with models, or a brilliant idea from your group (check to see how brilliant you are).

Shapes of the Land (2–3 classes)
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Background

An on-line article from *Canadian Geographic* called "Shapes of the Land" tell about glaciation and river delta formation. A key word search "global warming" + "glaciers" + "ice caps" will provide many resources on Canadian and international discussion of the melting of the ice caps and its consequences.

Procedure

Complete a K-W-L worksheet (from the Secondary Science document) on glaciers and the Arctic polar cap. The 'L' will be the independent part of your report so ask good questions. Each group will need an historian, a geologist, a water specialist, an environmentalist, and a reporter at large. Each has a special job in the group.

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Making Connections (3–4 classes)
Student Notes

Outcomes

Students will be expected to

- apply the concept of systems to show how changes in one component of a body of water causes change in other components in that system (111-6)
- describe the interactions of the ocean currents, winds, and regional climates (311-9)
- analyse factors that affect productivity and species distribution in marine and fresh water environments (311-8)
- predict and interpret trends in populations of a marine species for graphical data by interpolating and extrapolation data (210-4, 210-6)
- describe some positive and negative effects of marine technologies in the ocean (113-2)
- provide examples of problems related to the oceans that cannot be resolved using scientific and technological knowledge (113-10)

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Question

What are the affects of interactions among the ocean currents, winds and regional climates and species in the ocean?

Materials

- large bowl
- fish crackers

Procedure

Activity I

In the group you need to appoint a grandmother, a grandfather, two fathers, two mothers, four children, eight grandchildren.

Fill the bowl with fish crackers.

Start with the grandmother and grandfather. These two can choose as many handfuls of fish as they think are necessary.

The next two fish are the mothers and fathers, then the children, then the grandchildren.

Activity II

Below are some connections to be researched and reported on.
As a group, pick a topic to research. Make sure no one else has chosen this topic before proceeding. Some topics have more than one slant to them so may be repeated as long as the same item is not being reported on.

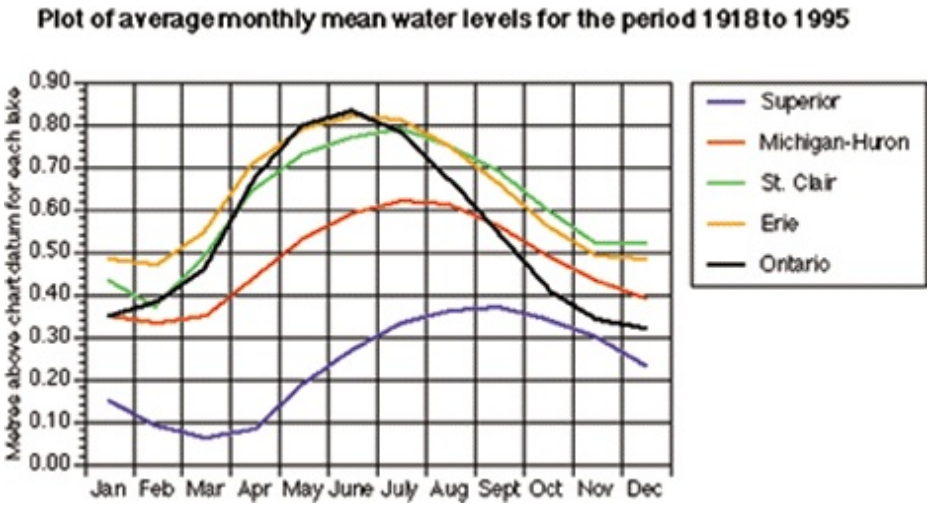
Topics for consideration are:

- Diagram the major currents of the oceans, the winds and climates associated with them and how these affect a species (for example whales and their travels, the return of salmon, a species of your choice)
- Look at some factors which have affected some aquatic species (Atlantic or Pacific salmon, rise and fall of sea urchin populations, cod populations, Right whales of the Bay of Fundy, or a species of your choice)
- Examine the effects of Sable gas production on a species near the Sable gully (whales would be an example).

Results

Activity I

- What did each generation notice about the amount of fish they had available?
- Did the amount influence how many were taken?
- Was any consideration given to the generations to come after?
- How many generations got to fish before there were no fish in the bowl?
- What could have been done for your fish population to ensure that there were fish for the grandchildren?
- Relate this to the history of cod fishing in Atlantic Canada. The graph below can be used to give the answers to the following questions.



- What was the mean water level for June for Lakes Michigan-Huron?
- Which lake has the lowest mean water level?
- What would you predict the mean water level would be for Lake Ontario in the following January?

Table 32
The Primary Fishing Industry, Atlantic Region, 1988–1996

	PRIMARY			MARICULTURE			TOTAL		
Year	Volume of Landings ('000 tonnes)	Value of Landings ($ million)	Employment (FTE)	Volume ('000 tonnes)	Value ($ million)	Employment (FTE)	Volume ('000 tonnes)	Value ($ million)	Employ-ment (FTE)
1988	1,385.1	1,016.5	28,290	9.1	53.0	690	1,394.2	1,069.5	28,980
1989	1,317.9	959.8	27,501	12.6	66.8	920	1,330.5	1,026.6	28,421
1990	1,342.4	953.9	26,392	16.2	98.9	1,160	1,358.6	1,052.8	27,552
1991	1,192.4	1,013.8	25,315	17.9	106.5	1,150	1,210.3	1,120.3	26,465
1992	1,020.4	984.1	26,428	19.1	108.0	1,220	1,039.5	1,092.1	27,648
1993	872.3	957.5	26,076	19.8	117.0	1,280	892.1	1,074.5	27,356
1994	719.3	1,125.9	25,215	24.4	123.0	1,400	743.7	1,248.9	26,615
1995	636.5	1,349.9	24,529	28.9	145.8	1,750	665.4	1,495.7	26,279
1996	679.7	1,123.6	21,552	32.7	159.0	1,800	712.4	1,282.6	23,352
Av. Rate of growth	-8.9%	1.3%	-3.4%	16.0%	13.7%	12.0%	-8.4%	2.3%	-2.7%

- Graph the data for Year vs Values of Landings using Table 32 from the federal government Web site. Create three questions to be asked using the graph you created.

Results

Activity II

The report:

Your report needs to be accurate, complete and have clear examples.

The format of your report needs to be discussed with your teacher. Some suggestions could be a Hyperstudio or PowerPoint presentation, a group (shared) report with maps, diagrams, a video interview with experts on your topic, a brilliant idea of your own (check to see how brilliant you are).

Making Connections (3–4 classes)
Teacher Notes

Outcomes

Students will be expected to

- apply the concept of systems to show how changes in one component of a body of water causes change in other components in that system (111-6)
- describe the interactions of the ocean currents, winds, and regional climates (311-9)
- analyse factors that affect productivity and species distribution in marine and fresh water environments (311-8)
- predict and interpret trends in populations of a marine species for graphical data by interpolating and extrapolation data (210-4, 210-6)
- describe some positive and negative effects of marine technologies in the ocean (113-2)
- provide examples of problems related to the oceans that cannot be resolved using scientific and technological knowledge (113-10)

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 individual was not responsible to group for work	procedure for activity was followed as directed group worked as a team to complete activity group discussed results together report uses complete, independent sentences connections made between activity and real world show understanding of concept	all parts of level 2 were accomplished connections between activity and real world questions show deep understanding through discussion, examples and/or added details from research report shows extra attention, outside research or details and connections made above and beyond classroom work/discussion report displays group co-operation and shared responsibility

Question

What are the affects of interactions among the ocean currents, winds and regional climates and species in the ocean?

Materials

- large bowl
- fish crackers

Background

The federal government Web site has good information for students to use when working on Activity I. Use the departments link to find Fisheries and Oceans. From there, there are many useful links for students. Other key words to search would be Sable gas, Hibernia oil, Sable gully, whales and cod.

Procedure

Activity I

In the group you need to appoint a grandmother, a grandfather, two fathers, two mothers, four children, eight grandchildren.

Fill the bowl with fish crackers.

Start with the grandmother and grandfather. These two can choose as many handfuls of fish as they think are necessary.

The next two fish are the mothers and fathers, then the children, then the grandchildren.

Activity II

Below are some connections to be researched and reported on.

As a group, pick a topic to research. Make sure no one else has chosen this topic before proceeding. Some topics have more than one slant to them so may be repeated as long as the same item is not being reported on.

Topics for consideration are:

Diagram the major currents of the oceans, the winds and climates associated with them and how these affect a species (for example whales and their travels, the return of salmon, a species of your choice)

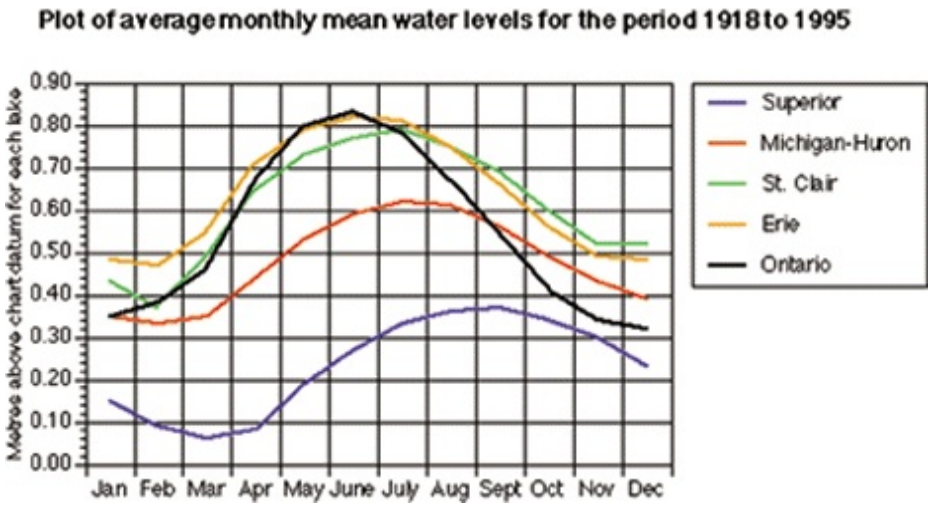
Look at some factors which have affected some aquatic species (Atlantic or Pacific salmon, rise and fall of sea urchin populations, cod populations, Right whales of the Bay of Fundy, or a species of your choice)

Examine the effects of Sable gas production on a species near the Sable gully (whales would be an example).

Results

Activity I

- What did each generation notice about the amount of fish they had available?
- Did the amount influence how many were taken?
- Was any consideration given to the generations to come after?
- How many generations got to fish before there were no fish in the bowl?
- What could have been done for your fish population to ensure that there were fish for the grandchildren?
- Relate this to the history of cod fishing in Atlantic Canada. The graph below can be used to give the answers to the following questions.



- What was the mean water level for June for Lakes Michigan-Huron?
- Which lake has the lowest mean water level?
- What would you predict the mean water level would be for Lake Ontario in the following January?

Table 32
The Primary Fishing Industry, Atlantic Region, 1988–1996

Year	PRIMARY			MARICULTURE			TOTAL		
	Volume of Landings ('000 tonnes)	Value of Landings ($ million)	Employment (FTE)	Volume ('000 tonnes)	Value ($ million)	Employment (FTE)	Volume ('000 tonnes)	Value ($ million)	Employ-ment (FTE)
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Av. Rate of growth	-8.9%	1.3%	-3.4%	16.0%	13.7%	12.0%	-8.4%	2.3%	-2.7%

- Graph the data for Year vs Values of Landings using Table 32 from the federal government Web site. Create three questions to be asked using the graph you created.

Results

Activity II

The report:

Your report needs to be accurate, complete and have clear examples.

The format of your report needs to be discussed with your teacher. Some suggestions could be a Hyperstudio or PowerPoint presentation, a group (shared) report with maps, diagrams, a video interview with experts on your topic, a brilliant idea of your own (check to see how brilliant you are).

Runoff (3 classes)
Student Notes

Outcomes

Students will be expected to

- select and integrate information, from various print and electronic sources related to processes of erosion and deposition that result from wave action and water flow (209-5, 311- 11)
- describe processes that lead to the development of ocean basins and continental drainage systems
- erosion (311- 7)
- prepare a presentation or report on the effect of tides and waves on a shoreline, and evaluate individual and group processes used in planning and completing the task (211-2, 211- 4)
- explain how waves and tides interact with shorelines (311-10b)
- provide examples of various technologies designed to contain damage due to waves and tides (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 scientifically sound 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 procedure showed deep understanding of how to test variables 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

How do different surfaces affect water runoff?

Safety

Wipe up spilled water to prevent accidents.

Materials/Apparatus

- clear, sealed tubes containing sand
- small gravel
- soil
- clay
- one or two large rocks
- graduated cylinder
- sink, basin or wall paper trough
- protractor
- filter paper
- balance
- rigid piece of acrylic (cut from yogurt or ice cream containers)
- sponges
- watering can
- paper towel
- small blocks of wood
- soil

Procedure

Activity I

Shake the deposition tube to mix the sediments.

Turn upright vertically and hold still.

Record your observations.

Activity II

As a group, create a hypothesis about whether surface affects how much runoff is created when it rains.

Look at the list of materials provided. As a group, devise a plan to simulate a parking lot surface, a grassy area, and an area of sandy soil.

Consider the following questions in your plan.

- What are you measuring?
- What are your variables?
- Which variables will you keep the same?
- Which variables will you change?
- Have your plan approved.

Results/Conclusion

Activity I

Draw and label a diagram to represent the deposition of sediments.

What sediments did you find at the bottom to the tube?

What kind of sediments were on the top?

In an ocean bay, how do sediments get into the bay?

As you go further out into the bay, the bottom of the bay has finer sediments. Why?

Activity II

Did your procedure allow your group to gather accurate data?

Are there any changes you would make to your procedure?

What did you discover about different surfaces and erosion?

Application

As a group, choose an erosion issue from local news. Report on the erosion cause, what is happening to the land, how it affects the people living there, any environmental impact on plants and/or animals in the area, what can/is being done at the moment.

Describe what technologies are being used to contain the damage. Are the solutions permanent? Predict what the area will look like in 100 years, 500 years, 5000 years.

Sketches/diagrams, maps, live interviews, videos, etc., are ways of reporting on your findings.

Runoff (3 classes)
Teacher Notes

Outcomes

Students will be expected to

- select and integrate information, from various print and electronic sources related to processes of erosion and deposition that result from wave action and water flow (209-5, 311- 11)
- describe processes that lead to the development of ocean basins and continental drainage systems
- erosion (311- 7)
- prepare a presentation or report on the effect of tides and waves on a shoreline, and evaluate individual and group processes used in planning and completing the task (211-2, 211- 4)
- explain how waves and tides interact with shorelines (311-10b)
- provide examples of various technologies designed to contain damage due to waves and tides (112-3)

Assessment

Beginning (you need to come for help and try again)	Its OK if you are OK with it	Wow!!
Level 1	Level 2	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 scientifically sound 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 procedure showed deep understanding of how to test variables 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

How do different surfaces affect water runoff?

Background

By doing the activity below, students will experience soil erosion. Grade 8 students may already have experience using a run-off table. If not, some discussion will be required before students design their experiment.

This activity is meant to lead students into research and discussion about local land erosion. Media sources such as television, radio, newspapers, the Internet, etc., should be used to give this issue a local face.

Safety

Wipe up spilled water to prevent accidents.

Materials/Apparatus

- clear, sealed tubes containing sand
- small gravel
- soil
- clay
- one or two large rocks
- graduated cylinder
- sink, basin or wall paper trough
- protractor
- filter paper
- balance
- rigid piece of acrylic (cut from yogurt or ice cream containers)
- sponges
- watering can
- paper towel
- small blocks of wood
- soil

Procedure

Activity I

Shake the deposition tube to mix the sediments.

Turn upright vertically and hold still.

Record your observations.

Activity II

As a group, create a hypothesis about whether surface affects how much runoff is created when it rains.

Look at the list of materials provided. As a group, devise a plan to simulate a parking lot surface, a grassy area, and an area of sandy soil.

Consider the following questions in your plan.

- What are you measuring?
- What are your variables?
- Which variables will you keep the same?
- Which variables will you change?

Have your plan approved.

Results/Conclusion

Activity I

Draw and label a diagram to represent the deposition of sediments.

What sediments did you find at the bottom to the tube?

What kind of sediments were on the top?

In an ocean bay, how do sediments get into the bay?

As you go further out into the bay, the bottom of the bay has finer sediments. Why?

Activity II

Did your procedure allow your group to gather accurate data?

Are there any changes you would make to your procedure?

What did you discover about different surfaces and erosion?

Application

As a group, choose an erosion issue from local news. Report on the erosion cause, what is happening to the land, how it affects the people living there, any environmental impact on plants and/or animals in the area, what can/is being done at the moment.

Describe what technologies are being used to contain the damage. Are the solutions permanent? Predict what the area will look like in 100 years, 500 years, 5000 years.

Sketches/diagrams, maps, live interviews, videos, etc., are ways of reporting on your findings.

Give Me a Wave (30 minutes)
Student Notes

Outcomes

Students will be expected to

- explain how waves and tides are generated (311-10a)
- formulate operational definitions on the basis of investigations of waves for
  - wave length
  - wave height
  - crest
  - trough (208-7)
- explain how waves and tides interact with shorelines (311-10b)
- describe processes that lead to the development of ocean basins and continental drainage systems
- glaciation (311-7)

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	procedure for activity was followed as directed	all parts of level 2 were accomplished
activity procedure was incorrectly carried out	group worked as a team to complete activity	extension activity was completed
activity was not completed	group discussed results together	connections between activity and real world questions show deep understanding through discussion, examples and/or added details from research
results/ conclusions were not completed	results/conclusions were answered using complete, independent sentences	diagrams, report show extra attention, outside research or details and connections made above and beyond classroom work/discussion
	connections made between activity and real world show understanding of concept	

Questions

How are waves formed?
What effect do they have on land?

Materials

- 1 L drink bottle with cap
- cooking oil
- water
- food colouring
- sand

Procedure

Put 250 ml oil in the bottle.

Fill the bottle to just below where the bottle begins to narrow. You should have at least 5 cm empty space at the top.

Add a few drops of food colouring. Cap the bottle tightly.

Hold the bottle horizontally.

Slowly tip the bottle back and forth. Record what happens.

Add about 50 ml sand to the bottle. Turn the bottle on its side and let the sand settle evenly on the bottom.

Gently tip the bottle back and forth. Record your observations paying particular attention to the sand.

Add a marble to the bottle. Repeat step # 6. Record your observations.

Analysis

Draw a diagram of the bottle when tipped gently. Label wave length, wave height, crest and trough.

When you tipped the bottle more vigorously, what happened to the crest and trough of the waves?

What happened to the sand when included in the wave action? Relate what you observed to what might happen to a beach during a winter storm.

Why are many beaches in Nova Scotia shaped like this?

The Earth does not tip back and forth. As a group, discuss how you think waves are generated.

How are really high surfs generated?

Extension

Investigate a weather event which generated high surf. Describe what made the surf higher than normal. What happened to the land surrounding the area?

Give Me a Wave (30 minutes)
Teacher Notes

Outcomes

Students will be expected to

- explain how waves and tides are generated (311-10a)
- formulate operational definitions on the basis of investigations of waves for
  - wave length
  - wave height
  - crest
  - trough (208-7)
- explain how waves and tides interact with shorelines (311-10b)
- describe processes that lead to the development of ocean basins and continental drainage systems
- glaciation (311-7)

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

Questions

How are waves formed?

What effect do they have on land?

Background

On hot summer days the sun can cause an on-shore wind. As the land is warmed up by the sun, bubbles of hot air form over things like car parks and wheat fields. (Car parks because the tarmac heats up and crops in fields because the air between the stalks heats up). Other things have the same effect. Flat roofs of buildings, airport runways, empty roads.

These bubbles of heated air eventually break free of the ground and rise upwards, often in a doughnut shape. As they rise, the air under them has to move inwards to fill the gap left and this is often felt as a localised breeze offering a brief cool moment on an otherwise hot day.

Eventually, this bubble of hot air reaches the colder air at 150 metres or more above the ground and reveals itself to the eye as a patch of white condensation, or, as we call it from down below, a cloud. When a few of these bubbles get together they form cumulus clouds, the white fluffy type you see over the land on hot days.

Near the coast this cold air moving in to fill the space under the thermal bubbles comes from the sea and by the end of a long hot day there are so many thermals rising that there is often a strong on-shore breeze. This we can utilize, of course, even though it might be a flat calm eight to ten km inland.

The tides also have an effect on winds. As the water level rises, the air is pushed upwards. It has to go somewhere and on even a slightly warm day with no obvious thermal activity it often moves inland, giving again an on-shore breeze.

As the tide goes out (water level goes down) the reverse can happen and any on-shore winds can be turned off just as if someone threw a switch.

Thermal forcing resulting from the contrast between land and sea leads to localized circulations that vary diurnally and seasonally. Land/sea breezes occur by lakes or in coastal regions. During the day the air over land heats up and rises. Aloft it moves over the ocean or lake where it sinks over the relatively cool ocean or lake. To complete the flow air moves onshore from the lake to land and this is

referred to as an "on-shore" breeze. At night the reverse conditions apply and we get an "off-shore" breeze, air moving from land to sea or lake.

On a much larger scale, both spatially and temporally, this circulation can apply to large coastlines. When this occurs it is referred to as a monsoon. The land/sea contrast in this case occurs seasonally. In the summer months the land is considerably warmer inducing an on shore breeze, in the winter the opposite. The onshore breeze is laden with moisture and results in precipitation on land as the air rises. Thus the monsoon is associated with heavy rain events. Although North America has a mild monsoon, it best known to occur in Asia, particularly India and surrounding countries.

Mountain breezes are thermally induced winds. Along the mountain slope the surface cools faster than the surrounding air, thus at any given altitude the surface air is colder and denser than the neighbouring air at that height. Thus there is a tendency for the air to sink downslope. During the day the opposite conditions apply and there is an up-slope wind. A chinook is a wind that travels over a mountain. On the windward side of the mountain the moisture-laden air forms clouds and precipitates. On the leeward side the dry air flows down the mountain. Dry air warms faster than moist air and so at the base of the mountain, the air is very dry and considerably warmer than when it started its ascent up the windward side of the mountain. This is a feature of the climate of Calgary and other communities on the leeward side of a mountain.

Materials

- 1 L drink bottle with cap
- cooking oil
- water
- food colouring
- sand

Procedure

Put 250 ml oil in the bottle.

Fill the bottle to just below where the bottle begins to narrow. You should have at least 5 cm empty space at the top.

Add a few drops of food colouring. Cap the bottle tightly.

Hold the bottle horizontally.

Slowly tip the bottle back and forth. Record what happens.

Add about 50 ml sand to the bottle. Turn the bottle on its side and let the sand settle evenly on the bottom.

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Add a marble to the bottle. Repeat step # 6. Record your observations.

Analysis

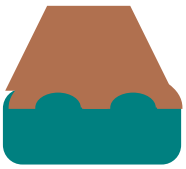
Draw a diagram of the bottle when tipped gently. Label wave length, wave height, crest and trough.

When you tipped the bottle more vigorously, what happened to the crest and trough of the waves?

What happened to the sand when included in the wave action? Relate what you observed to what might happen to a beach during a winter storm.

Why are many beaches in Nova Scotia shaped like this?

The Earth does not tip back and forth. As a group, discuss how you think waves are generated.



How are really high surfs generated?

Extension

Investigate a weather event which generated high surf. Describe what made the surf higher than normal. What happened to the land surrounding the area?

Physical Science: Fluids

Unseen World (45 minutes)
Student Notes

Outcomes

Students will be expected to

- use a light microscope or micro viewer correctly to produce a clear image of cells (209-3)
- explain the structural and functional relationships between and among cells, tissues, organs and systems in the human body (304-7)
- distinguish between plant and animal cells (304-5)
- explain that it is important to use proper terms when comparing plant and animal cells (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

Question

Do I know how to properly handle and care for a microscope?

What is the difference between a microscope slide and a micro viewer slide?

Are all body cells the same size and shape?

Why do you think this is the case?

Materials

- prepared slides of plant and animal cells
- microscope
- micro viewer slides of plant and animal cells
- micro viewers
- pond water sample (optional)

Procedure

Obtain two different slides (one plant and one animal), a worksheet, a microscope.

Carefully read and follow directions on sheet; read the evaluation rubric so you know what is expected.

Carefully observe/sketch each different slide at low and high power; include calculation of magnifications.

Hand in completed worksheet.

Beginning (you need to try again)	Its OK if you are OK with it	Wow!!
worksheet incomplete little evidence of care or learning	worksheet complete magnification recorded sketches show some detail sketches done in pencil	worksheet complete magnification calculations included sketches show care, detail pencil used for sketches slide sketches titled effort has been made to be neat, complete, detailed

Results Conclusion

Describe some differences you observed between plant and animal cells. What is at least one structure that a plant cell has that an animal does not? Why would this structure not be necessary in an animal cell?

Find the nucleus of the cell. Describe the relative size of this organelle. What happens to the image of the slide when you switch from low to high power? Calculate the magnification of slide image at low power. Do the same for high power. Be sure to show your thinking.

Extension

Create a series of your own wet mounted slides from different plants and animals (use pond water for your animal cells). Demonstrate that you can identify some important organelles in cells. Tell how the plant slides you have made differ from animal cells.

Unseen World (45 minutes)
Teacher Notes

Outcomes

Students will be expected to

- use a light microscope or micro viewer correctly to produce a clear image of
- cells (209-3)
- explain the structural and functional relationships between and among cells, tissues, organs and systems in the human body (304-7)
- distinguish between plant and animal cells (304-5)
- explain that it is important to use proper terms when comparing plant and animal cells (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

Question

Do I know how to properly handle and care for a microscope?

What is the difference between a microscope slide and a micro viewer slide?

Are all body cells the same size and shape?

Why do you think this is the case?

Materials

- prepared slides of plant and animal cells
- microscope
- micro viewer slides of plant and animal cells
- micro viewers
- pond water sample (optional)

Background

Students should be careful when handling the prepared slides and microscopes. Also, students should keep their areas clean and stay in their own work area.

If slides are prepared by students extra care should be taken when handling sharp instruments such as tweezers and cover slips. Students should keep their hands away from their face when handling the pond water and should wash their hands when they finish.

Students should be taught and given the opportunity to practice the skills required to observe cells using a microscope and/or micro viewer. The parts of the microscope should not be memorized but instead the focus (no pun intended) should be on the process of using the instruments available. Prepared slides of plant and animal cells should be compared and contrasted. Also, students should gain experience in preparing slides, such as a thin onion layer.

It should be noted that students should not harvest live human cells (for example, cheek cells) in this activity. If available, a video-microscope (video-cam) could be used to facilitate group observation of cells.

Observing a sample of pond water can provide a less static experience for the students. The students will enjoy trying to identify the organisms present by comparing them with diagrams of single-celled organisms provided in resource text.

Procedure

Obtain two different slides (one plant and one animal), a worksheet, a microscope.

Carefully read and follow directions on sheet; read the evaluation rubric so you know what is expected.

Carefully observe/sketch each different slide at low and high power; include calculation of magnifications.

Hand in completed worksheet.

Beginning (you need to try again)	Its OK if you are OK with it	Wow!!
worksheet incomplete little evidence of care or learning	worksheet complete magnification recorded sketches show some detail sketches done in pencil	worksheet complete magnification calculations included sketches show care, detail pencil used for sketches slide sketches titled effort has been made to be neat, complete, detailed

Results Conclusion

Describe some differences you observed between plant and animal cells. What is at least one structure that a plant cell has that an animal does not? Why would this structure not be necessary in an animal cell?

Find the nucleus of the cell. Describe the relative size of this organelle. What happens to the image of the slide when you switch from low to high power? Calculate the magnification of slide image at low power. Do the same for high power. Be sure to show your thinking.

Extension

Create a series of your own wet mounted slides from different plants and animals (use pond water for your animal cells). Demonstrate that you can identify some important organelles in cells. Tell how the plant slides you have made differ from animal cells.

A Pressing Problem (15 minutes)
Student Notes

Outcomes

Students will be expected to

- explain quantitatively the relationship between force area, and pressure (309-3)
- describe the science underlying hydraulic technologies (111-5)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 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 does force (depth) affect fluid pressure?

Materials

- milk carton
- large tub or sink
- water
- tape
- pen or other object for making holes

Safety

Use caution when using sharp objects. Spilling water is possible–make sure all spills are cleaned up promptly to avoid slipping.

Procedure

Make three holes (just below the top, around the middle and near the bottom of the carton) up one side of the milk carton. Cover them securely with one strip of tape.

Carefully fill the milk carton and hold it in the centre of the tub or sink.

Quickly remove the tape from all the holes at once.

Observe the water escaping and draw your observations.

Results Observations

Draw a series of diagrams to show what you saw.

Analysis

Gravity is exerting downward pressure on the water. If this was the only force acting on the water, it could not push sideways to flow out the hoes. Use these facts to help you explain what forces and directions might be acting on the water during this activity.

Does depth affect the pressure of water? Air pressure is said to be normal at sea level. What would you expect the air pressure to be like if you were standing on the shore of the Dead Sea, 400 m below sea level? What would you expect at the summit of Mt. Everest, 8848 m above sea level? What human tools and inventions make use of these changes in pressure?

A Pressing Problem (15 minutes)
Teacher Notes

Outcomes

Students will be expected to

- explain quantitatively the relationship between force area, and pressure (309-3)
- describe the science underlying hydraulic technologies (111-5)

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 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 does force (depth) affect fluid pressure?

Background

Gravity exerts a downward force on all matter on Earth. At any given depth (or altitude) particle exert a particular pressure. Additional pressure comes from the particle piled above them.

Fluids in a container are exerting static pressure on the walls of the container, which increases as the depth increases, since there are more particles piled above which are being attracted to the centre of the Earth.

As altitude increases, the opposite would occur—pressure will decrease because there are fewer particles above exerting downward force.

Materials

- milk carton
- large tub or sink
- water
- tape
- pen or other object for making holes

Safety

Use caution when using sharp objects. Spilling water is possible–make sure all spills are cleaned up promptly to avoid slipping.

Procedure

Make three holes (just below the top, around the middle and near the bottom of the carton) up one side of the milk carton. Cover them securely with one strip of tape.

Carefully fill the milk carton and hold it in the centre of the tub or sink.

Quickly remove the tape from all the holes at once.

Observe the water escaping and draw your observations.

Results Observations

Draw a series of diagrams to show what you saw.

Analysis

Gravity is exerting downward pressure on the water. If this was the only force acting on the water, it could not push sideways to flow out the hoes. Use these facts to help you explain what forces and directions might be acting on the water during this activity.

Does depth affect the pressure of water? Air pressure is said to be normal at sea level. What would you expect the air pressure to be like if you were standing on the shore of the Dead Sea, 400 m below sea level? What would you expect at the summit of Mt. Everest, 8848 m above sea level?

What human tools and inventions make use of these changes in pressure?

Bobbing for Buoyancy (20 minutes)
Student Notes

Outcomes

Students will be expected to

- describe the movement of objects in terms of balanced and unbalanced forces (309-2)
- provide examples of technologies that have been developed because of our understanding of density an buoyancy (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

What is the relationship between the weight of an object in air and in water?

What technologies make use of this behaviour?

Materials

- various objects (rocks, steel bolts, etc.)
- container of water spring
- scale string for holding objects

Procedure

Measure the weight of the object with the spring scale.

With the object still hanging from the spring scale, hold it so that the object is completely underwater and measure the weight again.

Record the weight of the object in air and in water.

Subtract the weight in water from the weight in air. This result is the buoyant force of the water acting on the object.

Analysis

What happened to the weight of the objects? Why? Describe what happened on a particle basis.

Tell the difference between mass and weight.

What human-made devices use this concept?

Why do divers wear weights on a belt when diving?

Extension

Test the weight of the object in other liquids of varying densities. Could this be used as another method of finding the density of different liquids?

Bobbing for Buoyancy (20 minutes)

Teacher Notes

Outcomes

Students will be expected to

- describe the movement of objects in terms of balanced and unbalanced forces (309-2)
- provide examples of technologies that have been developed because of our understanding of density an buoyancy (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

What is the relationship between the weight of an object in air and in water?

What technologies make use of this behaviour?

Background

Objects which sink in water appear to weigh less than they do in air. This is due to the buoyant force of the water—the water particles are closer together than air particles, and can thus support some of the weight of the object.

Measuring the weight of the object in both air and water, and subtracting them gives the buoyant force acting on the object.

Materials

- various objects (rocks, steel bolts, etc.)
- container of water spring
- scale string for holding objects

Procedure

Measure the weight of the object with the spring scale.

With the object still hanging from the spring scale, hold it so that the object is completely underwater and measure the weight again.

Record the weight of the object in air and in water.

Subtract the weight in water from the weight in air. This result is the buoyant force of the water acting on the object.

Analysis

What happened to the weight of the objects? Why? Describe what happened on a particle basis.

Tell the difference between mass and weight.

What human-made devices use this concept?

Why do divers wear weights on a belt when diving?

Extension

Test the weight of the object in other liquids of varying densities. Could this be used as another method of finding the density of different liquids?

Cartesian Condiments (20 minutes)
Student Notes

Outcomes

Students will be expected to

- provide examples of technologies that have been developed because of our understanding of density and buoyancy (111-1)
- describe the movement of objects in terms of balanced and unbalanced forces (309-2)
- identify and relate personal activities and potential applications to fluid dynamics (109-10, 112-7, 210-12)

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 does pressure affect the 'floatability' of an object?

Materials

- clear plastic bottle, such as a drink bottle with cap
- eye dropper
- condiments packages
- water

Procedure

Test the condiment packages by putting them into a container of water. Only packages which float will make Condiment Cartesian divers.

Fill the plastic bottle with water and put the diver in. Put the cap on tightly.

Squeeze the bottle gently and observe the diver's actions.

Try different amount of force. Can you make the diver 'dance'?

Conclusion

Write an entry in your science journal about your experience with the diver and the treasure. Include the answers to the questions below in your discussion. How does the amount of force affect the height the diver sits in the bottle? In what ways would this activity help you explain how a submarine works?

Extension

Research and report on how whales dive. Link your research to this activity.

Cartesian Condiments (20 minutes)
Teacher Notes

Outcomes

Students will be expected to

- provide examples of technologies that have been developed because of our understanding of density and buoyancy (111-1)
- describe the movement of objects in terms of balanced and unbalanced forces (309-2)
- identify and relate personal activities and potential applications to fluid dynamics (109-10, 112-7, 210-12)

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 does pressure affect the 'floatability' of an object?

Background

Rene Descartes invented the Cartesian diver to demonstrate both Archimedes' principle and Pascal's principle. The Cartesian diver is usually made so that initially it just barely floats.

As you apply pressure to the bottle, you apply pressure to the air bubble in the eye dropper, reducing its size. As the bubble's size reduces, the dropper becomes less buoyant and begins to sink. Release the pressure on the bottle an the dropper begins to rise back to the top.

Materials

- clear plastic bottle, such as a drink bottle with cap
- eye dropper
- condiments packages (soy sauce works well)
- water

Procedure

Test the condiment packages by putting them into a container of water. Only packages which float will make Condiment Cartesian divers.

Fill the plastic bottle with water and put the diver in. Put the cap on tightly.

Squeeze the bottle gently and observe the diver's actions.

Try different amount of force. Can you make the diver ‘dance’?

Conclusion

Write an entry in your science journal about your experience with the diver and the treasure. Include the answers to the questions below in your discussion.

How does the amount of force affect the height the diver sits in the bottle?

In what ways would this activity help you explain how a submarine works?

Extension

Research and report on how whales dive. Link your research to this activity.

Cartesian Conundrum (20 minutes)
Student Notes

Outcomes

Students will be expected to

- provide examples of technologies that have been developed because of our understanding of density and buoyancy (111-1)
- describe the movement of objects in terms of balanced an unbalanced forces (309-2)
- identify and relate personal activities and potential applications to fluid dynamics (109-10, 112-7, 210-12)

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 does pressure affect the 'floatability' of an object?

Materials

- clear plastic bottle such as a drink bottle with cap
- eye dropper
- two paperclips
- water

Procedure

Open up and bend a paper clip around the eye dropper so it has a hook coming out. Test the eye dropper for floatability by filling with water and suspending in water. This may take some fiddling. Work patiently.

Bend the other paper clip so it sits on the bottom of the bottle with a hook sticking up.

Fill the plastic bottle with water and put the diver in. Add the eye dropper 'diver'. Put the cap on tightly.

Squeeze the bottle gently and observe the diver's actions. You want the diver to go to the bottom and pick up the 'treasure'.

Try different amounts of force. Record your observations

Conclusion

Write an entry in your science journal about your experience with the diver and the treasure. Include the answers to the questions below in your discussion.

How does the amount of force affect the height the diver sits in the bottle?

In what ways would this activity help you explain how a submarine works?

Extension

Research and report on how whales dive. Link your research to this activity.

Cartesian Conundrum (20 minutes)
Teacher Notes

Outcomes

Students will be expected to

- provide examples of technologies that have been developed because of our understanding of density and buoyancy (111-1)
- describe the movement of objects in terms of balanced an unbalanced forces (309-2)
- identify and relate personal activities and potential applications to fluid dynamics (109-10, 112-7, 210-12)

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 pressure affect the 'floatability' of an object?

Background

Rene Descartes invented the Cartesian diver to demonstrate both Archimedes' principle and Pascal's principle. The Cartesian diver is usually made so that initially it just barely floats.

As you apply pressure to the bottle, you apply pressure to the air bubble in the eye dropper, reducing its size. As the bubble's size reduces, the dropper becomes less buoyant and begins to sink. Release the pressure on the bottle an the dropper begins to rise back to the top.

Students might benefit from a demonstration from Cartesian Condiments before they try this challenge.

Materials

- clear plastic bottle such as a drink bottle with cap
- eye dropper
- two paperclips
- water

Procedure

Open up and bend a paper clip around the eye dropper so it has a hook coming out. Test the eye dropper for floatability by filling with water and suspending in water. This may take some fiddling. Work patiently.

Bend the other paper clip so it sits on the bottom of the bottle with a hook sticking up.

Fill the plastic bottle with water and put the diver in. Add the eye dropper 'diver'. Put the cap on tightly.

Squeeze the bottle gently and observe the diver's actions. You want the diver to go to the bottom and pick up the 'treasure'.

Try different amounts of force. Record your observations

Conclusion

Write an entry in your science journal about your experience with the diver and the treasure. Include the answers to the questions below in your discussion.

How does the amount of force affect the height the diver sits in the bottle?

In what ways would this activity help you explain how a submarine works?

Extension

Research and report on how whales dive. Link your research to this activity.

Floating Art (20 minutes)
Teacher Notes

Outcomes

Students will be expected to

describe situations in life where the density of substances naturally changes or is intentionally changed (307-10)
provide examples of technologies that have been developed because of our understanding of density and buoyancy (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 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 connections made between activity and real world show understanding of concept	all parts of level 2 were accomplished connections between activity and real world questions show deep understanding through discussion, examples and/or added details from research art work shows extra attention, outside research or details and connections made above and beyond classroom work/discussion

Question

What are everyday items which utilize density and/or buoyancy?

Materials

- a collection of art supplies

Background

This activity links science to art. It also asks students to relate everyday occurrences and items to the concept of density and/or buoyancy. Many everyday items such as kayaks, lobster buoys, nets, sewage in the Halifax Harbour behave in special ways due to their density and/or buoyancy.

Students should be encouraged to create works of art which show creativity and display many of the items which utilize density and/ buoyancy. Some class discussion before the activity will help students think about density and/or buoyancy in everyday life.

Procedure

Use an art medium to demonstrate some everyday items which utilize density and/or buoyancy as part or how they work. The art could be a sculpture, collage, mural drawing, cartoon, etc.

Flowing Along (20 minutes)
Student Notes

Outcomes

Students will be expected to

- compare the viscosities of various liquids (307-6)
- design an experiment to test the viscosity of various common fluids and identify the major variables (208-6)

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

What factors affect viscosity?

Safety

Care needs to be taken when handling the motor oil, rubbing alcohol, detergent and hand cream. Gloves and safety goggles should be used as protection. Never put anything in your mouth during science activities.

Materials

- inclined plane ramp, marked with lines 10 cm apart marbles or ball bearings
- test tubes
- paper towels
- cleaner which dissolves the liquids
- eye droppers
- gloves/safety glasses
- stopwatch/timer
- liquids at room temperature:
- cooking oil
- corn syrup
- motor oil
- water
- molasses
- honey
- rubbing alcohol
- liquid detergent
- liquid hand cream

Procedure

Inclined Plane Tester

Set up a data table for recording information from this activity. The table should include the type of liquid, predicted rankings of the viscosity of the liquids, the time in seconds liquids took to move 10 cm, actual rate of flow (cm/s), actual rankings.

Predict the rankings of the liquids from least viscose to most viscose.
Set up the inclined plane.

Place one drop of a liquid on the start line. Time how many seconds it takes to flow down 10 cm.

Calculate rate of flow in cm/s.

Eye Dropper Tester

The data table could include the type of liquid, predicted number of drops, the number of drops that fell, actual drop rate (drops/second), actual rankings.

Fill the eye dropper with a liquid, hold it up without squeezing the bulb. Let liquid drip out of the tip.

Count the number of drops that fall in 10 seconds.

Calculate the rate of drop in cm/s.

Sinking Marble Tester

The data table should include the type of liquid, predicted rankings, time in seconds it takes the marble to sink, actual sinking rate (cm/s), actual rankings.

Fill a test tube (make sure the marble fits in freely) with each liquid to a depth of 10 cm.

Drop the marble into the liquid and time the number of seconds it takes to hit the bottom of the container. It is best to time each one five times and calculate an average time.

Calculate the sink time of each liquid (cm/s).

Analysis

Conclusion

How did the actual rankings of the viscosity of liquids compare among the three tests?

Which liquid is the most viscose? Which is the least?

How does viscosity affect rate of flow?

What factors could affect the viscosity of liquids? Why do we use motor oil to lubricate car valves and not water? Why do we not use molasses (which is more viscose)?

Extension

Repeat the tests above using colder or warmer versions of the liquids. Report your findings. What conclusions can you make about climate and the viscosity of liquids? Where in our lives do we take this information into account when we use machinery?

Flowing Along (20 minutes)
Teacher Notes

Outcomes

Students will be expected to

- compare the viscosities of various liquids (307-6)
- design an experiment to test the viscosity of various common fluids and identify the major variables (208-6)

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

What factors affect viscosity?

Background

Viscosity is a measure of the ability of a liquid to flow. It is often described as the 'thickness' of a liquid. One method of determining the viscosity of a liquid is the

measurement of the flow rate in centimetres per second for various liquids, using inclined planes.

Other tests could check the number of drops falling from a medicine dropper in 10 seconds, or the time it takes for a marble to sink to the bottom of 10 cm depth of liquid.

Safety

Care needs to be taken when handling the motor oil, rubbing alcohol, detergent and hand cream. Gloves and safety goggles should be used as protection. Never put anything in your mouth during science activities.

Materials

- inclined plane ramp, marked with lines 10 cm apart marbles or ball bearings
- test tubes
- paper towels
- cleaner which dissolves the liquids
- eye droppers
- gloves/safety glasses
- stopwatch/timer
- liquids at room temperature:
- cooking oil
- corn syrup
- motor oil
- water
- molasses
- honey
- rubbing alcohol
- liquid detergent
- liquid hand cream

Procedure

Inclined Plane Tester

Set up a data table for recording information from this activity. The table should include the type of liquid, predicted rankings of the viscosity of the liquids, the time in seconds liquids took to move 10 cm, actual rate of flow (cm/s), actual rankings.

Predict the rankings of the liquids from least viscose to most viscose.

Set up the inclined plane.

Place one drop of a liquid on the start line. Time how many seconds it takes to flow down 10 cm.

Calculate rate of flow in cm/s.

Eye Dropper Tester

The data table could include the type of liquid, predicted number of drops, the number of drops that fell, actual drop rate (drops/second), actual rankings.

Fill the eye dropper with a liquid, hold it up without squeezing the bulb. Let liquid drip out of the tip.

Count the number of drops that fall in 10 seconds.

Calculate the rate of drop in cm/s.

Sinking Marble Tester

The data table should include the type of liquid, predicted rankings, time in seconds it takes the marble to sink, actual sinking rate (cm/s), actual rankings.

Fill a test tube (make sure the marble fits in freely) with each liquid to a depth of 10 cm.

Drop the marble into the liquid and time the number of seconds it takes to hit the bottom of the container. It is best to time each one five times and calculate an average time.

Calculate the sink time of each liquid (cm/s).

Analysis

Conclusion

How did the actual rankings of the viscosity of liquids compare among the three tests?

Which liquid is the most viscose? Which is the least?

How does viscosity affect rate of flow?

What factors could affect the viscosity of liquids? Why do we use motor oil to lubricate car valves and not water? Why do we not use molasses (which is more viscose)?

Extension

Repeat the tests above using colder or warmer versions of the liquids. Report your findings. What conclusions can you make about climate and the viscosity of liquids? Where in our lives do we take this information into account when we use machinery?

Hydrometer Hijinks (20 minutes)
Student Notes

Outcomes

Students will be expected to

- describe the movement of objects in terms of balanced and unbalanced forces (309-2)
- provide examples of technologies that have been developed because of our understanding of density and buoyancy (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 a hydrometer can be constructed and used in testing density?

Materials

- plastic straw
- Plasticine™
- sand
- test tubes

- water
- salt water
- alcohol
- graduated cylinder
- permanent marker

Procedure

Fill the graduated cylinder with water so that the water bulges over the top.

Seal the end of the straw with a wad of Plasticine™. Make sure the Plasticine™ wraps entirely around the bottom and sides of the end of the straw.

Pour sand into the straw to give it weight.

Put the straw into the graduated cylinder and adjust the amount of sand so that about 1–2 cm of straw is above the water. ***Note***: Some water will spill from the graduated cylinder when you put the straw into it. Use a tray to contain the water.

Use the permanent marker to make a mark on the straw to indicate the density of water.

Test the salt water and the alcohol. Mark the straw for each.

Analysis

Rank the liquids you tested from least dense to most dense.

What does this tell you about the particles in each liquid?

Why would ships be able to carry more cargo across the Atlantic Ocean than on the Great Lakes?

Extension

Use a commercial hydrometer to calibrate hydrometers;
or
use homemade hydrometers to identify the density of unknown liquids;
or
use homemade hydrometers to test the density of water at various temperatures;
or

find out about the lines marked on the sides of cargo ships. What are the lines called? Why are they on the ship? What do they indicate?

Hydrometer Hijinks (20 minutes)
Teacher Notes

Outcomes

Students will be expected to

- describe the movement of objects in terms of balanced and unbalanced forces (309-2)
- provide examples of technologies that have been developed because of our understanding of density and buoyancy (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 a hydrometer can be constructed and used in testing density?

Background

Hydrometers are instruments which utilize the relationship between density and buoyancy to measure liquid density. When liquids have greater density, an object

will float higher (have greater buoyancy) and when a liquid is less dense, the object will sink farther down into it.

The height at which a calibrated floating object sit in the liquid can be used to measure the density of the liquid.

Materials

- plastic straw
- Plasticine™
- sand
- test tubes
- water
- salt water
- alcohol
- graduated cylinder
- permanent marker

Procedure

Fill the graduated cylinder with water so that the water bulges over the top.

Seal the end of the straw with a wad of Plasticine™. Make sure the Plasticine™ wraps entirely around the bottom and sides of the end of the straw.

Pour sand into the straw to give it weight.

Put the straw into the graduated cylinder and adjust the amount of sand so that about 1–2 cm of straw is above the water. ***Note***: Some water will spill from the graduated cylinder when you put the straw into it. Use a tray to contain the water.

Use the permanent marker to make a mark on the straw to indicate the density of water.

Test the salt water and the alcohol. Mark the straw for each.

Analysis

Rank the liquids you tested from least dense to most dense.

What does this tell you about the particles in each liquid?

Why would ships be able to carry more cargo across the Atlantic Ocean than on the Great Lakes?

Extension

Use a commercial hydrometer to calibrate hydrometers;
or
use homemade hydrometers to identify the density of unknown liquids;
or
use homemade hydrometers to test the density of water at various temperatures;
or
find out about the lines marked on the sides of cargo ships. What are the lines called? Why are they on the ship? What do they indicate?

Is It Dense? (45 minutes)
Student Notes

Outcomes

Students will be expected to

- analyse quantitatively the density of various substances and suggest explanations for discrepancies in data, such as the measurement of the volume of irregular objects by water displacement (210-7, 307-11)
- describe situations in life where the density of substances naturally changes or is intentionally changed (307-10)
- identify questions to investigate arising from practical problems involving floating, sinking and density (208-2)

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
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

What does density mean?

Materials/Apparatus

- regularly shaped cubes of wood of different sizes
- overflow can
- balance scale
- 50 ml beaker
- graduated cylinder

Procedure

Create a data chart to organize your data. Your chart might look like this.

Measurements	Block 1	Block 2	Block 3	Block 4
mass of wood (g)				
mass of beaker (g)				
mass of beaker+overflow (g)				
mass of overflow (g)				
volume of overflow (ml)				
l x w x h (cm^3)				
density = mass/volume				

Find the mass of the wood block using the balance.

Find the mass of a small beaker.

Set the overflow can by filling with water and letting it run until it stops on its own. Stick a pin in a wooden block.

Sink the block in the overflow can. Do not get your fingers in the water.

Collect the overflow in a beaker.

Find the mass of the beaker with the overflow water in it.

Find the mass of the overflow water. (step#6 – step#2).

Find the volume of the overflow water by transferring to a graduated cylinder.

Measure the length, width, height of the cube. Calculate its volume.

Analysis

Compare the mass of overflow the volume of overflow and the calculated volume. What do you notice? What does this tell you?

Compare the calculated density of each block of wood. What do you notice about the numbers? What does density mean? Explain in detail.

Extension

Find the density of other objects supplied by your teacher. Compare your measured densities with a density chart. Discuss your results (similarities and differences). What problems did you encounter? How could these problems be resolved?

Is It Dense? (45 minutes)
Teacher Notes

Outcomes

Students will be expected to

- analyse quantitatively the density of various substances and suggest explanations for discrepancies in data, such as the measurement of the volume of irregular objects by water displacement (210-7, 307-11)
- describe situations in life where the density of substances naturally changes or is intentionally changed (307-10)
- identify questions to investigate arising from practical problems involving floating, sinking and density (208-2)

Assessment

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Question

What does density mean?

Background

Density is the ratio of mass and volume. D=mass/volume. Students should not be told this formula until they have investigated some relationships by measuring. A discussion should follow about the relationship. That is, that density is a certain amount of particles in a given space.

Some review of solids, liquids and gases from grade 7 particle theory might help provide a picture of what density means in an object. The cubes of wood should be the same type of wood in three distinct sizes.

Materials/Apparatus

- regularly shaped cubes of wood of different sizes
- overflow can
- balance scale
- 50 ml beaker
- graduated cylinder

Procedure

Create a data chart to organize your data. Your chart might look like this.

Measurements	Block 1	Block 2	Block 3	Block 4
mass of wood (g)				
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l x w x h (cm^3)				
density = mass/volume				

Find the mass of the wood block using the balance.

Find the mass of a small beaker.

Set the overflow can by filling with water and letting it run until it stops on its own. Stick a pin in a wooden block.

Sink the block in the overflow can. Do not get your fingers in the water.

Collect the overflow in a beaker.

Find the mass of the beaker with the overflow water in it.

Find the mass of the overflow water. (step#6–step#2).

Find the volume of the overflow water by transferring to a graduated cylinder.

Measure the length, width, height of the cube. Calculate its volume.

Analysis

Compare the mass of overflow the volume of overflow and the calculated volume. What do you notice? What does this tell you?

Compare the calculated density of each block of wood. What do you notice about the numbers? What does density mean? Explain in detail.

Extension

Find the density of other objects supplied by your teacher. Compare your measured densities with a density chart. Discuss your results (similarities and differences). What problems did you encounter? How could these problems be resolved?

Lift It! (10 minutes)
Student Notes

Outcomes

Students will be expected to

- describe the science underlying hydraulic technologies (111-5)

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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Question

How can air be used to lift objects?

Materials

- balloon
- straw
- objects such as books
- fastening materials (tape, elastic bands)

Procedure

Use fastening materials to affix the straw into the mouth of the balloon.

Put one book on top of the balloon of a table.

Blow into the straw and observe what occurs.

Test how many books can be lifted by the air in the balloon.

Analysis

What part of the balloon makes the books lift?

Why is it more difficult to lift two books than one?

How could you change the design of the experiment to lift larger objects?

Extension

Find examples of how we use hydraulics in our lives. Make a detailed diagram, a collage of examples or a model of a common example of how hydraulics are useful in our lives.

Lift It! (10 minutes)
Teacher Notes

Outcomes

Students will be expected to

- describe the science underlying hydraulic technologies (111-5)

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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Question

How can air be used to lift objects?

Background

Air is compressible, but as it is compressed, it exerts greater pressure in all directions. As the air is compressed inside a balloon, it will exert pressure on any objects sitting on the balloon. Water or other fluids can be used in the same way to do work.

Materials

- balloon
- straw
- objects such as books
- fastening materials (tape, elastic bands)

Procedure

Use fastening materials to affix the straw into the mouth of the balloon.

Put one book on top of the balloon of a table.

Blow into the straw and observe what occurs.

Test how many books can be lifted by the air in the balloon.

Analysis

What part of the balloon makes the books lift?

Why is it more difficult to lift two books than one?

How could you change the design of the experiment to lift larger objects?

Extension

Find examples of how we use hydraulics in our lives. Make a detailed diagram, a collage of examples or a model of a common example of how hydraulics are useful in our lives.

Madly Off in All Directions (45 minutes)
Student Notes

Outcomes

Students will be expected to

- describe the relationship among mass, volume and density of solids (307-8)
- explain the effects of changes in temperature on the density of solids, liquids, and gases and relate the result to the particle model of matter (307-9)

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 are some ways I can show the affect of temperature on particles?

Materials

- paper/pencil
- colours
- poster board
- costumes, etc.

Procedure

In your group, discuss how particles behave as temperature increases or decreases.

Include in your discussion how solids, liquids, and gases change as temperature increases or decreases.

As a group show your understanding by doing one of the following activities:

- write a poem
- develop a skit
- draw a cartoon
- create logos or slogans
- perform a dance
- create a collage or a mural
- a brilliant idea of your own (check to see how brilliant you are)

Madly Off in All Directions (45 minutes)
Teacher Notes

Outcomes

Students will be expected to

- describe the relationship among mass, volume and density of solids (307-8)
- explain the effects of changes in temperature on the density of solids, liquids, and gases and relate the result to the particle model of matter (307-9)

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 are some ways I can show the affect of temperature on particles?

Background

This activity provides a link between science and art. It also allows students who need to demonstrate their understanding a creative way to do that. In addition, kinesthetic learners would benefit from the drama sections.

This activity could be used as an assessment event where students demonstrated their knowledge of the particle theory, how substances change state and their

ability to co-operate and problem solve. This activity could also be used as an extension for those students who need more challenge in the curriculum.

Materials

- paper/pencil
- colours
- poster board
- costumes, etc.

Procedure

In your group, discuss how particles behave as temperature increases or decreases.

Include in your discussion how solids, liquids, and gases change as temperature increases or decreases.

As a group show your understanding by doing one of the following activities:

- write a poem
- develop a skit
- draw a cartoon
- create logos or slogans
- perform a dance
- create a collage or a mural
- a brilliant idea of your own (check to see how brilliant you are)

Massive Overflow (20 minutes)
Student Notes

Outcomes

Students will be expected to

- analyse quantitatively the density of various substances and suggest explanations for discrepancies in data, such as the measurement of the volume of irregular objects by water displacement (210-7, 307-11)
- describe situations in life where the density of substances naturally changes or is intentionally changed (307-10)
- identify questions to investigate arising from practical problems involving floating, sinking, and density (208-2)

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 is the density of irregular objects found?

Materials

- balance scale
- irregularly shaped objects
- overflow can
- graduated cylinder
- regularly shaped objects

Procedure

Create a chart to record your data.

Measure the mass of each object using the balance scale.

Calculate the volume of the objects (length x width x height)

Using the overflow can and the graduated cylinder, measure the volume of water displaced by each object.

Analysis

What do you notice about the relationship between the calculated volume and the water displaced measurements?

How can the volume of water (ml) be equal to the volume of objects (cm3)?

Do you consider this method of finding volume to be accurate? Explain.

What other methods might be used to find the density of objects?

Massive Overflow (20 minutes)
Teacher Notes

Outcomes

Students will be expected to

- analyse quantitatively the density of various substances and suggest explanations for discrepancies in data, such as the measurement of the volume of irregular objects by water displacement (210-7, 307-11)
- describe situations in life where the density of substances naturally changes or is intentionally changed (307-10)
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Question

How is the density of irregular objects found?

Background

Density is the ratio of mass to volume. When irregularly shaped objects are being used for density problems, the volume must be found by such methods as water

displacement—either through the increase in volume in a graduated cylinder, or through the overflow of water from a container. The formula for calculating density is: D=mass/volume.

It would be a good learning experience if the activity *Floaters and Sinkers* is completed by students first. This activity allows students to discover the relationship.

Materials

- balance scale
- irregularly shaped objects
- overflow can
- graduated cylinder
- regularly shaped objects

Procedure

Create a chart to record your data.

Measure the mass of each object using the balance scale.

Calculate the volume of the objects (length x width x height)

Using the overflow can and the graduated cylinder, measure the volume of water displaced by each object.

Analysis

What do you notice about the relationship between the calculated volume and the water displaced measurements?

How can the volume of water (ml) be equal to the volume of objects (cm3)?

Do you consider this method of finding volume to be accurate? Explain.

What other methods might be used to find the density of objects?

When It Pours (10 minutes)
Student Notes

Outcomes

Students will be expected to

- identify and relate personal activities and potential applications to fluid dynamics (109-10, 112-7, 210-12)

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 solids flow the way liquids and gases do?

Materials

- Salt
- sand
- sugar
- rice
- water

- disposable pie plates

Procedure

Create a chart to record your observations.

Observe and record the appearance of the different materials as they are poured. Especially not any similarities and differences.

Analysis

Water is classified as a fluid. The other materials you worked with are classified as solids.

Did the solids behave like a fluid when poured? Which behaved most like fluids? Why do you think?

Was there any specific behaviour which you saw in the water's behaviour that was not seen when the solids were poured? Could this characteristic be part of the definition of a fluid? What would you say that characteristic was?

Extension

Are there any conditions under which a liquid behaves like a solid?

When It Pours (10 minutes)
Teacher Notes

Outcomes

Students will be expected to

- identify and relate personal activities and potential applications to fluid dynamics (109-10, 112-7, 210-12)

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 solids flow the way liquids and gases do?

Background

When materials flow, they move freely and spread out evenly within a space or a container. These materials are known as fluids. 'Pourability' is one characteristic of many fluids, but is not sufficient to classify a material as a fluid.

A mixture of cornstarch and water is an example for the extension. Cornstarch and water make what is known as a suspension. It can act like a liquid, or, when pressed, like a solid. When handled slowly and gently, it pours like a liquid. When hit hard, it behaves like a solid.

To make magic mud, empty a box of cornstarch into a large bowl and stir while you add water slowly. The "mud" should be as thick as icing so it's better to add too little water than too much. Add a few drops of food colouring to finish the job. Put your hands in the "goo"! What does it feel like? How does it act? What happens when you put some in your hands and press it? What happens after you stop pressing?

Materials

- Salt
- sand
- sugar
- rice
- water
- disposable pie plates

Procedure

Create a chart to record your observations.

Observe and record the appearance of the different materials as they are poured. Especially not any similarities and differences.

Analysis

Water is classified as a fluid. The other materials you worked with are classified as solids.

Did the solids behave like a fluid when poured? Which behaved most like fluids? Why do you think?

Was there any specific behaviour which you saw in the water's behaviour that was not seen when the solids were poured? Could this characteristic be part of the definition of a fluid? What would you say that characteristic was?

Extension

Are there any conditions under which a liquid behaves like a solid?

Sing a Song of ... Fluids (20 minutes)
Teacher Notes

Outcomes

Students will be expected to

- identify and relate personal activities and potential applications to fluid dynamics (109-10, 112-7, 210-12)
- persist in seeking answers to difficult questions and solutions to difficult problems (attitudes 430)
- work collaboratively in carry on out investigations as well as in generating and evaluating ideas (attitudes 431)

Assessment

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

How many songs can you remember which include some object or activity involving fluids, density, buoyancy and/or viscosity?

Background

This activity links science to art. Some class discussion before the activity will help students think about density and/or buoyancy in songs. Some starter ideas could be:

- Row, Row, Your Boat
- Yellow Submarine
- I'm Stuck on You
- Up, Up and Away

Materials

- paper
- pencil
- chart paper
- markers

Procedure

As a group, record the song titles for as many songs as you can which include an object or activity which involves fluids, density, buoyancy and/or viscosity.

Work together and share ideas to make your list as long as possible.

When the time is up, put your list on chart paper. Share with the rest of the class.

Analysis

What was your favourite song title?

How many were the same as other groups?

How many different (from other groups) songs did your group come up with?

Extension

Create your own song about buoyancy. You may use an existing tune or also create your own tune. Perform your song live or on video or audio tape.

Tight Squeeze (45 minutes)
Student Notes

Outcomes

Students will be expected to

- explain qualitatively the relationship among pressure, volume and temperature when liquid and gaseous fluids are compressed or heated (309-4)
- describe the science underlying hydraulic technologies (111-5)

Assessment

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

What happens to the pressure on air when the volume is altered?

Materials/Apparatus

- PASCO Pressure sensor (absolute) with syringe and connectors
- DataStudio Workbook file: Tightsqueeze.ds
- This file can be found at http://lrt.ednet.ns.ca/IEI/scriprobe.html It will not open from the Web site, but it can be saved on your hard drive or a disk.

Safety

As students attempt to push the plunger in to 5 ml, they may find that the syringe can slip and the plunger spring outward as the pressure is released. Safety glasses are recommended.

Procedure

Connect the Science Workshop Interface box to the computer and run the DataStudio software.

Open the activity 'tightsqueeze.ds'.

Move from one page to the next, following the instructions and doing the activity.

The file can be saved at the end of the activity as long as a new name is used.

Tight Squeeze (45 minutes)
Teacher Notes

Outcomes

Students will be expected to

- explain qualitatively the relationship among pressure, volume and temperature when liquid and gaseous fluids are compressed or heated (309-4)
- describe the science underlying hydraulic technologies (111-5)

Assessment

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Question

What happens to the pressure on air when the volume is altered?

Background

Gasses differ from liquids in that they are very compressible. Therefore, it is clear from the graph that the pressure and the volume of air have an inverse relationship (as the volume increases the pressure decreases and vice versa).

However, if the same experiment was carried out with water, the results would be much less dramatic -liquids are nearly completely incompressible, and the syringe plunger would not squeeze the liquid very far. The pressure would increase rapidly to a point that a person would not be able to press any harder.

Materials/Apparatus

- PASCO Pressure sensor (absolute) with syringe and connectors
- DataStudio Workbook file: Tightsqueeze.ds
- This file can be found at http://lrt.ednet.ns.ca/IEI/scriprobe.html It will not open from the Web site, but it can be saved on your hard drive or a disk.

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Procedure

Connect the Science Workshop Interface box to the computer and run the DataStudio software.

Open the activity 'tightsqueeze.ds'.

Move from one page to the next, following the instructions and doing the activity.

The file can be saved at the end of the activity as long as a new name is used.

Analysis

The activity requires extrapolation of new points from the graph as well as an extension to describe a plan for testing liquids.

Note: As part of the activity, the student is asked to plan an experiment which would test liquids. The pressure sensor ***cannot*** be used with liquids. Students will need to design an experiment which would use other methods of collecting data.

Tower of Liquids (10 minutes)
Student Notes

Outcomes

Students will be expected to

- identify questions to investigate arising from practical problems involving floating, sinking and density (208-2)

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

What substances will float and what ones will sink?

Materials

- corn oil
- glycerine
- water (coloured green)
- corn syrup
- small steel object

- small piece of rubber
- small piece of plastic
- small piece of wood
- large test tube

Procedure

Draw a diagram to predict what these materials look like if put into a test tube.

Label your diagram.

Add the materials to the test tube.

Draw a second diagram to record your observations.

Label your diagram.

Analysis

How did your predictions differ from your observations?

Did you have trouble deciding where the different solids and liquids would be found in the tower?

What did you need to consider when deciding their locations?

Are there questions that arise form this activity which could be tested further?

What other tests could be done?

If you had to describe your results to a grade 5 science class, what would you say?

Extension

Find a technology which humans use that uses the concepts discovered here. Describe the technology, what it does and how it works. What kind of jobs are associated with this technology?

Tower of Liquids (10 minutes)
Teacher Notes

Outcomes

Students will be expected to

- identify questions to investigate arising from practical problems involving floating, sinking and density (208-2)

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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Label your diagram.

Add the materials to the test tube.

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Analysis

How did your predictions differ from your observations?

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What did you need to consider when deciding their locations?

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If you had to describe your results to a grade 5 science class, what would you say?

Extension

Find a technology which humans use that uses the concepts discovered here. Describe the technology, what it does and how it works. What kind of jobs are associated with this technology?

A Weighty Problem (45 minutes)
Student Notes

Outcomes

Students will be expected to

- test and compare a student-constructed dynamometer with a commercial dynamometer (210-13)
- calibrate a student-constructed dynamometer with known masses (210-14)
- describe qualitatively the difference between mass and weight (309-1)

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 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 a handmade device measure weight accurately?

Materials

- elastic bands
- pencil
- paper
- masking tape

- spring scale
- various objects
- masses

Procedure

Use the materials provided to construct a scale for measuring weight.

Use the commercial spring scale and masses to calibrate your device.

Measure the weight of the various objects with our device, and then check your results using the spring scale. A chart would be a good way to organize your data.

Analysis

How did the commercial spring scale help you calibrate your device?

What changes did you have to make to your device in order to make it work accurately?

What unit is used to measure weight? What unit is used for mass?

How does mass relate to weight? Mention differences and how many grams = ? Newtons.

Are there any materials that might be more accurate than elastic bands?

Why might these materials be more effective?

Physical Science: Optics

Light At Work (45 minutes)
Student Notes

Outcomes

Students will be expected to

- describe the laws fo reflection of visible light and their applications in everyday life
- regular versus diffused reflection
- angle of incidence = angle of reflection (308-9)
- formulate operational definitions of incidence, reflection and the normal (208-7)
- estimate angles of incident and reflection (209-2)
- work co-operatively and collaboratively with others to plan and safely construct an optical device using mirrors (209-6, 211-1)

Assessment

Beginning (you need to come for help and try again)	Its OK if you are OK with it	Wow!!
Level 1	Level 2	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 kaleidoscopes 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 connections between activity and real world questions show deep understanding through discussion, examples and/or added details from research kaleidoscope shows extra attention, outside research or details and connections made above and beyond classroom work/discussion

Safety

Compass tools and knives are dangerous. Your teacher may choose to do these cuts for you.

Materials

- small stuff—feathers, confetti, glitter, small beads, etc.
- two chip canisters (chips removed)
- black permanent
- marker
- transparent tape
- craft plastic (picked up from craft stores)
- flexible clear plastic (transparencies for overhead projectors work well)
- craft knife
- compass tool from math set
- scissors
- patience!

Procedure

Mark one can as can#1.

Take the 2nd can (can #2), remove the plastic lid and cut off the rolled end.

Then, from the bottom, cut a sleeve 5.5 cm in length (again, measure and mark around the can to get a precise cut).

Using scissors, cut the sleeve open by simply cutting the length of the tube. Take the sleeve and wrap it around can #1. Separate the sleeve until it glides or rotates around can #1 smoothly, and then gently add 2 strips of tape over the gap. Try rotating again; make sure it glides smoothly. Add tape to the edge along the length of the cut.

Cut a piece of thin cardboard 22.5 cm x 15 cm. With a pencil, draw lines to divide the cards into four equal strips (5.6 cm each).

Score the lines so the cardboard is easier to fold.

Stick foil over the end two strips keeping it as smooth as possible.

Colour the strip next to the foil black or cover with black paper.

Fold along the score lines with the foil and black to the inside to form a triangle. The blank strip on the end will be folded under to form support.

Add a long piece of tape to keep the triangle intact.

Slide the triangle into can #1 making sure it has a snug fit then remove and set aside.

Create a peephole. Use the compass tool and drill a hole in the centre of the metal end of can #1.

Take the clear plastic transparencies and cut out a circle that is the same size as the lid, using the lid as a guide for marking and measuring.

Lay the sequence or beads inside the plastic lid of can #1.

With small pieces of tape, secure the plastic on the open side of the plastic lid. Make sure you tape the entire edge down.

Insert the triangle into can #1.

Insert the lid. It should be snug.

Point the lid end at a light source. View through the hole in the metal end. Rotate the kaleidoscope using the sleeve you attached over can #1.

Analysis

This device has a number of pieces of technology. Show your understanding or how light works by including answers to the following:

- What was the purpose of colouring the craft plastic black before inserting them as a triangle into tube?

Light At Work (45 minutes)
Teacher Notes

Outcomes

Students will be expected to

- describe the laws fo reflection of visible light and their applications in everyday life
- regular versus diffused reflection
- angle of incidence = angle of reflection (308-9)
- formulate operational definitions of incidence, reflection and the normal (208-7)
- estimate angles of incident and reflection (209-2)
- work co-operatively and collaboratively with others to plan and safely construct an optical device using mirrors (209-6, 211-1)

Assessment

Beginning (you need to come for help and try again)	Its OK if you are OK with it	Wow!!
Level 1	Level 2	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 kaleidoscopes 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 connections between activity and real world questions show deep understanding through discussion, examples and/or added details from research kaleidoscope shows extra attention, outside research or details and connections made above and beyond classroom work/discussion

Safety

Compass tools and knives are dangerous. You may choose to do these cuts for the students.

Materials

- small stuff—feathers, confetti, glitter, small beads, etc.
- two chip canisters (chips removed)
- black permanent
- marker
- transparent tape
- craft plastic (picked up from craft stores)
- flexible clear plastic (transparencies for overhead projectors work well)
- craft knife
- compass tool from math set
- scissors
- patience!

Procedure

Mark one can as can#1.

Take the 2nd can (can #2), remove the plastic lid and cut off the rolled end.

Then, from the bottom, cut a sleeve 5.5 cm in length (again, measure and mark around the can to get a precise cut).

Using scissors, cut the sleeve open by simply cutting the length of the tube. Take the sleeve and wrap it around can #1. Separate the sleeve until it glides or rotates around can #1 smoothly, and then gently add 2 strips of tape over the gap. Try rotating again; make sure it glides smoothly. Add tape to the edge along the length of the cut.

Cut a piece of thin cardboard 22.5 cm x 15 cm. With a pencil, draw lines to divide the cards into four equal strips (5.6 cm each).

Score the lines so the cardboard is easier to fold.

Stick foil over the end two strips keeping it as smooth as possible.

Colour the strip next to the foil black or cover with black paper.

Fold along the score lines with the foil and black to the inside to form a triangle. The blank strip on the end will be folded under to form support.

Add a long piece of tape to keep the triangle intact.

Slide the triangle into can #1 making sure it has a snug fit then remove and set aside.
Create a peephole. Use the compass tool and drill a hole in the centre of the metal end of can #1.

Take the clear plastic transparencies and cut out a circle that is the same size as the lid, using the lid as a guide for marking and measuring.

Lay the sequence or beads inside the plastic lid of can #1.

With small pieces of tape, secure the plastic on the open side of the plastic lid. Make sure you tape the entire edge down.

Insert the triangle into can #1.

Insert the lid. It should be snug.

Point the lid end at a light source. View through the hole in the metal end. Rotate the kaleidoscope using the sleeve you attached over can #1.

Analysis

This device has a number of pieces of technology. Show your understanding or how light works by including answers to the following:

- What was the purpose of colouring the craft plastic black before inserting them as a triangle into tube?

A Group Wave (4-5 classes)
Student Notes

Outcomes

Students will be expected to

- describe different types of electromagnetic radiation, including infrared, ultraviolet, X-rays, microwaves and radio waves (308-11)
- compare the properties of visible light to the properties of other types of electromagnetic radiation, including infrared, ultraviolet, X-rays, microwaves, and radio waves (308-12)
- explain the importance of using the words frequency and wavelength correctly (109-13)
- provide examples related to optics that illustrate that scientific and technological activities take place individually and in group settings (112-8)
- provide possible negative and positive effects of technologies associated with electromagnetic radiation (113-2)
- describe how optical technologies have developed through systematic trial-and-error processes constrained by the optical properties of the materials (109-5)
- provide examples of optical technologies that enable scientific research and relate personal activities associated with such technologies (109-10, 111-3)

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 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

As a class, decide on a standard scale for the electromagnetic spectrum. This is necessary because each group will create one part of the whole spectrum.

When scale has been established, divide into working groups. You will be asked to do three tasks each different from the other groups. When groups put their tasks together, you will have created an entire spectrum and information on people and technology related to this electromagnetic spectrum.

Procedure

Task I

As a group, decide which of the seven parts of the spectrum you will investigate. Put your group's name on the class sign-up sheet. One part of the spectrum per class. No repeats.

Create a visual representation of you part for the class wall mural of the electromagnetic spectrum. Mention name, wavelength and frequency.

Include a visual to show an example of work they do or how we use them.

Mention dangers associated with this part of the spectrum.

Task II

As a group, choose at least one technology which uses your part of the spectrum. Find out:

- how this technology works
- how it was developed
- people involved in its development
- where it is used
- people who would use this technology today

Be creative in your presentation of this information. Models, interviews with people who use the technology today, mock interviews with inventors, skits, etc., are all ways to share this information with your classmates.

Task III

As a group, pick an historical figure to research who was responsible for some optic development associated with the electromagnetic spectrum. Some suggestions are below. You may want to pick from outside this list. When your group has decided, sign-up for you choice. No repeats.

- Isaac Newton
- Johannes Kepler
- Galileo Galilei
- James Gregory

Be creative in your display of the information you find about the person and the optical device they were responsible for devising. You need to explain how the device uses light. A mobile, a model, a 3-D visual display or your own brilliant idea are ways to display your knowledge.

A Group Wave (4-5 classes)
Teacher Notes

Outcomes

Students will be expected to

- describe different types of electromagnetic radiation, including infrared, ultraviolet, X-rays, microwaves and radio waves (308-11)
- compare the properties of visible light to the properties of other types of electromagnetic radiation, including infrared, ultraviolet, X-rays, microwaves, and radio waves (308-12)
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- provide examples related to optics that illustrate that scientific and technological activities take place individually and in group settings (112-8)
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- describe how optical technologies have developed through systematic trial-and-error processes constrained by the optical properties of the materials (109-5)
- provide examples of optical technologies that enable scientific research and relate personal activities associated with such technologies (109-10, 111-3)

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Background

This activity is designed as a jigsaw activity. Depending on the personality of your class, you could rearrange the groups for each part of the jigsaw or allow the groups to remain together and choose the parts they wish to investigate.

Encourage different modes of expression to accommodate different styles of learning. All reports do not need to be written. Notes can be taken from a skit or interview just as well. Keywords have been given for searching. It is suggested that the teacher do some preliminary searching using these keywords and have a number of useful sites for the students to use. This speeds up research, is safer and keeps students from wandering over the Internet.

Groups of five work well for the wall mural but may need to be adjusted so all parts of the spectrum are covered.

A brief discussion on wavelength, frequency and the make-up of the electromagnetic spectrum will be necessary as a class to determine the scale of the class model of the spectrum.

As a class, decide on a standard scale for the electromagnetic spectrum. This is necessary because each group will create one part of the whole spectrum.

When scale has been established, divide into working groups. You will be asked to do three tasks each different from the other groups. When groups put their tasks together, you will have created an entire spectrum and information on people and technology related to this electromagnetic spectrum.

Procedure

Task I

As a group, decide which of the seven parts of the spectrum you will investigate. Put your group's name on the class sign-up sheet. One part of the spectrum per class. No repeats.

Create a visual representation of you part for the class wall mural of the electromagnetic spectrum. Mention name, wavelength and frequency.

Include a visual to show an example of work they do or how we use them.

Mention dangers associated with this part of the spectrum.

Task II

As a group, choose at least one technology which uses your part of the spectrum. Find out:

- how this technology works
- how it was developed
- people involved in its development
- where it is used
- people who would use this technology today

Be creative in your presentation of this information. Models, interviews with people who use the technology today, mock interviews with inventors, skits, etc., are all ways to share this information with your classmates.

Task III

As a group, pick an historical figure to research who was responsible for some optic development associated with the electromagnetic spectrum. Some suggestions are below. You may want to pick from outside this list. When your group has decided, sign-up for you choice. No repeats.

- Isaac Newton
- Johannes Kepler
- Galileo Galilei
- James Gregory

Be creative in your display of the information you find about the person and the optical device they were responsible for devising. You need to explain how the device uses light. A mobile, a model, a 3-D visual display or your own brilliant idea are ways to display your knowledge.

Larger Than Life (45 minutes)
Student Notes

Outcomes

Students will be expected to

- identify and correct practical problems in a the way a constructed optical device functions (210-14)

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 magnifiers work?

Materials

- small pieces of cardboard (recipe cards or file folders would do)
- plastic food wrap
- tape
- scissors

- eye dropper
- bowl or container
- print from newspaper or text
- water
- lenses from the optics kit

Procedure

Cut a small (5 mm) hole out of the middle of the cardboard.

Tape a piece of plastic food wrap across the hole.

Put some water in a bowl.

Fill up the eye dropper with water.

Put a few drops of water on the plastic covering.

Put it on top of some print or a small object.

Move up and away from the object until it is larger and in focus.

Have a group member measure from the hole to the object. Record the measurement.

Have other group members repeat the procedure for different objects.

Get other lenses from the optics kit to experiment with. Record the distance from the lens to the focussed object. A chart would be a good way to keep track of your data.

Lens Type	distance from object to lens when in focus
water magnifier	
concave	
convex	

Analysis

Read about focal length in your text book. Review the procedure for this activity.

Did you find the focal length of your magnifier? How?

What did you discover about the images projected by other lenses? What does this tell you about the focal length of other lenses?

Draw diagrams of how the light rays are travelling in each type of lens.

Find examples in our lives where we use concave and convex mirrors. Why would each type have been chosen for that situation?

Extension

Explore the development of microscope lenses throughout history. Your report could be an electronic report, a decorative wall display or written as an illustrated children's book suitable for grade 5-6 students.

Larger Than Life (45 minutes)
Teacher Notes

Outcomes

Students will be expected to

- identify and correct practical problems in a the way a constructed optical device functions (210-14)

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 magnifiers work?

Background

Focal length—the distance from a lens or mirror to its focal point.

The focal length, f, is the defining parameter of most lenses and mirrors.

A drum microscope was made in the 1800s. It was built in the midpoint of the development of compound microscopes (containing more than one lens) that began in the very early 1600s (Jansen's 1608 microscope with two lenses) and carries on today.

Its predecessor is the single lens, or simple, microscope which came to fame in the mid 1600s due to the work of Antony van Leewenhoek who founded the science of microbiology.

The Leewenhoek microscope was simplicity in itself. It had a single lens mounted on a metal plate with screws to move the specimen across the field of view and to focus its image. The lens was the key and permitted magnification of 70 to 270.

A lens works by refraction and is shaped so that the light rays near the centre are hardly refracted and those at the periphery are refracted very much more. A parallel beam of light passing through a convex lens is focussed to a spot. The distance from the centre of the lens to the spot is known as the focal length of the lens. The greater the curvature of a convex lens, the shorter the focal length. The shorter the focal length, the greater the magnification. That is, highly curved lens surfaces are associated with short focal lengths and high magnification. They are called strong lenses.

The magnification M (also referred to as lateral magnification) is defined as the ratio of image and object dimensions.

magnification, M = image length/object length

Materials

- small pieces of cardboard (recipe cards or file folders would do)
- plastic food wrap
- tape
- scissors
- eye dropper
- bowl or container
- print from newspaper or text
- water
- lenses from the optics kit

Procedure

Cut a small (5 mm) hole out of the middle of the cardboard.

Tape a piece of plastic food wrap across the hole.

Put some water in a bowl.

Fill up the eye dropper with water.

Put a few drops of water on the plastic covering.

Put it on top of some print or a small object.

Move up and away from the object until it is larger and in focus.

Have a group member measure from the hole to the object. Record the measurement.

Have other group members repeat the procedure for different objects.

Get other lenses from the optics kit to experiment with. Record the distance from the lens to the focussed object. A chart would be a good way to keep track of your data.

Lens Type	distance from object to lens when in focus
water magnifier	
concave	
convex	

Analysis

Read about focal length in your text book. Review the procedure for this activity.

Did you find the focal length of your magnifier? How?

What did you discover about the images projected by other lenses? What does this tell you about the focal length of other lenses?

Draw diagrams of how the light rays are travelling in each type of lens.

Find examples in our lives where we use concave and convex mirrors. Why would each type have been chosen for that situation?

Extension

Explore the development of microscope lenses throughout history. Your report could be an electronic report, a decorative wall display or written as an illustrated children's book suitable for grade 5–6 students.

Line Up Light (15 minutes)
Student Notes

Outcomes

Students will be expected to

- identify and describe the following properties of visible light travels in a straight line (rectilinear propagation) (308-8)

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

Looking directly at a bare light source (bulb or sun) is dangerous to the eyes.

Materials

- hole punch
- four recipe cards
- flashlight

- flexible drinking draw
- Plasticine™

Procedure

Punch a small hole in the centre of each card. Make sure each hole is in exactly the same position on each card.

Line the cards up at 15 cm intervals on a table using Plasticine™ to hold each in place.

Shine the flashlight so the beam travels through the hole in each card. Record observations including any adjustments you had to make.

Move a card out of line. Record your observations. Next, keeping the straw straight, look through the straw at the light source. Record your observations.

Bend the straw and look at the light source again. Record your observations.

Analysis

What happened to the light beam when the cards were lined up? What adjustments were necessary to get the light beam to travel through all the cards? What happened when you moved a card?

What happened when looking through the straight straw? What did you observe when you bent the straw?

Conclusion

What can you say about how a beam of light travels?

Extension

Describe one technology which uses the concept that light travels in a straight line. Tell what it is used for, the history of its invention and briefly how it works.

Line Up Light (15 minutes)
Teacher Notes

Outcomes

Students will be expected to

- identify and describe the following properties of visible light travels in a straight line (rectilinear propagation) (308-8)

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

This activity combined with the activity in the text p. 12–13 and the silhouette activity are good ways to introduce the way light travels.

Safety

Looking directly at a bare light source (bulb or sun) is dangerous to the eyes.

Materials

- hole punch
- four recipe cards
- flashlight
- flexible drinking draw
- Plasticine™

Procedure

Punch a small hole in the centre of each card. Make sure each hole is in exactly the same position on each card.

Line the cards up at 15 cm intervals on a table using Plasticine™ to hold each in place.

Shine the flashlight so the beam travels through the hole in each card. Record observations including any adjustments you had to make.

Move a card out of line. Record your observations. Next, keeping the straw straight, look through the straw at the light source. Record your observations.

Bend the straw and look at the light source again. Record your observations.

Analysis

What happened to the light beam when the cards were lined up? What adjustments were necessary to get the light beam to travel through all the cards? What happened when you moved a card?

What happened when looking through the straight straw? What did you observe when you bent the straw?

Conclusion

What can you say about how a beam of light travels?

Extension

Describe one technology which uses the concept that light travels in a straight line. Tell what it is used for, the history of its invention and briefly how it works.

Up Periscope! (45 minutes)
Student Notes

Outcomes

Students will be expected to

- work co-operatively and collaboratively with others to plan and safely construct an optical device using mirrors (209-6, 211-1)
- identify and correct practical problems in the way a constructed optical device functions (210-14)

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 periscope works as intended 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 connections between activity and real world questions show deep understanding through discussion, examples and/or added details from research periscope shows extra attention, outside research or details and connections made above and beyond classroom work/discussion

Question

How can I see around corners?

Safety

Cutting with knives is dangerous. Check with your teacher for instructions. Care should be taken when handling the glass mirrors.

Materials

- two 1L milk cartons
- two small pocket mirrors (flat ones work best)
- utility knife or X-Acto knife
- ruler
- pencil or pen
- masking tape

Procedure

Use the knife to cut around the top of each milk carton, removing the peaked "roof."

Cut a hole at the bottom of the front of one milk carton. Leave about 6 mm of carton on each side of the hole.

Put the carton on its side and turn it so the hole you just cut is facing to your right.

On the side that's facing up, measure 7 cm up the left edge of the carton, and use the pencil to make a mark there.

Use your ruler to draw a diagonal line from the bottom right corner to the mark you made.

Starting at the bottom right corner, cut on that line. Don't cut all the way to the left edge of the carton-just make the cut as long as one side of your mirror. If your mirror is thick, widen the cut to fit.

Slide the mirror through the slot so the reflecting side faces the hole in the front of the carton. Tape the mirror loosely in place.

Hold the carton up to your eye and look through the hole that you cut. You should see your ceiling through the top of the carton. If what you see looks tilted, adjust the mirror and tape it again.

Repeat steps 2 through 7 with the second milk carton.

Stand one carton up on a table, with the hole facing you. Place the other carton upside-down, with the mirror on the top and the hole facing away from you.

Use your hand to pinch the open end of the upside-down carton just enough for it to slide into the other carton. Tape the two cartons together.

Now you have a periscope! If you look through the bottom hole, you can see over fences that are taller than you. If you look through the top hole, you can see under tables. If you hold it sideways, you can see around corners.

Conclusion

Describe how the light travels through the periscope.

Can you see around corners?

Describe some uses for this technology in our lives.

Up Periscope! (45 minutes)
Teacher Notes

Outcomes

Students will be expected to

- work co-operatively and collaboratively with others to plan and safely construct an optical device using mirrors (209-6, 211-1)
- identify and correct practical problems in the way a constructed optical device functions (210-14)

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 can I see around corners?

Background

Choose either this activity or the kaleidoscope activity to accomplish the outcomes listed above. It is not intended that you do both.

Safety

Cutting with knives is dangerous. You might choose to cut for your students. Care should be taken when handling the glass mirrors.

Materials

- two 1L milk cartons
- two small pocket mirrors (flat ones work best)
- utility knife or X-Acto knife
- ruler
- pencil or pen
- masking tape

Procedure

Use the knife to cut around the top of each milk carton, removing the peaked "roof."

Cut a hole at the bottom of the front of one milk carton. Leave about 6 mm of carton on each side of the hole.

Put the carton on its side and turn it so the hole you just cut is facing to your right.

On the side that's facing up, measure 7 cm up the left edge of the carton, and use the pencil to make a mark there.

Use your ruler to draw a diagonal line from the bottom right corner to the mark you made.

Starting at the bottom right corner, cut on that line. Don't cut all the way to the left edge of the carton-just make the cut as long as one side of your mirror. If your mirror is thick, widen the cut to fit.

Slide the mirror through the slot so the reflecting side faces the hole in the front of the carton. Tape the mirror loosely in place.

Hold the carton up to your eye and look through the hole that you cut. You should see your ceiling through the top of the carton. If what you see looks tilted, adjust the mirror and tape it again.

Repeat steps 2 through 7 with the second milk carton.

Stand one carton up on a table, with the hole facing you. Place the other carton upside-down, with the mirror on the top and the hole facing away from you.

Use your hand to pinch the open end of the upside-down carton just enough for it to slide into the other carton. Tape the two cartons together.

Now you have a periscope! If you look through the bottom hole, you can see over fences that are taller than you. If you look through the top hole, you can see under tables. If you hold it sideways, you can see around corners.

Conclusion

Describe how the light travels through the periscope.

Can you see around corners?

Describe some uses for this technology in our lives.

Pouring Light (10 minutes)
Teacher Notes

Outcomes

Students will be expected to

- rephrase questions related to refraction in a testable form (208-1)
- describe qualitatively how visible light is refracted (210-11, 308-10)

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 light be poured?

Background

This activity is a good question starter to do after students have investigated that light travels in a straight line and before some activities on refraction.

Alternately, it could be used after the refraction activity as an assessment by having the students observe the demonstration and write or diagram what is happening to the light.

There are two sets of analysis questions to use depending on whether this is an introduction or a culminating activity. The light bends because of refraction. Students will come to use this term to explain their observations.

Materials

- pop can
- flashlight
- duct tape
- nailwaterbeaker
- can opener

Procedure

Write your own answer to the question with this activity before you begin. Make sure you explain your thoughts.

With a can opener, remove the top of the pop can which has the opening. Clean the can.

Make a small hole in the side of the can near the bottom. Tape it shut.

Fill the can almost to the top with water.

Place the flashlight with the light pointing into the can. You may want to duct tape it in place.

Place the can over the beaker(someone could hold it for you.)

Turn off the room light. Turn on the flashlight.

Hold the can above the beaker. Remove the tape to allow the water to run into the beaker.

Record your observations.

Conclusion

If the activity is an introduction

Are you observations the same or different from your hypothesis. Mention the similarities and differences.

What do you know about how light travels? (Think back to previous activities.)

What did you observe as the water flowed? How does this differ from what you already know about the path of light?

In your group write or create a diagram which you think explains how the light travelled.

As you work through this part of your study on light, watch for examples in life which are similar to what you observed. Keep a list to discuss at the end of this section.

If the activity is a culminating activity

Write a paragraph or two to clearly explain what is happening. Discuss what you wrote as a hypothesis and how your observations were similar and different. Some things to include would be what you know about the way light travels and how you can make light go in different directions. Be sure to mention some of the technical terms we have studied during this study on light.

Properly labelled diagrams may be used to enhance your explanation.

An outline or thought web will help organize your thoughts before you write so you do not ramble.

Extension

Find some examples of how refraction is used in our daily lives. Mention the purpose, how the effect is created and who would use this technique.

A Shadow of Yourself (30 minutes)
Student Notes

Outcomes

Students will be expected to

- identify and describe the following properties of visible light light travels in a straight line (308-8)

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

- a light source such as a large flashlight or overhead projector
- black construction paper
- white paper or newsprint

Procedure

Find a partner for this activity.

Tape a piece of white paper or newspaper to the wall.

One person stands sideways in front of the light source. The shadow created is projected onto the paper.

The partner carefully traces around the shadow to create a silhouette.

Remove the paper from the wall.

Change places and repeat for the other partner.

Carefully cut out the silhouette.

Trace the silhouette onto black paper. Carefully cut out the black paper silhouette keeping all the detail from the shadow. Cut out where the eye would be if you wish.

Mount the finished silhouette on a background paper of your choice.

Extension

Set designers in the theatre use this concept to create backgrounds for sets. Find out how this is done for the theatre and what jobs are involved in using this concept.

A Shadow of Yourself (30 minutes)
Teacher Notes

Outcomes

Students will be expected to

- identify and describe the following properties of visible light light travels in a straight line (308-8)

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

- a light source such as a large flashlight or overhead projector
- black construction paper
- white paper or newsprint

Background

This activity is a good art/science link. It could be used as a wrap-up discussion after using the light in a straight line activity and/or the *Watching Light Travel*

activity in the text. Discussion should involve where the shadow comes from, why it is formed and how the light is travelling to form it.

Procedure

Find a partner for this activity.

Tape a piece of white paper or newspaper to the wall.

One person stands sideways in front of the light source. The shadow created is projected onto the paper.

The partner carefully traces around the shadow to create a silhouette.

Remove the paper from the wall.

Change places and repeat for the other partner.

Carefully cut out the silhouette.

Trace the silhouette onto black paper. Carefully cut out the black paper silhouette keeping all the detail from the shadow. Cut out where the eye would be if you wish.

Mount the finished silhouette on a background paper of your choice.

Extension

Set designers in the theatre use this concept to create backgrounds for sets. Find out how this is done for the theatre and what jobs are involved in using this concept.

Life Science: Cells, Tissues, Organs, and Systems

The Respiratory System is connected to … (45 minutes)

Student Notes

Outcomes

Students will be expected to

- relate the needs and functions of various cells and organs to the needs and functions of the human organism as a whole (304-8)
- describe three examples of the interdependence of various systems of the human body (304-10)
- evaluate individual and group processes used in researching the roles of the main organ systems (211-4)
- explain structural and functional relationships between and among cells, tissues, organs, and systems in the human body (304-7)

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

What systems, in addition to the respiratory system, work together to help you breath? Describe how each of the above systems are interconnected to the respiratory system.

Materials

- The Ultimate Human Body CD
- handout titled "How Other Body Systems Interact with the Respiratory System"

Procedure

Follow the instructions provided on handout titled "How Other Body Systems Interact with the Respiratory System."

To show your understanding of the interrelatedness of the systems of the human body, answer the questions in the space provided on this sheet.

Research the interconnectedness of two systems (for example, muscular/skeletal, respiratory/circulatory, etc.) and report your findings. This report could take the form of written report, computerized slide show, oral presentation, drama production, puppet show, cartoon or some brilliant idea of your own (check with your teacher to make sure it is truly brilliant).

Extension

Build a model of a minimum of three systems to show how they are interrelated. Be prepared to show how the model works and how the systems are related;

or

interview a health professional on how their job relates to the systems of the human body. Be sure to find out what education is needed, what other professions interact with this job and what responsibilities are attached to this job.

The Respiratory System is connected to … (45 minutes)

Teacher Notes

Outcomes

Students will be expected to

- relate the needs and functions of various cells and organs to the needs and functions of the human organism as a whole (304-8)
- describe three examples of the interdependence of various systems of the human body (304-10)
- evaluate individual and group processes used in researching the roles of the main organ systems (211-4)
- explain structural and functional relationships between and among cells, tissues, organs, and systems in the human body (304-7)

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

What systems, in addition to the respiratory system, work together to help you breath? Describe how each of the above systems are interconnected to the respiratory system.

Background

The aim of this station is to use software that supports and enhances the curriculum. Multimedia, such as “The Ultimate Human Body” can be used in a variety of ways:

- as an individual activity at a learning centre.
- as an individual research tool
- as a cooperative study by small groups at a computer
- as a teacher led visual facilitated by a LCD projector

Setting this activity up as a station encourages independent learning and allows students to reinforce concepts used in previous activities.

Before the students take part in the lesson suggested in the accompanying student page the students should have spent some time studying the individual body systems, which can also be supported by the use of the The Ultimate Human Body.

This activity will allow the students to bring together and connect what they already know about individual systems. Its important that students view the body systems as an interconnected whole instead of separate entities.

Materials

- The Ultimate Human Body CD
- handout titled "How Other Body Systems Interact with the Respiratory System"

Procedure

Follow the instructions provided on handout titled "How Other Body Systems Interact with the Respiratory System."

To show your understanding of the interrelatedness of the systems of the human body, answer the questions in the space provided on this sheet.

Research the interconnectedness of two systems (for example, muscular/skeletal, respiratory/circulatory, etc.) and report your findings. This report could take the form of written report, computerized slide show, oral presentation, drama production, puppet show, cartoon or some brilliant idea of your own (check with your teacher to make sure it is truly brilliant).

Extension

Build a model of a minimum of three systems to show how they are interrelated. Be prepared to show how the model works and how the systems are related;

or

interview a health professional on how their job relates to the systems of the human body. Be sure to find out what education is needed, what other professions interact with this job and what responsibilities are attached to this job.

Building a Model of a Cell (2 × 45 minutes)
Student Notes

Outcomes

Students will be expected to

- explain that it is important to use proper terms when comparing plant and animal cells (109-13)
- distinguish between plant and animal cells (304-5)
- work co-operatively with team members to develop and construct models of cells (211-3)

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 model shows understanding of how a cell works connections made between activity and real world show understanding of concept	all parts of level 2 were accomplished connections between activity and real world questions show deep understanding through discussion, examples and/or added details from research model shows extra attention, outside research or details and connections made above and beyond classroom work/discussion

Materials/Apparatus

You can use any materials that you can find at home or in the classroom (read the safety concerns below). The following materials are ones you may chose to use: gelatin, modelling clay, shoe-box, hard candies, marshmallows, pipe-cleaners, empty film canisters, dried pasta, etc.

Safety

Make sure the materials you use are safe and that you have permission to use them.

Procedure

Read and discuss the make-up of plant and animal cells in class.

Think about what materials you might want to use. (If you are building a plant cell, what will you use for the cell wall? What will you use for the nucleus? etc.) Build a 3-D model of a plant or animal cell. Your model should include the following organelles: cell wall (plant cells only), cell membrane, vacuoles, nucleus, cytoplasm, endoplasmic reticulum, mitochondria and chloroplasts (plant cells only). Label the parts of your model.

Present your model to the rest of your class. The date for this presentation will be _____.

Building a Model of a Cell (2 × 45 minutes)
Teacher Notes

Outcomes

Students will be expected to

- explain that it is important to use proper terms when comparing plant and animal cells (109-13)
- distinguish between plant and animal cells (304-5)
- work co-operatively with team members to develop and construct models of cells (211-3)

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 model shows understanding of how a cell works connections made between activity and real world show understanding of concept	all parts of level 2 were accomplished connections between activity and real world questions show deep understanding through discussion, examples and/or added details from research model shows extra attention, outside research or details and connections made above and beyond classroom work/discussion

Materials/Apparatus

You can use any materials that you can find at home or in the classroom (read the safety concerns below). The following materials are ones you may chose to use: gelatin, modelling clay, shoe-box, hard candies, marshmallows, pipe-cleaners, empty film canisters, dried pasta, etc. SafetyMake sure the materials you use are safe and that you have permission to use them.

Background

The emphasis here is hands-on learning to reinforce the function of cell organelles. Students need not memorize the parts of the cell but rather understand the functioning of the cell. Instead of a physical model, students could model the parts by taking on the role of an organelle and presenting a drama production to the class.

Procedure

Read and discuss the make-up of plant and animal cells in class.

Think about what materials you might want to use. (If you are building a plant cell, what will you use for the cell wall? What will you use for the nucleus? etc.) Build a 3-D model of a plant or animal cell. Your model should include the following organelles: cell wall (plant cells only), cell membrane, vacuoles, nucleus, cytoplasm, endoplasmic reticulum, mitochondria and chloroplasts (plant cells only). Label the parts of your model.

Present your model to the rest of your class. The date for this presentation will be _____.

A Cell Factory (45 minutes)
Student Notes

Outcomes

Students will be expected to

- explain that it is important to use proper terms to compare and contrast plant and animal cells (109-13)
- illustrate and explain that the cell is a living system that exhibits the following characteristics of life:
  - growth
  - movement
  - stimulus/response
  - reproduction (304-4)

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 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 connections made between activity and real world show understanding of concept presentation showed practice and 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 presentation was polished, informative, knowledgeable and had shared responsibility

Question

How do the following cell organelles—cell wall, cell membrane, vacuoles, nucleus, cytoplasm, mitochondria and chloroplasts—compare to the parts of a factory?

Procedure

Discuss the functions of cell organelles with the class.

Try to compare the functions of the organelles in the description with the parts of a factory by completing the table below (one is done for you).

Discuss your comparisons with the other members of your group.
After some discussion try to come to a consensus, in your group, and put your groups comparisons on flip chart paper.

Present your comparison to the rest of the class and compare your answers with other groups.

Results

Table 1: A Comparison of a Plant Cell to a Factory

Organelles	**Factory Part**	**Reason**
cell wall		
cell membrane		
vacuole		
nucleus	the boss	both control activities
cytoplasm		
mitochondria		
ER		
chloroplast		

Extension

Create a cartoon to show your understanding of how cell organelles function within a cell. Your cartoon should show comparison between cell organelles and a

factory, a car, a household or some other item in our lives which requires parts to do a specific job to make the whole item function.

A Cell Factory (45 minutes)
Teacher Notes

Outcomes

Students will be expected to

- explain that it is important to use proper terms to compare and contrast plant and animal cells (109-13)
- illustrate and explain that the cell is a living system that exhibits the following characteristics of life:
  - growth
  - movement
  - stimulus/response
  - reproduction (304-4)

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 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 connections made between activity and real world show understanding of concept presentation showed practice and 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 presentation was polished, informative, knowledgeable and had shared responsibility

Question

How do the following cell organelles—cell wall, cell membrane, vacuoles, nucleus, cytoplasm, mitochondria and chloroplasts—compare to the parts of a factory?

Background

If the concept of a factory is foreign to students, find an example of a unit whose specialized functions contribute to the functioning of the whole unit. Possible examples could be a family, an automobile, a hospital, a computer, etc.

Procedure

Discuss the functions of cell organelles with the class.

Try to compare the functions of the organelles in the description with the parts of a factory by completing the table below (one is done for you).

Discuss your comparisons with the other members of your group.

After some discussion try to come to a consensus, in your group, and put your groups comparisons on flip chart paper.

Present your comparison to the rest of the class and compare your answers with other groups.

Results

Table 1: A Comparison of a Plant Cell to a Factory

Organelles	**Factory Part**	**Reason**
cell wall		
cell membrane		
vacuole		
nucleus	the boss	both control activities
cytoplasm		
mitochondria		
ER		
chloroplast		

Extension

Create a cartoon to show your understanding of how cell organelles function within a cell. Your cartoon should show comparison between cell organelles and a factory, a car, a household or some other item in our lives which requires parts to do a specific job to make the whole item function.

You Decide (2–3 classes)
Teacher Notes

Outcomes

Students will be expected to

- make informed decisions about applications of science and technology that are associated with human body systems, taking into account personal and social advantages and disadvantages (113-8)
- describe the science underlying various technologies used to assist or replace unhealthy organs or systems (111-5)
- provide examples of careers that are associated with the health of body systems (112-10)

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
computer 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 does the medical community decide who qualifies for a transplanted organ(s)?

Background

Some discussion will be necessary about technologies already available and a bit of the science behind them. See the Science Curriculum Guide, p. 64 for some devices to consider.
If additional research is done on the internet, care should be taken when searching. It is recommended that the teacher preview some useful sites so students are searching in a safe and educationally valuable area.

Procedure

As a group, discuss the categories to be considered when making this decision. Decide which categories should be considered by the medical team when making this decision.

Find out what alternative medical interventions are available (other than transplant).

Read the attached scenario of two transplant candidates.

As a group discuss which candidate will get the transplant. Why?

Present your reasons on chart paper to be presented to the hospital administrator about your decision.

Analysis

What issues arose as your group decided on how to make the decision?

What further information did your group feel it needed if the decision was to made justly?

Were there alternative medical interventions which were acceptable for either candidate? Explain fully.

How did your group feel about the candidate who did not receive the transplant? Include some people's comments in your discussion as well as how you felt personally?

Why, in Canada, do we not have enough organs to be transplanted? How does one become an organ donor?

Is being an organ donor something that you would consider? Explain your reasons.

What careers and occupations would people have in this activity? Be as thorough as you can in your list. Are there any careers which appeal to you in this list? Why or why not?

Decisions, Decisions

It's difficult to decide who should and who should not receive an organ transplant. Technology has created a problem that did not exist twenty years ago and hopefully will not exist twenty years from now. Currently society is forced to deal with the reality that people will die because there are not enough organs to save everyone. The scarcity of organs for transplant make them a valuable and precious item. No one wants to waste them on a candidate that will not "benefit." The problem lies in determining what constitutes a "benefit" to the patient. It's difficult to define benefit because practically every patient will benefit from the transplant. Without the transplant the patient is dead and anything is an improvement over death. So, how does society or the allocation committee decide who's benefit is the greatest? It is nearly impossible to assess a person's life and its value in such a way.

Step # 1

Issues the group must decide are important (or not) are:

- ability to pay for medication
- social worth (how person has behaved in society)
- wishes of the patient
- medical need
- duration of benefit
- change in quality of life
- amount of organs needed

Your group must decide how many of these criteria will be considered in the decision making process.

Step # 2

Candidate #1: Terri Adams

Terri Adams is 57 years old. She has four children ages 35, 34, 32, and 29. She has been happily married for the last 37 years. The cause of her kidney disorder is unknown. Terri has been on the waiting list for a kidney transplant for the last

year and a half. She is expected to live another six years if she receives the transplant. Terri's lifestyle will most likely have to be altered after the transplant.

She will be unable to carry out daily living activities. She will have to quit her job at a local store and she will also have to stop volunteering at the children's hospital. Terri does not have insurance and is unsure how she will pay the drugs she will need after the transplant. It is also thought that Terri will need a liver transplant in the next three or four years. Her family support system is excellent. Her husband, children, and extended family are all pulling for her. They want her to beat the odds. Terri has stated that she does not want to burden her family economically or physically. She wants to do what is best for everyone.

Candidate #2: Casey Smith
Casey Smith is 49 years old. She has two children ages 25 and 27. She is recently divorced. Casey was an alcoholic for twenty years and has recently joined an alcoholics recovery group. She has been sober for the last year. Her kidney disorder is most likely a result of her alcoholism. She has been on the waiting list for a liver for the past two years. She will die in six months without the transplant. Casey is expected to live for another four years if she does receive the kidney.

Her lifestyle should be virtually unaltered after the transplant. Casey will be able to continue normal daily activities such as working. She has very little family support as a result of her alcoholism. Casey has health care insurance and it will cover all the costs of the transplant. Casey has stated that she wants to live no matter what the cost so she can become close to her family again. She says she's wasted so much of her life and she only needs one more chance to make things right.

The time has come...who will live and who will die?

Classification	**Terri Adams**	**Casey Smith**
Medical Criteria		
Meets All Requirements		Meets All Requirements
Duration of Benefit		4 years6 years
Change in Quality of Life		
Normal Functioning		
Altered Functioning		
Urgency of Need		
Will die in 6 months		Will die in 6 months
Amount of Resources		Required only a liver a liver and possibly a kidney
Ability to Pay Insurance		

No Insurance		
Social Worth	No Family or	
Family and Community		
Community Interaction	Interaction Perceived	
Obstacles to Treatment		
No Family Support	None	
Patient's Contribution		
Alcoholism	None	
to the Disease		
Patient's Wishes	Wants to live	Does not want to be a
whatever the cost burden		

A person should be evaluated according to their functional status. Once the patient has been evaluated, there should be a meeting with the patient, their family, and the patient's physician to determine if the transplant is worth the wait. The meeting will evaluate if the patient can accept the post transplant hardships, whether the hardships be economic, social, or functional.

At this point the patient should be placed on a waiting list. Once on the list there are no further subjective evaluations. The patient just must wait their turn.

The Heart of the Matter (Heart Rate Probes) (45 minutes)

Student Notes

Outcomes

Students will be expected to

- rephrase questions into testable form about the factors that affect physical fitness and health (208-1)
- design and carry out an experiment to compare and contrast heart rate in an individual during various levels of activity and identify and control the major variables (208-6, 209-1)
- explain variations in the heart rate and breathing rate in an individual during various levels of activity when the experiment is repeated (210-7)

Questions

How might you rephrase the following question into a testable form: "How does exercise affect heart rate?"

What happens to your heart rate after you have performed physical activity?

Materials/Apparatus

- stop watch
- an interface
- heart rate probes and probe software

Safety

Be aware of any medical conditions which would affect the your ability to perform physical activity as required.

Take the same precautions around the probes and interface as they do around computers (i.e. keep food and drinks away from the computer area)

Procedure

In pairs design an activity where you could compare your heart rate at rest and after exercise. A well-designed experiment asks a question in wording that can be tested. Make sure you identify the variables (controlled, manipulated and responding) which are part of your experiment.

Carry out your experiment. Answer the analysis questions to show your understanding.

Analysis

What variables needed to be considered when testing heart rate at rest and after exercise?

Is there any part of your experiment which needs to be changed? Explain.

Compare your heart rate at rest and after exercise.

Compare your breathing rate at rest and after exercise. What two body systems have you compared in answering the questions above? How are they connected to each other (what roles do they play)?

What other body systems were involved in your experiment? How are they connected?

Extension

After rephrasing question(s) into a testable form, design your own experiment to compare and contrast the heart rate of an individual during various levels of activity. Identify the variables which should be controlled: such as the way you will measure heart rate, the type and length of activity, etc.

The Heart of the Matter (Heart Rate Probes) (45 minutes)

Teacher Notes

Outcomes

Students will be expected to

- rephrase questions into testable form about the factors that affect physical fitness and health (208-1)
- design and carry out an experiment to compare and contrast heart rate in an individual during various levels of activity and identify and control the major variables (208-6, 209-1)
- explain variations in the heart rate and breathing rate in an individual during various levels of activity when the experiment is repeated (210-7)

Questions

How might you rephrase the following question into a testable form: "How does exercise affect heart rate?"

What happens to your heart rate after you have performed physical activity?

Background

Students can be exposed to various methods of determining heart rate, such as finding their pulse on their necks and wrist and the use of probes. The idea of a resting heart rate should be discussed and that each individual's resting heart rate will differ. The factors affecting your resting heart rate should be discussed: age, physical fitness, weight, etc.

This activity could begin by having the students find their pulse and then estimating their resting heart rate (i.e. they could count the number of beats for 15 seconds and then multiply this number by 4). Students could then perform some form of physical activity. Immediately following this activity they should measure their pulse rate again.

Students could then perform an inquiry involving heart rate probes that is designed by themselves based on their rephrased questions or an activity such as the one included in Pasco Scientific "Middle School Science Lab with Computers Teacher's Guide," activity MSS 15 (Heart Rate) can be used.

Students could use the probe software to analyse their data.

Materials/Apparatus

- stop watch
- an interface
- heart rate probes and probe software

Safety

Be aware of any medical conditions which would affect the your ability to perform physical activity as required.

Take the same precautions around the probes and interface as they do around computers (i.e. keep food and drinks away from the computer area)

Procedure

In pairs design an activity where you could compare your heart rate at rest and after exercise. A well-designed experiment asks a question in wording that can be tested. Make sure you identify the variables (controlled, manipulated and responding) which are part of your experiment.

Carry out your experiment. Answer the analysis questions to show your understanding.

Analysis

What variables needed to be considered when testing heart rate at rest and after exercise?

Is there any part of your experiment which needs to be changed? Explain.

Compare your heart rate at rest and after exercise.

Compare your breathing rate at rest and after exercise. What two body systems have you compared in answering the questions above? How are they connected to each other (what roles do they play)?

What other body systems were involved in your experiment? How are they connected?

Extension

After rephrasing question(s) into a testable form, design your own experiment to compare and contrast the heart rate of an individual during various levels of activity. Identify the variables which should be controlled: such as the way you will measure heart rate, the type and length of activity, etc.

Heart Walk (45 minutes)
Student Notes

Outcomes

Students will be expected to

- explain structural and functional relationships between and among cells, tissues, organs, and systems in the human body (304-7)
- describe examples of the interdependence of various systems of the human body (309-10)

Assessment

Beginning (you need to come for help and try again)	Its OK if you are OK with it	Wow!!
Level 1	Level 2	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 the heart and lungs work within our body?

Materials

- clean floor
- bristol board

- masking tape
- blue, black and red markers
- O2 and CO2 cards
- heart labels

Safety

As you move through the heart walk you must move in an orderly fashion making sure to respect each others space. Only move when you hear your teacher say 'contract' or 'relax.'

Procedure

The teacher must 'keep the beat' by continuing to repeat the phrase 'contract'... 'relax'... 'contract'...

You can start anywhere, however, for ease of explanation we will start in the left lung. Begin by holding a CO_2 card.

Now put down the CO_2 card and pick up an O_2 card (representing the exchange of gases in the lungs).

Leave the lung and follow the red arrows toward the left atrium.

In the left atrium wait for the teacher to say 'relax' and then proceed to enter the left ventricle (you are filling it with blood).

Remain in the left ventricle until the teacher says 'contract'. Then exit through the aorta and follow the red arrows toward the brain cell (representing oxygenated blood being carried to the trillions of cells in the body delivering oxygen, nutrients and water).

When you reach the cell you can enter (this is representing diffusion).

Once inside you should drop off your O_2 card and pick up a CO_2 card (this is representing cellular respiration taking place). Now you can 'diffuse' out of the cell and into the blood.

Follow the blue arrows back to the heart, enter the right atrium and wait for your signal (these blood vessels carry waste products of cellular respiration away from the body cells and back to the heart and then lungs for removal from the body). Upon hearing 'relax' enter the right ventricle (you are now filling it with oxygen poor blood).

Once you hear 'contract' you are pumped out of the heart and towards the lung (following the blue arrows).

When you reach the lung you can put down the CO_2 card and pick up the O_2 card, completing the cycle.

Analysis

Why does the brain cell require O_2 and produce CO_2? (i.e. Why did you drop off a O_2 card and pick up a CO_2 card?)

What process allows you to enter and leave the brain cell?

What important process is occurring at the lungs? (i.e. Why drop off a CO_2 card and pick up a O_2 card?

Explain how the respiratory and circulatory systems work together to get O_2 from the air to the body cells.

During the activity, what changed when the teacher said, "Now our body is going to get on a treadmill and run?" Explain what caused this change.

Heart Walk (45 minutes)
Teacher Notes

Outcomes

Students will be expected to

- explain structural and functional relationships between and among cells, tissues, organs, and systems in the human body (304-7)
- describe examples of the interdependence of various systems of the human body (309-10)

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 dagrams, report show extra attention, outside research or details and connections made above and beyond classroom work/discussion

Question

How do the heart and lungs work within our body?

Background

Rationale: The “Heart Walk” can be one of many strategies used to help students visualize and understand the interrelatedness of the body cells, the respiratory system and the circulatory system. It is a visual and kinesthetic instructional tool.

Materials

- clean floor
- bristol board
- masking tape
- blue, black and red markers
- O2 and CO2 cards
- heart labels

Procedure

The following signs must be made out of bristol board:

- Right Atrium - Brain Cell
- Right Ventricle - Left Lung
- Left Atrium - O_2 cards (20)
- Left Ventricle - CO_2 cards (20)

Approximately one hour is needed to set up the "Heart walk" on the classroom floor.

Move the tables out of the way and sweep the floor.

Using masking tape, create the model of the heart on the floor as shown in the accompanying diagram. The heart should be approximately 4 metres long.

Draw an outline on the floor with the masking tape to represent a brain cell.

Turn a table upside down, on the right side of the room, to represent the lung.

Colour the outline of the heart and cell in marker.

Arrows can also be made with masking tape and should be coloured red and blue.

Lay down the signs in the appropriate places (see accompanying diagram).

Directions

There are many ways to proceed. One suggestion would be to walk through the system once while you are explaining the processes talking place. After this you could have a few students at a time slowly walk through the system and describe what is taking place. If the students are cooperating you may try to have as many as 20 students travelling through the system. The teacher will control the flow of the students by saying the words 'contract'... 'relax'... 'contract', etc.

(Note: The teacher must 'keep the beat' by continuing to repeat the phrase 'contract'... 'relax'... 'contract'...)

The student (or teacher) can start anywhere, however, for ease of explanation we will start in the left lung. The student should begin by holding a CO_2 card.

In the lung the student places the CO_2 card down and picks up an O_2 card (representing the exchange of gases in the lungs).

The student leaves the lung as oxygenated blood and travels toward the left atrium (following the red arrows).

In the left atrium the student waits for the teacher to say 'relax' and then proceeds to enter the left ventricle filling it with blood.

The student remains until the teacher says 'contract'. He/she exits through the aorta and follow the red arrows toward the brain cell (representing oxygenated blood being carried to the trillions of cells in the body delivering oxygen, nutrients and water).
Once at the cell the student 'diffuses' in (cellular respiration can now take place). The student puts down the O_2 card and picks up the CO_2 card as they 'diffuse' out of the cell and into the blood (these blood vessels carry waste products of cellular respiration away from the body cells and back to the heart and then lungs for removal from the body).

The student then follows the blue arrows back to the heart, enters the right atrium and waits.

Upon hearing 'relax' he/she enters the right ventricle (filling it with oxygen poor blood).

Once they hear 'contract' they are pumped out of the heart and towards the lungs (following the blue arrows).

Once the student reaches the lungs they again put down the CO_2 card and pick up the O_2 card, completing the cycle.

Analysis

Why does the brain cell require O_2 and produce CO_2? (i.e. Why did you drop off a O_2 card and pick up a CO_2 card?)

What process allows you to enter and leave the brain cell?

What important process is occurring at the lungs?(i.e. Why drop off a CO_2 card and pick up a O_2 card?

Explain how the respiratory and circulatory systems work together to get O_2 from the air to the body cells.

During the activity, what changed when the teacher said "Now our body is going to get on a treadmill and run" Explain what caused this change.

It's a Small World (3–5 days)
Student Notes

Outcomes

Students will be expected to

- use a light microscope or micro viewer correctly to produce a clear image of cells (209-3)
- explain the structural and functional relationships between and among cells, tissues, organs and systems in the human body (304-7)
- distinguish between plant and animal cells (304-5)
- explain that it is important to use proper terms when comparing plant and animal cells (109-13)

Questions

Do I know how to properly handle and care for a microscope?

What is the difference between a microscope slide and a micro viewer slide?

Are all body cells the same size and shape? Why do you think this is the case?

Materials/Apparatus

- prepared slides of plant and animal cells
- microscope
- micro viewer slides of plant and animal cells
- micro viewers
- pond water sample (optional)

Procedure

Students can work through this guided activity on the microscope independently if the activities are set up as stations. The emphasis on this series of activities should be on the care and handling of the microscope, how to use the microscope to investigate, how to calculate magnification and the difference between plant and animal cells. Although some activities walk through the parts of the microscope, the purpose is to become familiar with terms not to memorize the parts of the microscope.

To manage assessment and evaluation, students should submit to the teacher an activity as it is completed.

Microscope Extravaganza

You are about to embark on a tour of microscopes. Some of this will be review; some will be newly acquired skills. The tour is designed so you can move at your own pace. Be careful to use your time wisely; there is a deadline to be observed. Each part of the extravaganza has a rubric so you know what is expected of you. Read these carefully as you begin so you do not disappoint yourself when evaluation time comes.

Some parts of these activities can be completed at home so if you get behind during class, take advantage of this extra learning time. Ready? Off we go!

Task I—A Self-guided Review of the Microscope

In this part of the tour, you need a microscope, a booklet, a piece of loose-leaf, a pencil and two brains—yours and one other (find a partner who has one).

The answers are in the booklet so you can check your work when you are finished. In order to review and/or learn, you must cover the answers to begin with. There is nothing to be learned from copying the answers. Please use the two brains present to get as much out of this exercise as possible. Of course, there may be some things both brains have forgotten.

This is to be expected; not to worry—perfection won't happen until November! DO NOT WRITE ON THE BOOKLET ITSELF. USE YOUR LOOSELEAF.

Checklist of tasks:

- Gather supplies mentioned above.
- Read first pages of booklet with review notes.
- Fold loose-leaf in half lengthwise; cover answer side of booklet.
- Answer as many questions as you and your partner can (don't worry about correctness; try as many as you can).
- Put an asterisk on any answer line that the two of you must leave blank.
- When a page is finished, remove loose-leaf from answers; check them; place any corrected answers in brackets on the answer line; proceed to the next page.
- When you have finished completely and corrected it, return the booklet, hand in your corrected looseleaf. Go on to next task.

Evaluation Rubric

Beginning (you need to come for help and try again)	Its OK if you are OK with it	Wow!!
incomplete uncorrected little evidence of effort	most answers tried missing/incorrect answers have been corrected some evidence that you were learning skills	most answers completed all missing/incorrect answers have been corrected obvious effort to teach yourself about the microscope blue/black pen used for written answers

Task II—Slide Activity

Checklist of tasks:

- Obtain two different slides (one from each group), a worksheet, a microscope.
- Carefully read and follow directions on sheet; read the evaluation rubric so you know what is expected.
- Carefully observe/sketch each different slide at low and high power; include calculation of magnifications.
- Hand in completed worksheet. Go on to next task.

Evaluation Rubric

Beginning (you need to come for help and try again)	Its OK if you are OK with it	Wow!!
worksheet incomplete little evidence of care or learning	worksheet complete magnification recorded sketches show some detail sketches done in pencil	worksheet complete magnification calculations included sketches show care, detail pencil used for sketches slide sketches titled effort has been made to be neat, complete, detailed

Task III—Review Worksheet

- This worksheet may be completed at home if you are getting behind in class.

- Get review sheet of parts of the microscope and how to calculate magnification
- Complete both sides of the worksheet.
- Hand in completed worksheet. Go on to next task.

Evaluation Rubric

Beginning (you need to come for help and try again)	Its OK if you are OK with it	Wow!!
worksheet is incomplete	all parts of worksheet completed labels neatly printed in pencil sketches done neatly in pencil	all parts of worksheet completed labels neatly printed in pencil obvious effort, care, detail present on the worksheet

Task IV—Using the Compound Microscope Worksheet

- Some of this worksheet can be completed at home. Work efficiently in the classroom to complete the parts which need the microscopes. You may use home time to catch up on the other parts of this work sheet.
- Checklist of tasks:
- Obtain worksheet, microscope, slide, coverslip and other supplies required by the worksheet.
- Carefully read the worksheet to learn what to do; read the evaluation rubric so you know what is expected of you.
- Work carefully through the worksheet, answering the questions as you go.
- Hand in completed worksheet. Go on to next task.

Evaluation Rubric

Beginning (you need to come for help and try again)	Its OK if you are OK with it	Wow!!
worksheet incomplete little evidence of effort	worksheet complete sketches neatly done in pencil effort to learn; care in answers evident	worksheet complete sketches neatly done in pencil questions answered in complete sentences blue/black pen used for written answers care, detail obvious in answers, sketches effort to learn; care in answers evident

Task V—A Puzzling Conclusion

Checklist of tasks:

- On the Internet, go to the puzzlemaker.com site.
- Choose one of the seven word puzzles to create a puzzle about the microscope to show what you now know about the microscope. Include a minimum of 10 items.
- When your puzzle is completed and checked, ask permission to print two copies.
- Use one copy to create a solution key to your puzzle; give the other puzzle to someone else in your class to solve.
- Write on your solution copy, who you gave the puzzle to. Correct the puzzle for them when they are finished.
- Get a puzzle from someone else in the class to solve. Have it corrected by the creator(s).
- Hand in your own solution key and the corrected puzzle you solved.

Evaluation Rubric

Beginning (you need to come for help and try again)	Its OK if you are OK with it	Wow!!
puzzle you created has errors puzzle you created has no solution key puzzle you created has less than 10 items you did not do someone else's puzzle	puzzle is error free only one print used solution key is complete and correct minimum 10 items present other person's puzzle solved	puzzle is error free only one print used solution key is complete and correct minimum 10 items present other person's puzzle solved more than minimum items present extra effort, creativity involved in creation of puzzle

Body Work (30 minutes)
Student Notes

Outcomes

Students will be expected to

- provide examples of careers that are associated with the health of body systems (112-10)

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

What careers/professions/occupations are associated with the health systems of the body?

Materials

- the names of 50 careers printed on cards
- flip chart paper
- markers

Procedure

Each member of the group will receive cards with the names of 12 or 13 careers (the group will receive 50 careers in total).

Your job will be to go through the cards and decide careers deal with the health of body systems.

After each member of the group goes through the cards have been assigned, the group will discuss their individual decisions.

One member of the group will then list the careers they (the entire group) feel deal with the health of body systems on flip chart paper.

Transfer these careers into the blanks below.

As a class we will discuss each group's choices.

To show your own understanding of this activity, answer the analysis questions.

Analysis

Name at least three occupations where a connection to body systems was easy to make. Why are these jobs be easy to identify with health?

Name at least two jobs where the connection to health of body systems was more difficult to make. Describe the difficulties and why they would exist.

Name at least one surprise occupation (one where you did not know there was a health connection). Describe the job, what education you need and why the connection was surprising to you.

Of all the careers in the game which were connected to the health of body systems, which do you find interesting? Why? Are there any you might like to study further later on in your educational career?

Extension

Use the [career book] to investigate a career which is associated with the health of body systems in more depth. Prepare a presentation or a report on what the responsibilities are, what education is needed, salary, job openings and whether this career could be pursued in Nova Scotia;

or

interview a person from one of the occupations related to health you discussed in class. Find out how they got the job, how long they have been doing it, the responsibilities of the job, how they enjoy it, how long they think they will be in this occupation, any other interesting facts you can think of.

We Have a System (45 minutes)
Teacher Notes

Outcomes

Students will be expected to

- describe the basic factors that affect the functions and efficiency of the human respiratory, circulatory, digestive, excretory and nervous systems (304-9)
- compare the early idea that living organisms were made of air, fire, and water with the modern cell theory (110-2)
- illustrate examples of conflicting evidence relate to how we should maintain and/or treat body systems (110-5)

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 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 illustrate how a system of the body works?

Can I describe how to care for a chosen body system?

Background

Students need previous information to build their system. This activity could be used as an independent learning activity or as a cumulative or assessment activity. If clear plastic painter sheet and a standard body shape is used for each group, the systems can be stacked together to produce a visual of the interaction of the systems. Pinning the systems to a clothes hanger will allow for a vertical visual.

Research and discussion about original beliefs of the workings of the body (110-2) and the continuing conflicting information we receive about how to care for our body systems today (110-5) help students think critically about conflicting information and strengthen their ability to discern good science from 'hype.'

To create the collection of items to build the systems, a box could be created where students contributed recyclables from home.

Dividing the class into five groups will create five different systems.

Materials

- a collection of recyclables, fabric, crafts supplies, for example: paper rolls, plastic bottles, film canisters, fun foam, yarn, etc.
- roll of newsprint or plastic painter sheet
- scissors

Procedure

As a group, choose from the following systems: respiratory, circulatory, digestive, excretory or nervous.

Trace a body shape on a piece of newsprint or clear plastic.

Decide what items from the supply box would be useful to create your system.

Prepare an oral presentation where group members tell how your chosen system works. In addition to the function, the group must be able to tell how to care for your chosen system. Include in your care instructions some conflicting medical opinions on how the system should be cared for.