Science.gc.ca Activity Book 3

Canada

Welcome to the THIRD Science.gc.ca Activity Book!

Games, experiments, and activities galore! That's what you'll find in the third edition of the Science.gc.ca Activity Book.

Science.gc.ca is the official Government of Canada website for Science and Technology (S&T) information and resources. Our site includes cool features such as: Ask a Scientist, where you can ask all your scientific questions to real scientists, Videos, Flash Games, and Educational Resources.

We have put together this Activity Book to stir your inner scientist. Whether you are in Elementary, Intermediate or High School there are activities for all ages and skill levels. These activities can be done individually or with friends in class, at camp, at home or with your Girl Guides or Scout clubs.

Download the book at Science.gc.ca to get started! Learn how to build a Simulated Martian Greenhouse or decode the Mystery Phrase. Find this and MUCH more in the Third Edition of the Science.gc.ca Activity Book.

Science.gc.ca would like to thank our funding partners for their ongoing participation and support:

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Sincerely,
The Science.gc.ca Team

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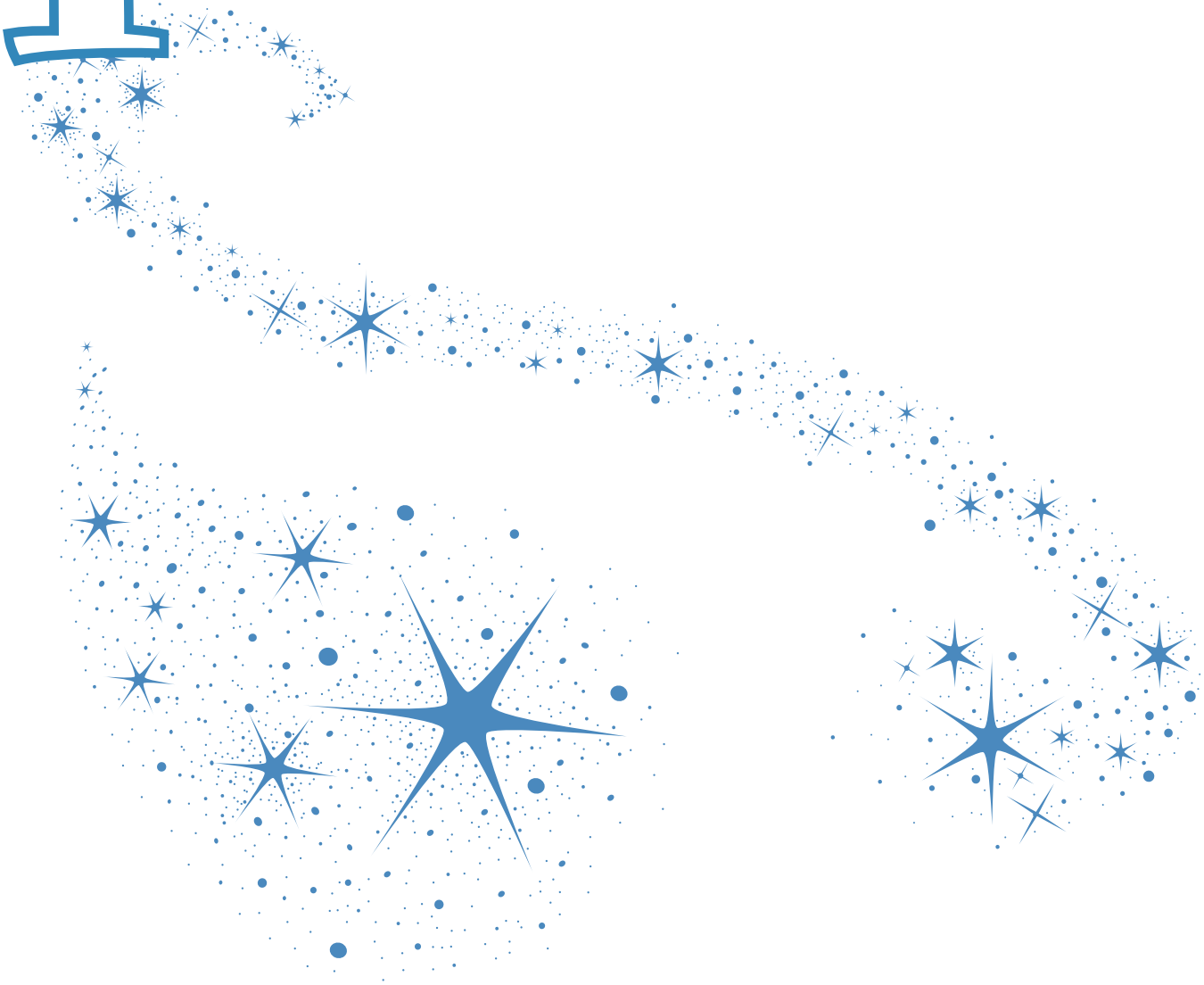
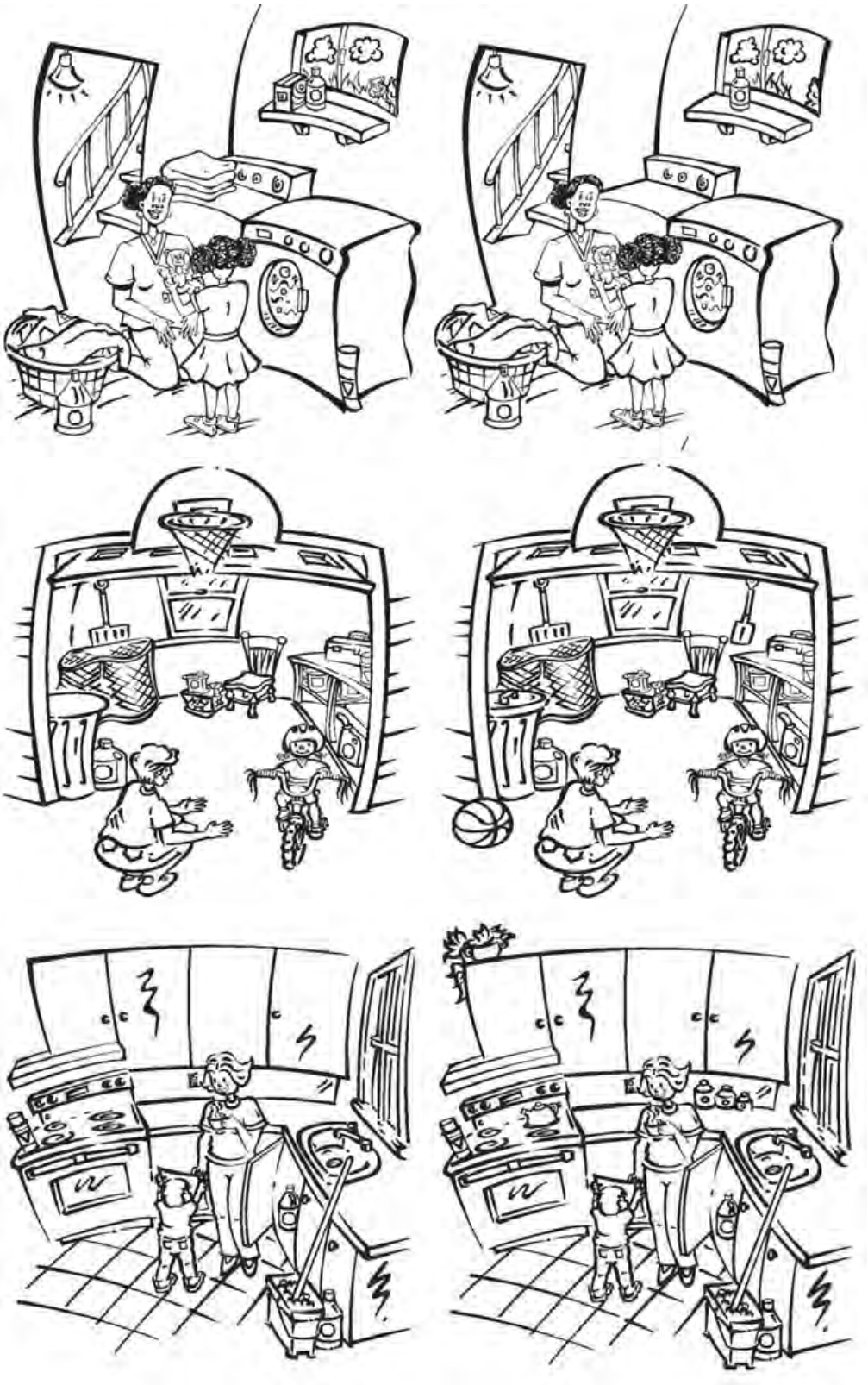
1 Elementary Level

The activities in this section are applicable for individuals aged 5-10.

Please note that some of the activities in this section may require adult supervision and assistance.



1 Spot the difference



2 Environmental Word Search

E	C	O	S	Y	S	T	E	M	X	I	H	M	T	D	L
N	W	T	O	L	P	Q	W	A	C	T	Y	N	X	B	A
E	D	U	C	A	T	E	M	S	R	E	D	U	C	E	M
R	F	V	H	P	L	G	T	A	Y	D	N	O	R	H	A
G	M	I	A	W	A	R	E	N	E	S	S	X	E	A	G
Y	B	R	N	F	U	E	F	A	I	U	D	U	U	P	F
S	F	O	G	N	T	E	B	C	O	M	P	O	S	T	A
O	P	R	E	V	E	N	T	D	E	H	A	C	E	P	H
I	M	N	O	R	C	N	R	E	C	Y	C	L	E	O	C
L	Z	E	B	C	N	A	O	V	O	U	N	E	H	L	I
V	I	M	D	U	Z	I	B	H	S	C	E	A	T	L	N
X	I	T	N	A	R	X	A	C	T	I	O	N	A	U	Y
A	L	P	H	D	A	T	N	W	S	L	G	Q	V	T	O
Z	V	N	E	G	C	W	A	N	O	N	T	O	X	I	C
C	O	N	S	E	R	V	A	T	I	O	N	S	B	O	D
N	E	O	M	T	X	G	I	O	P	Q	U	P	O	N	X

Circle the Word

Circle all the words listed below in the puzzle.

Look carefully as some words can overlap and run in any direction.

action	conservation	~~green~~	recycle
awareness	earth	nonhazardous	reduce
change	ecosystem	nontoxic	reuse
clean	educate	pollution	
compost	energy	prevent	

3 Recycling Maze

Help Steve, the student recycle the cans on his way to school.

Find a path which enters the maze and goes through all the cans an recycling boxes, without using any part of the path more than once. He must collect two cans before going to each recycling box.

4 Print a Fish!

This activity comes from an ancient Japanese tradition called gyotaku (pronounced ghio-ta-koo). In Japanese, the word gyo means fish and the word taku means rubbing. This rubbing or printing technique is still used in Japan for fishers to record their catches.

This technique has evolved over time and is now recognized as an art form throughout the world. You will create a beautiful fish print that you can display in your room or classroom.

You may want to try using different types of paper for this activity. Thinner paper (tissue paper, rice paper) will show more details of your fish, but they tend to wrinkle much more easily when wet. Thicker paper (construction paper) is easier to handle, but will not allow for a detailed fish print.

You may need to practice this activity several times to get the technique down. Be patient and you will discover that the more you practice, the more detailed your fish prints will become.

Things You'll Need:

- 1 whole fish (you can buy your fish from the fish department of a grocery store)
- newspaper
- paper towels
- newsprint (check out an art store or hobby store)
- water-soluable paint (liquid tempera paint or artist's acrylic paint)
- paint brush
- masking tape

Let's Get Started:

1. Wash the fish with soap and water.
2. Lay the fish on a sheet of newspaper. Paint one side of the fish with the paint (any color will do, although blue works great!). If you need to, you can thin your paint with some water. Stroke the fish from tail to head (the ink will catch under the scales and spines and will improve the print, especially if you use a thin coat of paint).
3. Paint the fins and tail last, since they tend to dry out quickly. Do not paint the eye.
4. If the newspaper under your fish becomes wet while you're painting, move the fish to a clean sheet of newspaper before printing. If you don't your print will pick up leftover splotches of color.
5. Carefully and slowly lay a sheet of newsprint over the fish. Taking care not to move the paper, use your hands and fingers to gently press the paper over the. Press the paper gently over the fins and tail. Be careful not to wrinkle the paper or you will get a blurred or double image.
6. Slowly and carefully peel the paper off. Paint the eye with a small brush. Tape the print to a wall and allow to dry.
7. Be sure to wash your hands thoroughly when your are done with warm water and soap.

5 Whale of a Mobile!

Making a whale mobile is a fun way to celebrate Oceans Day. The steps below tell you how to make paper whales using the Japanese art of paper folding, origami. Since whales live in groups, make lots to keep the first one company. Then attach the whales to two sticks to make a mobile. Hang it up to show your friends!

You'll need:

- square sheets of paper
- scissors
- a black marker
- thread
- two straight sticks (about 30 cm. long)
- two pieces of string (about 30 cm. long)

Getting Started:

1. Fold a square of paper in half to form a triangle. Unfold.
2. Fold again so that one side of each triangle rests along the centre line, creating a long point.
3. Fold the tip of the short point down to meet the other tips.
4. Fold in half again along the original centre fold so that the loose edges are on the inside.
5. With the paper as shown, fold the upper corners to the inside and the tail diagonally upward.
6. Using scissors, cut a slit in the tail halfway down and fold each piece to the outside. Add eyes and a mouth with a black marker.
7. Poke a small hole in the top of the whale. Put a long piece of thread through the hole and tie a knot.
8. With a piece of string, tie two sticks together to form a cross. Then tie the whale to the mobile. Be sure to space out the other whales so the mobile will be balanced. Finally, use another piece of string to hang your mobile up. A masterpiece!

6 See The Sea Shrimp!

Things You'll Need:

- brine shrimp eggs (available from any pet store)
- noniodized or kosher salt (available at most grocery stores) 2
- litre pot or large bowl
- water
- teaspoon
- medicine dropper
- magnifying glass a
- ged tap water (see below)

Let's Get Started:

1. Fill the pot with water and allow it to sit for 3 days, stirring it occasionally.(Most city water has chlorine in it, which will kill the shrimp. By letting it "age" for several days the chlorine gas can escape from the water).
2. Mix 5 teaspoons of noniodized salt with the water until dissolved.
3. Add ½ teaspoon of brine shrimp eggs to the salt water and place the pot in a warm spot.
4. Use the medicine dropper to remove some eggs from the water and observe them with your magnifying glass. Check a drop of water everyday. You may wish to create a series of drawings or illustrations to record the growth of your brine shrimp.

What happens:

The brine shrimp eggs will begin to hatch in about 2 days. They will continue to grow in the water until they reach their adult stage. You will be able to watch this growth period over several days.

Brine Shrimp eggs that are purchased at a pet store are the fertilized eggs of very tiny animals called brine shrimp. The eggs you purchase are dried and can be kept for a very long periods of time. When they are added to the salt water, the eggs "wake up" and begin to grow. Brine shrimp eggs are sold as fish food for aquariums.

7 Jet Boat!

Some sailors just don't have the time or patience to let their crafts drift on the gentle breezes. For these captains, there is the balloon-powered jet boat, perfect for racing in pools, ponds or bathtubs. To make one, you'll need a ½-inch diameter plastic pipe elbow (ask at your local hardware store), two 5-1/2 by 8-inch Styrofoam food trays, a balloon and a rubber band.

Directions:

Thread the nut on the plastic pipe elbow, cut a hole in the bottom of one of the trays, and push through the elbow's non-threaded end. Stretch the balloon over the threaded end. Secure the elbow underneath the tray with the rubber band, wrapping it around several times. Cut a rudder from the second tray, and insert it through a slit cut in the stern of the boat. To operate your vessel, inflate the balloon by blowing into the elbow. Block the end of the pipe elbow with your finger as you set the boat in the water, then release it and watch the boat zip away!

8 I Haven't the Foggiest Idea!

Fog is related to oceans? In what way? Quite simply, fog is made from water. Check it out:

Fog in a Bottle

It's so easy …

1. Fill a large jar or wide-mouthed bottle to the top with hot water (you may want to get a parent or teacher to help you with this part).
2. Pour most of the water out, except for an inch (25mm) or so on the bottom.
3. Set a strainer over the mouth of the jar, and put ice cubes in the strainer.

Before long, the cold air from the ice cubes will cause the water to condense from the warm, moist air in the bottle forming … you guessed it … fog!

9 Definition Match and Symbol Identification

Definition Match

Draw a line from the word to its meaning.

1. Flammable	Licking, eating, drinking, or sometimes smelling this product can cause illness or death.
2. Corrosive	These "super glues" can glue skin with skin.
3. Poison	This product, or its fumes can catch fire easily if it is near heat, flame or sparks.
4. Explosive	This container can explode if it is heated or punctured
5. Quick skin-bonding adhesive	This product can burn skin or eyes, or throat and stomach, if you drink it.

Symbol Identification

10 Jumble Words

Unscramble the following words and, using the highlighted letters, find the **secret word!**

1. Y G R E N C L C I

2. I T A N - G D L N I I

3. G G T H I L I N

4. M S T C O P O

5. R O T H S E T M T A

6. R U N T F O F

7. Y E R E G N

Secret word: _ _ _ _ _ _ _ _ _ _

11 Find them

In this picture, there are four "energy wasters" and three "energy savers." Can you FIND THEM?

12 Crossword

Word Search

F	A	R	M	B	A	E	N	V	F
L	P	F	F	A	T	N	U	E	O
A	R	R	N	G	G	E	T	G	O
W	O	U	M	E	R	R	R	E	D
A	T	I	E	R	A	G	I	T	P
S	E	T	A	M	I	Y	E	A	L
H	I	C	T	S	N	E	N	B	A
D	N	D	A	I	R	Y	T	L	N
V	I	T	A	M	I	N	D	E	T
E	A	T	I	A	N	I	M	A	L
B	A	C	T	E	R	I	A	E	T

The words listed below are hidden in the word search puzzle. Some are written across and some are written down. Can you find them all?

- ANIMAL
- BACTERIA
- EAT
- ENERGY
- FARM
- FAT
- FOOD
- FRUIT
- GERMS
- GRAIN
- MEAT
- NUTRIENT
- PLANT
- PROTEIN
- VEGETABLE
- VITAMIN
- WASH

Use the remaining letters to complete the sentence below:

I must eat a _____ _____ to be healthy.

13 Mystery Phrase!

How to play:

In the following table, each symbol represents two letters. Use this code to find the mystery phrase!

?	&	!	%	&		!	!					
%	!	%	%	&	£							
#	@	!	?	%	%	+	!	&	+	@	!	
#	%	@	&	%	!	¥		+	!			
£	@	*	%		?	#	*	@	@	£		

!	@	#	$	%	?	&	*	+	=	¿	£	¥
A	B	C	D	E	F	G	H	I	J	K	L	M
N	O	P	Q	R	S	T	U	V	W	X	Y	Z

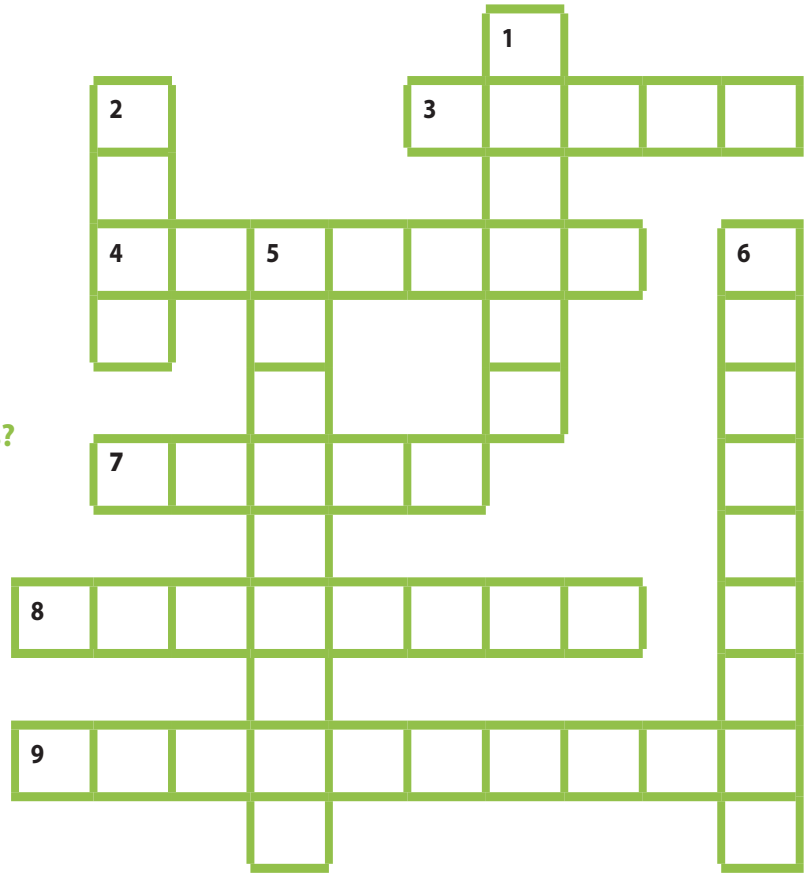
14 Find the Meaning!

How to play:

We've chosen some picture for you.

What do you think each one represents?

Answer by filling in the grid.



Down:

2. 

1. 

6. 

5. 

Across:

4. 

3. 

7. 

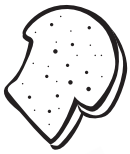
8. 

9. 

15 Plant or Animal?

Is it a plant or an animal?

If the food product comes from a plant, draw a line to the tomato plant. If the food product comes from an animal, draw a line to the cow.


bread slice


egg

tofu


milk


eggplant


asparagus

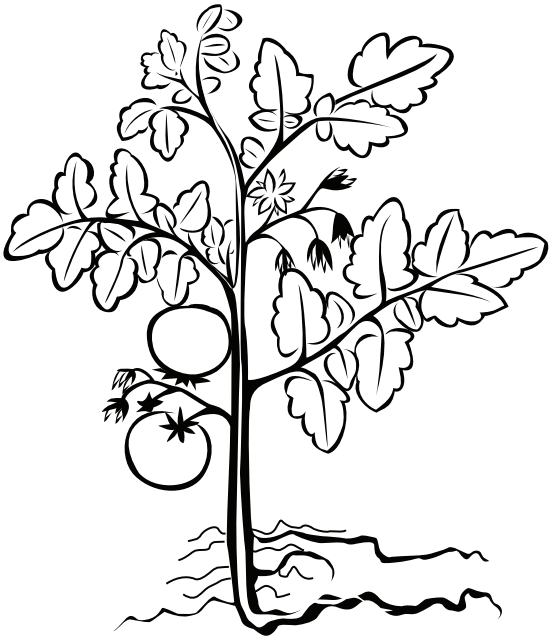

corn


rice


pita


chicken

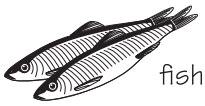

animal


plant

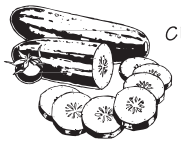

beans

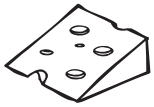

peanut


steak


fish


apple


cucumber


cheese


potato


broccoli


shrimp

16 Word Scrambles

Easy

HSFI _____

ASLE _____

ELE _____

RABC _____

NDAS _____

ISDUQ _____

ENCAO _____

Medium

LMCA _____

LEPK _____

ONOL _____

FERE _____

LGLU _____

CORA _____

TOBA _____

NUTA _____

RHKAS _____

INLAS _____

ETROT _____

HEWLA _____

RCALO _____

CBAHE _____

BCASU _____

GEALA _____

HARD

LTREUT _____

RLASUW _____

IRMNAL _____

SMEULS _____

NALSOM _____

HPLINOD _____

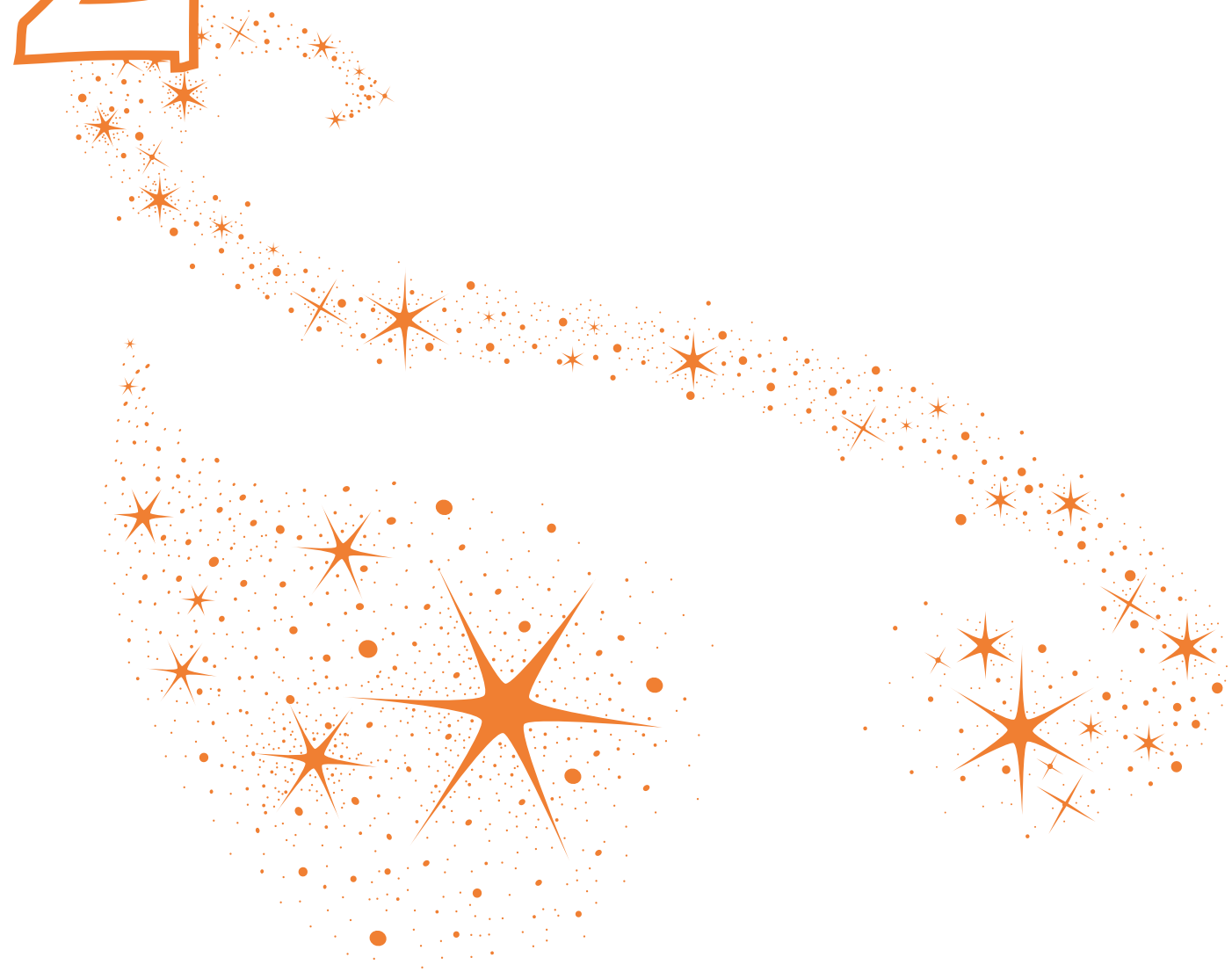
HRNWALA _____

GLABUE _____

2 Intermediate Level

The activities in this section are applicable for individuals aged 11-15.

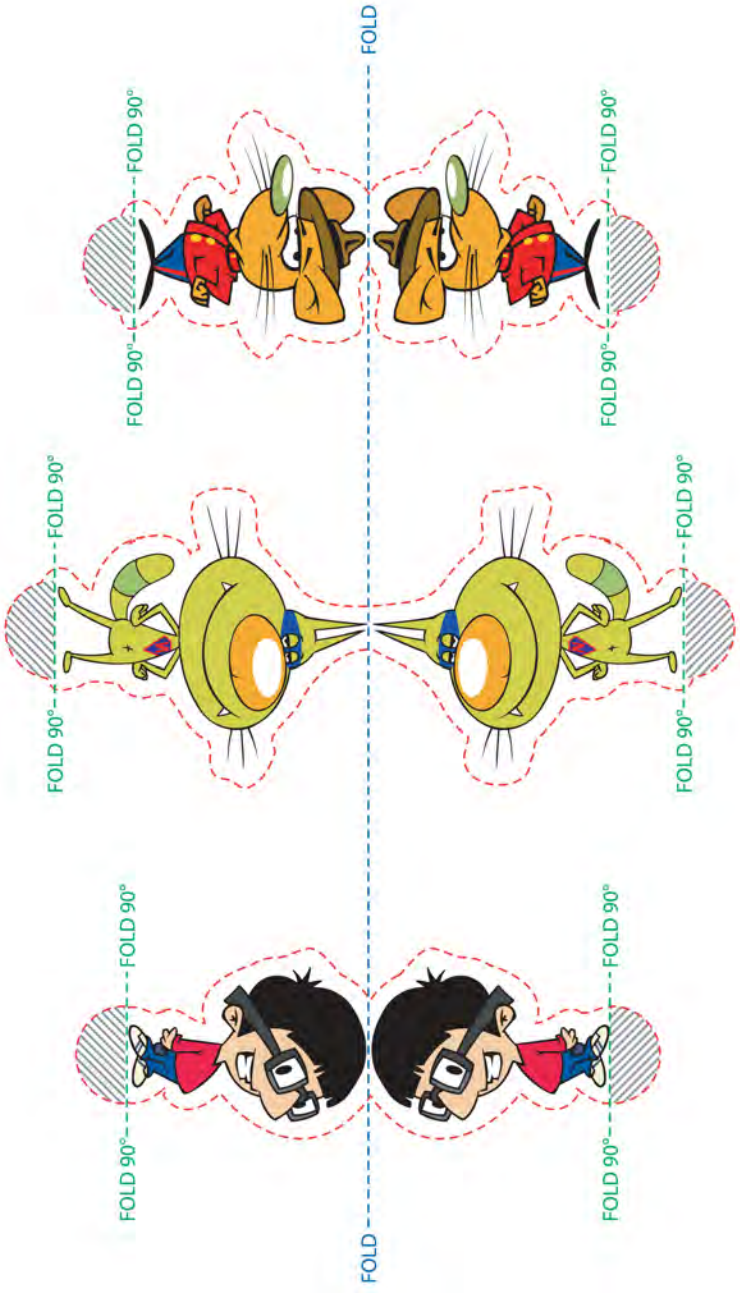
Please note that some of the activities in this section may require adult supervision and assistance.



1 Pathways and Pitfalls!

Rules of play:

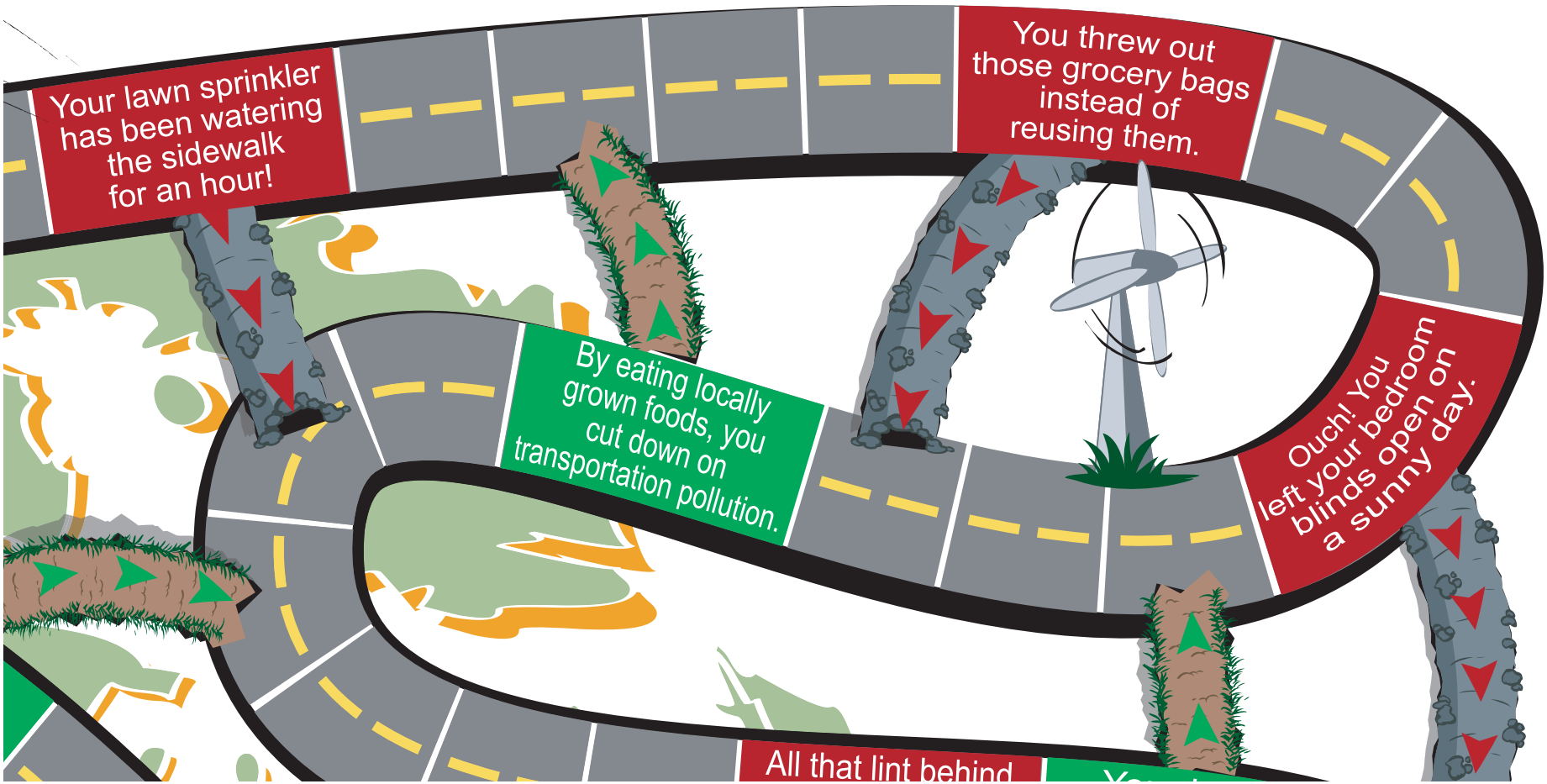
- To make markers, cut out one character image for each player and paste or tape them to small coins.
- Then roll the dice in turn to see how many spaces you can move. If you land on a pathway, jump ahead to the new location.
- If you land on pitfall, back you go! If you roll doubles or land on another player's marker, take another turn!
- The winner is the first across the finish line.

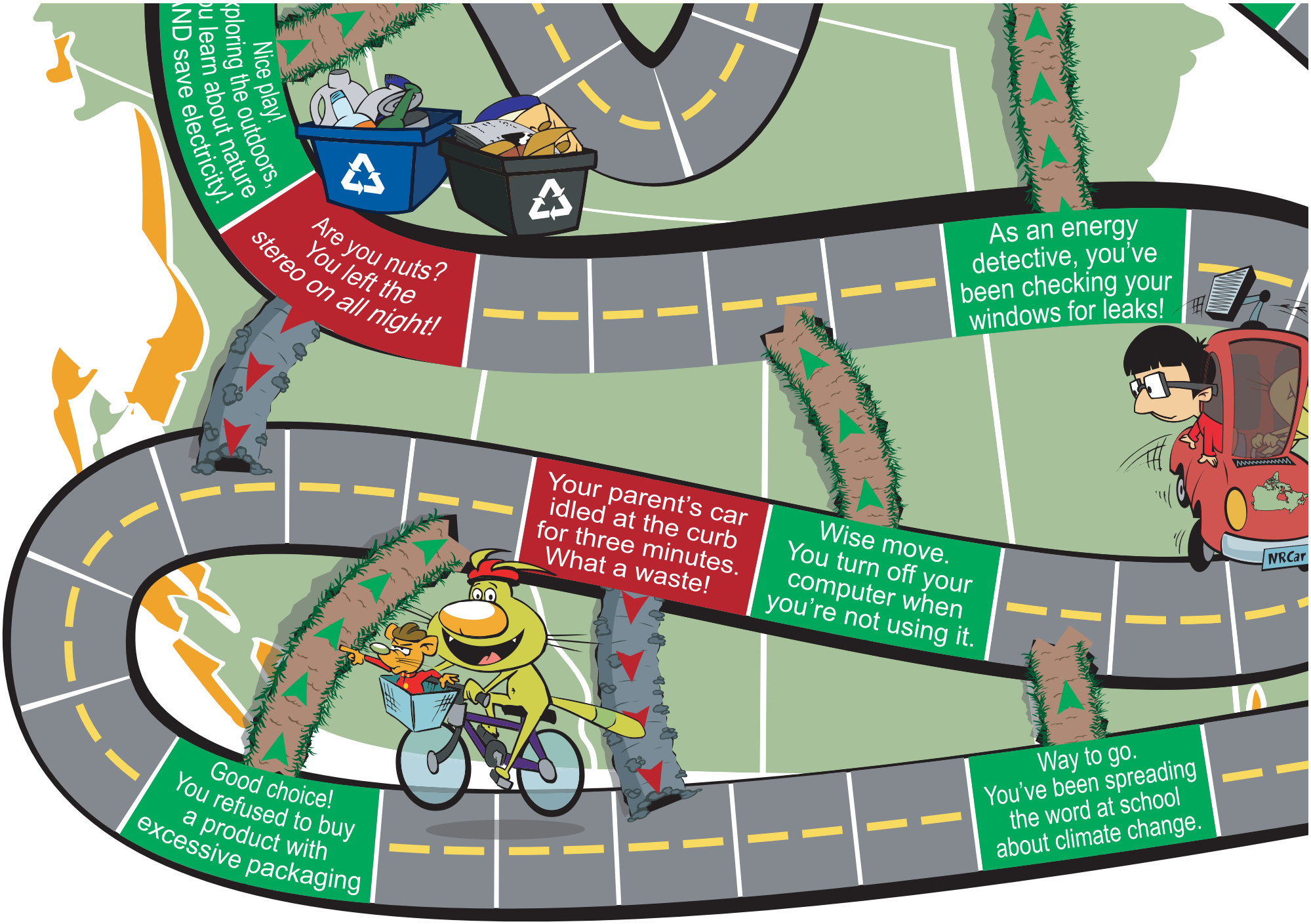



CALENDAR CLUBHOUSE
CONGRATULATIONS!!
You've saved energy and have learnt actions to take to meet the
One-Tonne Challenge!
CITY BUS
Stop chucking candy wrappers on the ground!
Hey, quit buying non-rechargeable batteries for that MP3 player.
Excellent! You participated in a community clean-up project!

Pathways & Pitfalls

The Energy and Environment Game for Canadians





Natural Resources Canada

Ressources naturelles Canada

Canada. We're al

'l in this together.

Canada

2 Candy Chromatography

Ever wondered why candies are different colours? Many candies contain coloured dyes. To see the colours used in Smarties® or M&Ms® candies, you can dissolve the dyes out of the candies using a technique called chromatography.

Materials:

- M&M® or Smarties® candies (1 of each colour)
- coffee filter paper
- cotton swabs
- water

Procedure:

1. Place the coffee filter paper upside down on a table top.
2. Place a candy in the centre of the paper
3. Dip a cotton swab into the water and hold it above the candy allowing a little water to drip onto the candy.
4. Repeat this fairly slowly until the candy is quite wet and the circle of water on the blotting paper is about 5 cm across.
5. In a little while you should be able to see rings of different colours around the candy.

How does it work?

The colour in the sugar coating of the candy shell dissolves in the water. The water is drawn out through the paper by capillary action and moves in a growing circle. The different inks which make up the colour move at different speeds and so they are separated. This process is called chromatography. (The word "chromatography" is derived from two Greek words: "chroma" meaning colour and "graphein" to write.)

Using this process you can see some candies have just one dye while others are made up of more than one dye. Note that once the colour and sugar has been removed from the shell all the candies are the same colour underneath.

Try the experiment again with a different type of candies, magic markers, or other coloured substances such as food colouring and Kool-Aid.

Note: Activity adapted from multiple sources by NRC scientist Dr. Mike Day.

3 HAZMAT Team to the Rescue: Simple Machines Challenge

What Does HAZMAT Mean?

A hazardous material (or HAZMAT) is any solid, liquid or gas that can harm people, animals, plants, objects or the environment. In Canada, these types of materials are more commonly called Dangerous Goods. Hazardous materials or dangerous goods may be explosive, corrosive, toxic, radioactive, flammable or biohazardous.

Handling Hazardous Materials Needs a Soft Touch:

In order to minimize the risks associated with hazardous materials, they must be safely used, stored, transported and disposed. Organizations which regularly deal with hazardous materials often have "HAZMAT teams," which are groups of people specifically trained to deal with accidents, spills and transportation of hazardous materials. These teams often train at specially designed locations and are required to wear special clothing and equipment such as gloves, suits, goggles, visors, etc.

Lifting Up and Moving Out

As you can imagine, moving hazardous materials from place to place is a delicate job. Today, lifting and moving large, heavy containers of hazardous materials is usually done with cranes or forklifts, but in the past, these machines would not have been available. Before the invention of complex machines, people used what are known as "simple machines." Simple machines help to make our work easier by enabling us to use less mechanical effort to move objects.

Six types of simple machines are the wedge, inclined plane, screw, lever, pulley and wheel & axle. In this challenge, students will apply their knowledge of rollers, wheels & axles, levers, inclined planes and pulleys in lifting and moving objects.

Before performing this challenge, students should be familiar with:

- The function of various types of simple machines
- Designing and building
- Working collaboratively

Investigation

Learning Objectives:

Students will:

- Make a written plan, requiring the use of one or more simple machines, to lift and move heavy load
- Apply understanding of simple machines by lifting and moving a heavy load
- Select and use materials to accomplish a given task
- Communicate about how simple machines were used to move the load
- Work collaboratively and effectively in a small group to solve a practical problem

Teaching Strategies:

- Creating and carrying out a plan
- Applying understanding of simple machines
- Working collaboratively in small groups
- Communicating results

In this challenge students will work in groups of four. Substitute your own parameters for the words in parentheses and then print the challenge, materials, observations and conclusions below for the students.

The HAZMAT Simple Machines Challenge

Your HAZMAT team has been contacted to move a large plastic open tub (e.g., 20 L Rubbermaid® tote, etc.) filled with highly corrosive liquid (water) that was found dumped in a sensitive natural area (classroom, gym, etc.). Your team must move the tub from where it was found to your containment truck (e.g., taped off area several metres away from where tub starts). The tub is too heavy to be lifted manually by your team, so you will need to use your knowledge of simple machines to carefully lift and move the tub of water without spilling it.

As any spilled liquid could contaminate the environment, the tub may not be dragged along the ground. Your group will have access to the materials which were in your containment truck as well as any other simple machines that their site supervisor (the teacher) will allow your group to use. Each HAZMAT team will also be required to wear protective safety devices (work gloves, goggles, lab coats, etc.) during the HAZMAT Challenge.

HAZMAT teams must have highly qualified members, each having a primary responsibility but all working together to achieve the best possible results. Each team will include:

- **Designer:** responsible for creating the design, obtaining the authorization to proceed from the site supervisor, and recording the 'as-built' drawing.
- **Materials Manager:** responsible for choosing which materials to use from the containment truck as well as having any additional materials authorized by the site supervisor.
- **Constructor-Builder:** in collaboration with all team members, the Constructor assembles the moving system according to the drawing plan, suggests modifications to team and moves the hazardous waste container.
- **Communication Specialist:** spokesperson for the team who presents the project to others.

Materials in the HAZMAT Truck

1. Metre sticks
2. Snow or other shovels
3. Masking tape
4. Wooden shims
5. Hammers and nails
6. 2L pop bottles
7. Large apple juice cans
8. Broom handles
9. Wooden rolling pins
10. Rope
11. Clothesline pulleys
12. Wood

Before the challenge, each team will need to create a written outline of how they plan to lift and move the tub of water. The plan will need to be clear and well-developed and should include materials, procedures and labelled diagrams of the planned set-up.

Observations and Conclusions

After the challenge, the Communications Specialist will lead the group in creating a poster which will explain through drawings and text the successful strategy that the group used, so that other HAZMAT teams could replicate their method. The poster will be presented orally to the other HAZMAT teams by the communication specialist.

Discussion

Do you know which chemical elements are hazardous? Explore the interactive Periodic Table to find five.

Extended Activities

1. Challenge the students to move the bin over additional obstacles, such as up an inclined plane or onto a step, across grass or over a gap.
2. Have the students learn about the Workplace Hazardous Materials Information System (WHMIS), which is Canada's national hazard communication standard. WHMIS is responsible for the labelling of hazardous products, as well as worker and workplace education and training programs.
3. Have the students research the properties of various hazardous materials (e.g., corrosives, flammable liquids and gases, explosives, radioactive materials, etc.).
4. Using the internet, have the students find a company, government agency, etc. which has a HAZMAT team. If possible, have the students contact the team to learn more about what they do.

4 Swirling Milk

Materials:

- 1 flat bowl or aluminium pie pan – about 18cm diameter and at least 3cm deep
- Milk (enough to cover the bottom of the container about 2cm deep)
- Several different colours of food colouring (red, yellow, blue, and green work well)
- Liquid dishwashing detergent
- Toothpicks

Procedure:

1. Pour about 2cm of milk into the bowl. (use one bowl for each 4-6 students, if possible).
2. Keep back from the table so that the milk becomes motionless.
3. Imagine the bowl as the face of a clock, with 12 o'clock at the top, 3 o'clock to the right, 6 o'clock at the bottom, and 9 o'clock to the left.
4. Drop 2 drops of each food colour carefully into the milk near the outside edge of the bowl, one colour at 12 o'clock, the second colour at 3 o'clock, the third colour at 6 o'clock, and the fourth colour at 9 o'clock, in any order. There should be one spot each of red, yellow, blue, and green. Do not bump the table or do anything else to mix the colours.
5. Take a toothpick and dip the one end into the dishwashing detergent.
6. Touch the detergent end of the toothpick into the middle of the bowl of milk, and hold it there for at least 30 seconds. Observe carefully. Do the colours mix initially, or just swirl in their own section of the bowl? **Do not use the toothpick to stir the milk.**
7. Lift the toothpick, and touch it to the milk in the center of one of the colours. Observe carefully.
8. Touch the toothpick into other areas of the milk, dipping it first into the detergent again if necessary. Observe carefully.
9. When you are certain that you are finished with the activity, dispose of the milk down the drain.

Observations:

Initially, the food colours swirl in different patterns across and under the surface of the milk for several minutes. Note that the colours do not actually mix with each other, but continue in separate swirling patterns. The time of swirling may depend on the temperature of the milk and amount of dishwashing liquid you use. You can repeat step 6 to reactivate the swirling motion if needed. Moving the toothpick to a new spot can later result in mixing of the various colours.

How does it work?

The reason for the swirling motion of the food colours is caused by changes in surface tension of the milk after adding the drop of liquid dishwashing detergent. Detergent molecules have a partially charged polar end and an uncharged nonpolar end. Thus, they can bind weakly to either polar or nonpolar neighbouring molecules. When detergent is introduced into the center of the bowl, it may bind weakly to the water in the milk, decreasing its surface tension so that it flows more easily, and indirectly setting up the swirling motion.

5 Colour Drops

Watch the ways in which food colouring can move through different liquids.

Materials:

- Plastics cups
- Water
- Salt
- Seltzer water
- Food colouring

Procedure:

1. Fill two plastic cups 2/3 full with water.
2. Add 1 drop of food colouring to the first cup and immediately observe what happens.
3. Add the salt to the second cup and stir until the salt dissolves. Add one drop of food colouring to this cup and immediately observe.
4. Fill the third cup 2/3 full with seltzer water, add 1 drop of food colouring and observe.

Observations:

In plain water the drop slowly swirls and moves throughout. In salt water, the drop starts to sink and then rises. In seltzer water, the drop quickly disperses and evenly colours the liquid.

How does it work?

Putting food colouring in plain water does not have a dramatic effect other than that the colour becomes more pale (diluted). The gas bubbles in the seltzer water act to speed things up, like an invisible stirring spoon. The drop of food colouring is quickly broken up and carried to all parts of the liquid. Salt water is more dense than plain water. This means that anything less dense will float on the top, including the food colouring (which is a drop of coloured water).

Note: Activity adapted from multiple sources by NRC scientist Dr. Mike Day.

6 Environment Week Quiz

1. **Planting trees in your neighbourhood is one of the best things you can do for the local environment and for the planet because:**

   a. They produce oxygen

   b. They remove carbon dioxide and contaminants from the air

   c. They provide habitat for birds and other wildlife

   d. All of the above

2. **Choosing ENERGY STAR-qualified products when replacing old equipment can cut your household energy bills by:**

   a. Approximately 10%

   b. Approximately 20%

   c. Approximately 30%

   d. Approximately 40%

3. **Humans use at least 40,000 species of plants and animals every day for their different needs.**

   a. True

   b. False

4. **Which of the following species are at risk in Canada?**

   a. Prairie-Chicken

   b. Grizzly Bear

   c. Atlantic Walrus

   d. All of the above

5. **Biodiversity only includes the number of different species of plants, animals and microorganisms in existence.**

   a. True

   b. False

6. **The way to guarantee that a plugged-in electronic device is not consuming power is to:**

   a. Place device on standby

   b. Turn device off

   c. Unplug device from the outlet

   d. If device is fully charged, then it will not consume any more energy

7. **Ocean ecosystems are able to:**

   a. Take sewage and recycle it into nutrients

   b. Scrub toxins out of the water

   c. Turn carbon dioxide into food and oxygen

   d. All of the above

8. **It is better to have a larger, energy-efficient refrigerator than a smaller refrigerator of the same model.**

   a. True

   b. False

9. **If every driver of a passenger car or small truck avoided idling by three minutes a day, collectively over the year, we would save:**

   a. 630 million liters of fuel

   b. Over 1.4 million tones of GHG emissions

   c. $630 million annually in fuel costs

   d. All of the above

10. **Which of the following residential waste will green bins NOT turn into compost?**

   a. Plastics

   b. Yard waste

   c. Food soiled paper products

   d. Food scraps

7 Important Decisions Don't Just Happen

Student exercise

1. Find the four best neighbourhoods for the playground.
2. Find the four best neighbourhoods for the seniors' centre.
3. Find the two best neighbourhoods for the medical centre by using the results from request numbers one and two.
4. Find the five best neighbourhoods for the bus route.

    a. Once your group decides which neighbourhoods the first service should be located in, mark them on the census grid map. Do this by filling in the squares for each neighbourhood with the colour for the service. (The colour for each service is shown in the legend.) Neighbourhood 1, one of the choices for locating the playground, has already been marked for you. You may go ahead and colour it in with yellow. Continue to find the next best neighbourhoods for a playground and the senior's centre. (It is possible to have more than one service located in the same neighbourhood.)

    b. After you have correctly identified the best neighbourhoods for the playground and the senior's centre, the best place for the medical centre should be automatically evident. (Hint* the neighbourhoods selected for the playground and the seniors' centre will overlap.) Indicate the best neighbourhoods for the medical centre by circling the two neighbourhoods with the appropriate colour.

    c. The final task is to identify the five best neighbourhoods for the bus route using **Handout 1 Table 1** and **Handout 2**. The bus route should accommodate the neighbourhoods with the largest populations.

The following exercise asks you to make some decisions:

Data-R-Us has assigned you four client requests. Each request is looking for data which will help to locate the most appropriate neighbourhoods in Maple for specific services.

1. The first request is from the town of Maple community volunteer league, which has raised funds to build a new playground.
2. The second request is from the Maple Town Council, which has designated money from the city budget, to build a seniors' centre.
3. The third request comes from the Get Well Medical Clinic. The primary users of the medical clinic are children and seniors. Get Well would like to expand into Maple and is looking for a location close to large numbers of children and seniors.
4. The fourth request comes from the town of Maple's Department of Public Transportation. They are looking to start a new bus route in an area where there will be a demand for public transportation.

Consider this:

Imagine that you have looked at the census report on the town of Maple and have picked the data that best describe the people who will use the services. Table 1 is the result of this effort. Take a moment to study the table.

Table 1

Request number	Service	Who needs the service	Census Data
1	playground	children	people - 15 years and under
2	seniors' centre	seniors	people - 65 years and over
3	medical centre	children and seniors	people – 15 years and under people – 65 years and over
4	new bus route	everyone	total population

Handout 2: Census data

Imagine that you have looked at the census report on Maple and have picked the data that shows the population in each neighbourhood based on their age. **Table 2** is the result of this effort.

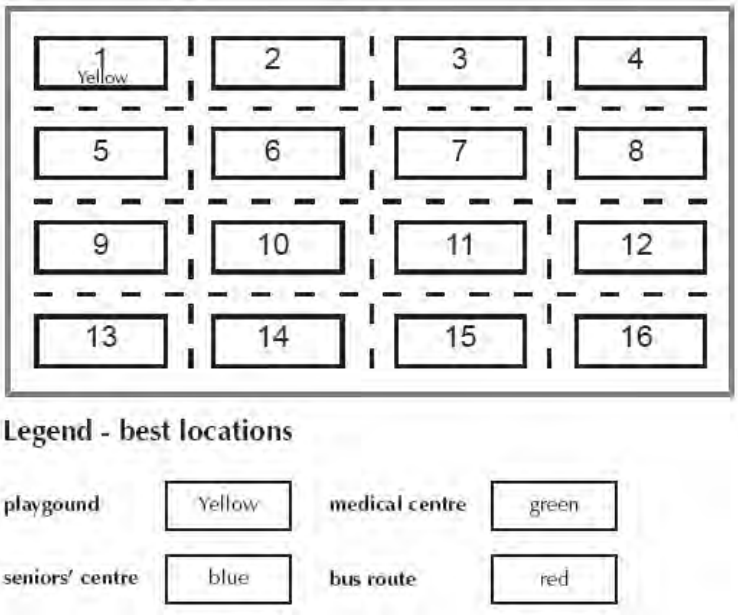
Table 2: Population by neighbourhood

Neighborhood	People - 15 years and under	People -65 years and over	Total population
1	175	79	365
2	170	190	450
3	5	250	312
4	95	145	520
5	171	94	470
6	150	201	440
7	65	220	335
8	84	98	522
9	20	100	207
10	27	5	171
11	90	78	568
12	75	43	608
13	17	76	192
14	15	22	169
15	120	11	632
16	20	1	163

Handout 3: Census grid map of Maple

The town is divided into 16 neighbourhoods which appear on the grid map below.

Census map of Maple



1. Find the four best neighbourhoods for the playground.
2. Find the four best neighbourhoods for the seniors' centre.
3. Find the two best neighbourhoods for the medical centre by using the results from request numbers one and two.
4. Find the five best neighbourhoods for the bus route.

    a. Once your group decides which neighbourhoods the first service should be located in, mark them on the census grid map. Do this by filling in the squares for each neighbourhood with the colour for the service. (The colour for each service is shown in the legend.) Neighbourhood 1, one of the choices for locating the playground, has already been marked for you. You may go ahead and colour it in with yellow. Continue to find the next best neighbourhoods for a playground and the senior's centre. (It is possible to have more than one service located in the same neighbourhood.)

    b. After you have correctly identified the best neighbourhoods for the playground and the senior's centre, the best place for the medical centre should be automatically evident. (Hint* the neighbourhoods selected for the playground and the senior's centre will overlap.) Indicate the best neighbourhoods for the medical centre by circling the two neighbourhoods with the appropriate colour.

    c. The final task is to identify the five best neighbourhoods for the bus route using Handout 1 Table 1 and Handout 2. The bus route should accommodate the neighbourhoods with the largest populations.

8 Apple Ocean

Objectives

To learn about the small percentage of the ocean that is productive, providing food and shelter for a variety of plants, and people.

Activities

An apple will be cut up to illustrate what part of the Earth is land, what part is ocean, and what proportion is the most productive part of the ocean.

Background

All the water in the world today was here when the Earth was formed. The water of the Earth has remained unchanged in quantity throughout the four or five billion years of its existence. About 97% of the water on the Earth is in the ocean.

- Only a small percentage of the ocean is productive. These productive areas are the coastal regions.
- Canada has many different coastal ecosystems including rocky shores, estuaries, salt marshes, sandy beaches, barrier islands, cliffs and fjords, tidal mudflats, coastal bogs, bays, and inlets.
- Estuaries, salt marshes, and rocky shores are very productive environments.
- These areas provide sources of food for wildlife and humans, and act as nurseries for many commercial fish species.

Procedures

Looking at the land part of our planet:

1. Cut your apple into four equal pieces. Set three of the pieces aside for later use. These represent the three-quarters of the Earth that is covered with ocean. Mark them 'OCEAN.' The remaining quarter represents the land, or areas not covered by ocean.

2. Cut this one-quarter into two equal pieces. One piece represents all the land that is too dry, too wet, or too hot for people. This is uninhabitable land-mountains, deserts.... The other piece, one-eighth of the Earth's surface, is where people can live.

3. Cut this one-eighth piece into four pieces and set aside three of them. The remaining piece represents the portion of the habitable land in which we are able to grow food.

4. Take this 1/32 piece and cut off a thin slice. This tiny slice represents 3/100 of 1% of the Earth's surface. All of our drinkable water comes from this area. What is the significance of this or what does this suggest to you?

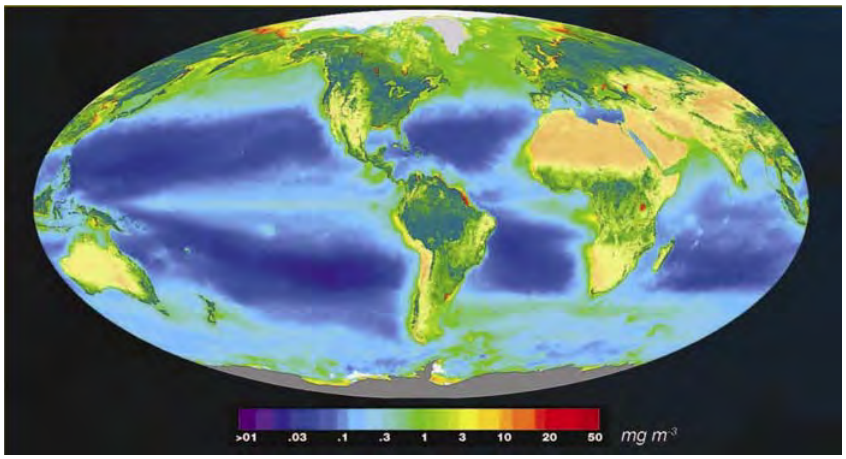
Now look at the ocean part of our planet:

5. Take one of the three 'ocean' pieces and cut it in half. This piece, an eighth of the world's surface, represents the productive coastal zones of the oceans.

6. Cut this one-eighth piece into four equal parts. One of these represents the productive area along the Atlantic coast of North America. What does this tell you about the amount of productive aquatic area in the world?

7. **Eat the apple.**

Activity Materials



Materials:

- Knives, apples, non-toxic markers

Location: Indoors

Time required: 30 Minutes

Minimum people required: 1

Subjects:

- Science, mathematics (fractions), social studies

Grade level: 6 And up

Key words:

- Salt marshes, saltwater, estuaries, rocky shores, productivity

(Apple Ocean activity modified from the Huntsman Marine Science Centre)

9 Where are we from?

Activity 4: Where do we come from?

Suggested level: **elementary, intermediate**
Subjects: **geography, social studies, language arts**

Overview

This activity makes students aware of the countries in which people who immigrate to Canada are born. Students will gain an understanding of the multicultural nature of Canadian society by examining the cultural diversity present within their classroom.

Duration: 1-2 class periods. As an enrichment exercise, they can look at how immigrants contribute to our society.

Note: See the **Teacher's Guide** for general background on the census and census vocabulary.

Learning objectives

- Develop an awareness of the countries in which people who immigrate to Canada are born.
- Help students locate their country of birth on a world map.
- Explore / express personal experiences of immigration to Canada through pictures or stories.
- Recognise contributions that immigrants have made and continue to make to Canadian society.

Vocabulary

diversity, immigrate, immigration, immigration source areas, place of birth

Materials

- **Teacher's Guide**
- **Handout 1**: Immigration source areas
- **Handout 2**: Immigrant population by country of birth and period of immigration
- **Handout 3**: How immigrants contribute to Canada

Getting started

Using the background information provided in the **Teacher's Guide**, tell students about the census and let them know that Canada's next census takes place in May 2011. Explain that immigration information is used to provide services for new immigrants to Canada.

Census activity

1. Distribute **Handout 1**: Immigration source areas

   Ask your students to name the country in which they were born and find its approximate location on the world map. Instruct students to write in the name of their country near its location and draw an arrow connecting their place of birth to where they live now in Canada. Students who were born in Canada can simply place a dot near their place of birth. Have all students outline or colour in the countries based on the colour key at the bottom of the **Handout 1**.

   (Maps can be displayed so that students can see the various places of birth of their classmates. Options include increasing the size of the map and having all students write on one map or copying the map to an overhead and using this for the entire class.)

2. On **Handout 2**: Immigrant population by country of birth and period of immigration, you will find a graph.

   Ask your students to colour the stacked columns in the graph according to the colour key at the bottom of **Handout 1**. Compare **Handout 1** and **Handout 2** side-by-side in order to have a better visual representation of the origins of Canada's immigrant population.

   For more detailed information check our website www.statcan.gc.ca.

- Click on the census image on the top right corner of the page.
- Select Release topics under 2006 Census, on the left side of the page.
- Select Immigration and citizenship.
- Select Topic-based tabulations.
- Select Period of immigration.
- Table 5 provides the full data used to produce the table in **Handout 2**.

3. Let your students tell the story

(a) Do a mini survey of the classroom counting the total number of students from each country. Display the results on the board, Smartboard or overhead.

(b) In a class that includes students who have immigrated to Canada, invite students to share their experiences.

(c) If all of the students were born in Canada, invite someone from outside the class who immigrated to Canada to share their experiences.

(d) Students with parents, grandparents, or neighbours who are immigrants, could ask them about their experience, and report back to the class with the stories they have gathered.

Here are a few questions you can use to start the discussion.

Where were you born?

How long ago did you come to Canada?

Why did you come?

When you immigrated to Canada, were there others who came here at the same time?

Did you already speak English or French when you came to Canada?

What language(s) did you learn as a young child? Do you still speak it (them) now?

Did you play the same or different games? Tell us about your culture's art and music.

What was the most important thing you brought with you when you came to Canada?

What did you find hardest to learn or adjust to in Canada?

What do you like best about living here?

(e) Have each student express ideas about immigrating to Canada by writing a story or drawing pictures. Students who were born in Canada may write or draw from the perspective of a fictional student who immigrated to Canada.

Activity 4: Enrichment

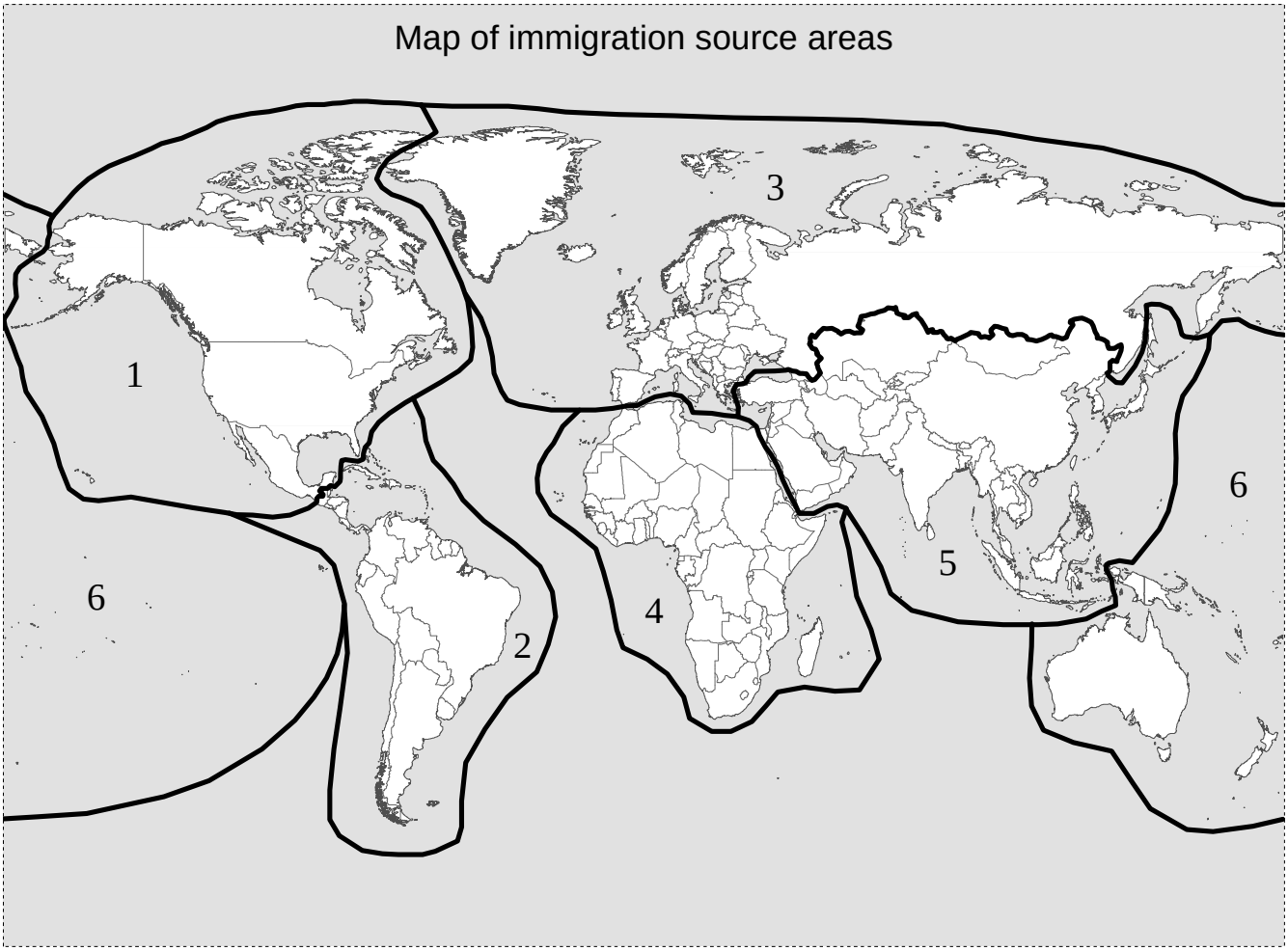
1. Ask your students to write a story (their own or one they have heard) about immigration to Canada. This story could be included in a book format where each student's story can be a chapter.
2. Using **Handout 3**: How immigrants contribute to Canada, help your students research a source area and country of their choice or a country which fits into the social studies curriculum. The work could be done individually or in groups.
3. Ask your students to visit the Statistics Canada website, www.statcan.gc.ca, and research immigration characteristics of their community and province.

   - Click on the census image on the top right corner of the page.
   - Select the *2006 Community Profiles* button, which also appears on the right side of the page.

   Ask students to produce a chart using the data in the profiles. Charts may be drawn by hand or, where available, by using software such as Excel.

Name: **Date:**

Handout 1: Immigration source areas



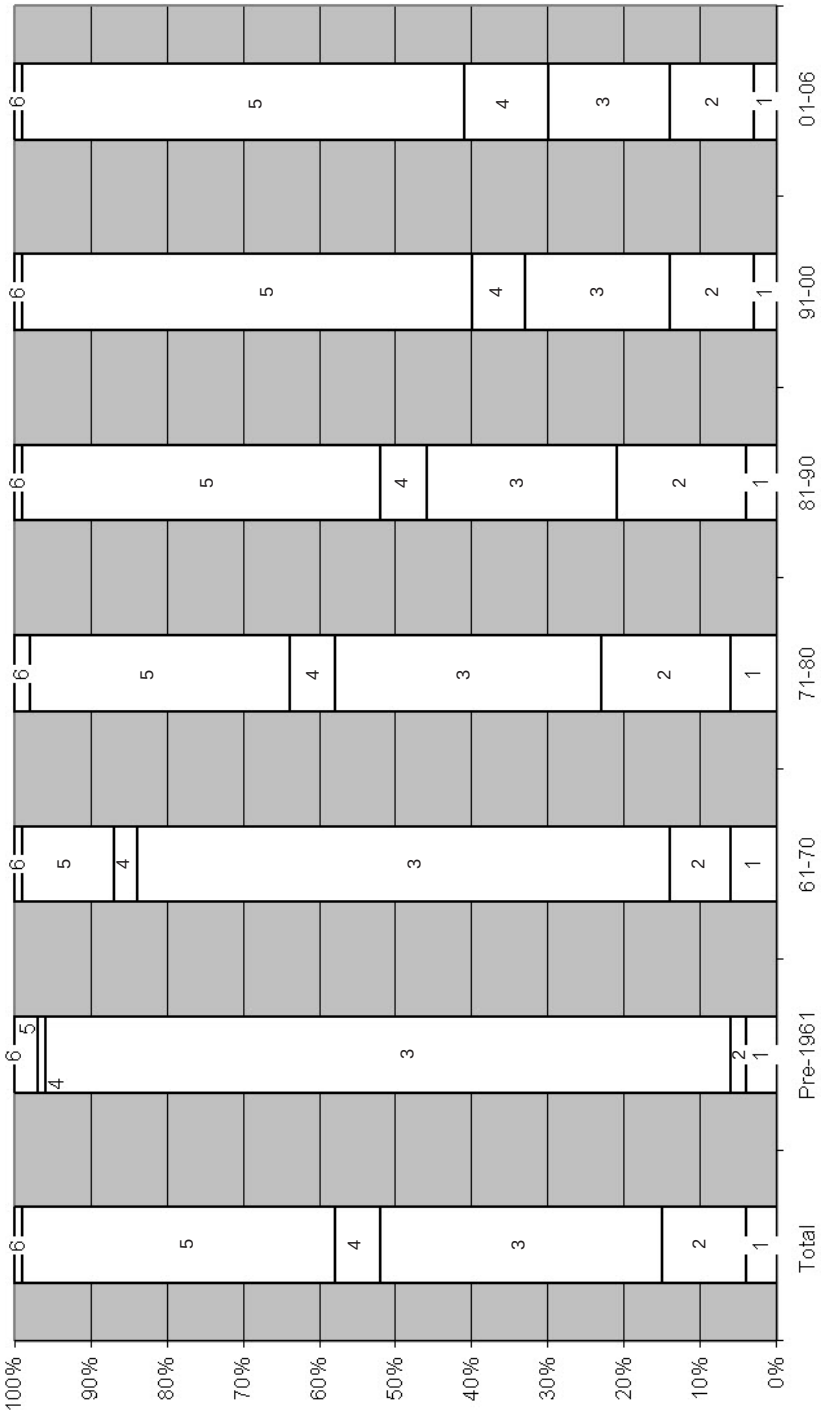
Color the map and graph using the colour key.

Colour key legend

1. North America (excluding Canada)..... red
2. Central America, the Caribbean and South America..... green
3. Europe and Russia..... yellow
4. Africa..... blue
5. Asia and the Middle East..... orange
6. Oceania and other Pacific Islands..... purple

Name: Date:

Handout 2: Immigrant population by country of birth and period of immigration



Graph 1: Immigrant population by place of birth and period of immigration

Name: **Date:**

Handout 3: How immigrants contribute to Canada

Pick an immigration source area that you would like to research online and circle its name.

Africa	Asia and the Middle East	Europe and Russia	Central America, the Caribbean and South America	North America (excluding Canada)	Oceania and other Pacific Islands

1. Using a map, name some countries that are located within your immigration source area.

a. _____ b. _____

c. _____ d. _____

2. Name some large cities within the countries you listed in Question 1.

a. _____ b. _____

c. _____ d. _____

3. Pick a country within your immigration source area and do some research online. Write down the most interesting things you find out. Include things such as special customs, festivals, foods, etc.

Country : _____

_____

_____

Handout 3: How immigrants contribute to Canada

4. (a) List some people you know who have immigrated to Canada and tell where they came from. These people could be friends or classmates, or people you know in your neighbourhood. They could be either adults or children.

relationship:_____ from:_____

relationship:_____ from:_____

relationship:_____ from:_____

(b) Think of the names of some well-known Canadians you've read or heard about, both past and present, whose families immigrated to Canada.

name:_____ from:_____

famous for:_____

name:_____ from:_____

famous for:_____

10 Immigration and Citizenship

Activity 6: Immigration and citizenship

Suggested level: **elementary, intermediate**
Subjects: **mathematics, geography, social studies, language arts**

Overview

Students will colour a pie chart which indicates the place of birth of Canada's immigrant population. Students will also colour a corresponding map of immigration source areas. Next, students will create a paper chain based on the pie chart and map. This would be an excellent visual display for a bulletin board.

Duration: 1-2 class periods.

Note: See the **Teacher's Guide** for general background to the census and census vocabulary.

Learning objectives

- Develop an awareness of the places of birth of people who immigrate to Canada.
- Develop an awareness of Canadian immigration patterns.

Vocabulary

census, immigrant, immigration source areas, place of birth, period of immigration

Materials

- **Teacher's Guide**
- **Handout 1**: Immigration source areas
- **Handout 2**: Place of birth of the immigrant population of Canada
- **Handout 3**: Immigrant population of Canada, paper chain

Getting started

1. Using the background information provided in the **Teacher's Guide**, tell students about the census and explain that the next one takes place in May 2011. Make sure students understand that in a census all the people in the country are counted, not just Canadian citizens. Discuss the importance of immigration information gathered in previous censuses. The data are used to provide services to immigrants. Immigrants are an important part of the population.
2. Do a mini-survey of the classroom asking the country of birth of each student. Make an overhead of **Handout 1** and place dots on the immigration source areas which include these countries. One dot for each student's place of birth. Which immigration source area (North America, Central America etc) contains the most dots?

Census activity

Scissors, glue and coloured markers, coloured pencils or crayons are required for this activity.

1. Distribute **Handout 1**. Discuss the map and the division lines. This map groups immigration source areas into broad categories indicated at the bottom of the handout. Corresponding numbers appear on the map itself. Students will begin by colouring in the map according to the colour key.
2. Distribute **Handout 2** and discuss the pie chart presented. This pie chart is a graphic representation of the places of birth of the immigrant population in Canada from 2001–2006. Next, students will colour in the pie chart according to the colour key at the bottom of **Handout 1**.
3. Have the students make a three dimensional representation (a paper chain) of the immigrant population's places of birth using the percentages presented in the pie chart. The paper chain activity may be done as a class, in smaller groups or individually. Copy and distribute **Handout 3** accordingly.

   Students will colour the links according to the colour key on the bottom of **Handout 1** and then cut them apart so that they have individual links. Students will then glue together the links to represent the places of birth of the immigrant population from 2001–2006.

   (Hint: 1% = 1 link. Therefore if the student is representing the Canadian immigrant place of birth as Africa, they should have 11 links, which is 11% as per the pie chart in **Handout 2**.)

Activity 6: Enrichment

Invite a person, who immigrated to Canada, to visit your class. Have them bring personal photos of their place of birth and speak to the class about immigrating to Canada.

Students may choose one of the following writing activities:

a. write a short account of the guest speaker. In this account the student will highlight what they found to be the most interesting part of what your guest speaker has shared with them.

b. write a newspaper article reporting on the guest speaker's journey to Canada and starting a life here.

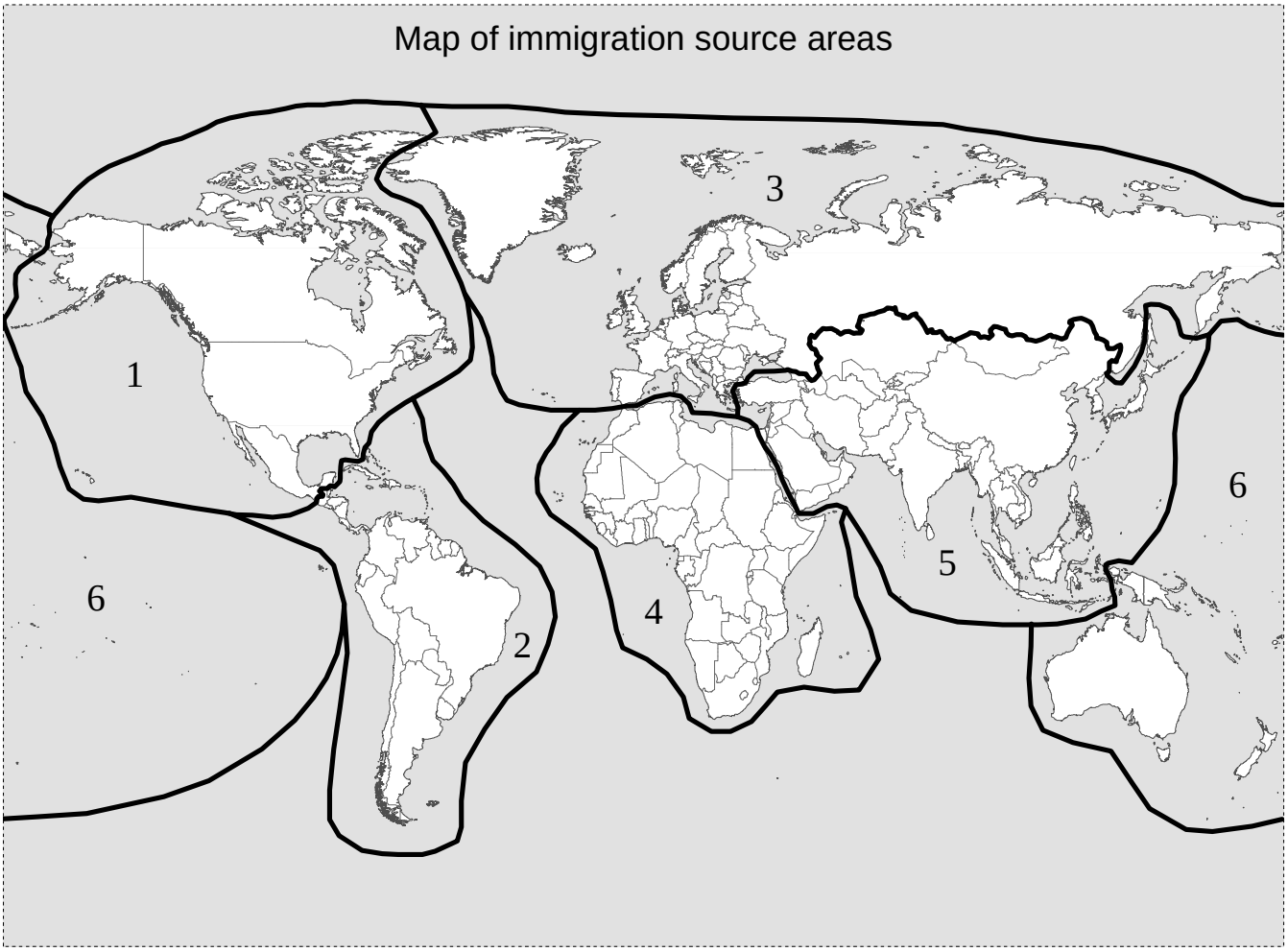
c. write a diary entry about the day the guest speaker arrived in Canada. Write from the guest speaker's perspective.

Note: For more detailed information on immigration, visit our website at www.statcan.gc.ca

- Click on the Census image on the right side of the page.
- Select Release topics under 2006 Census, on the left side of the page.
- Select Immigration and citizenship.
- Select Topic based tabulations.
- Select Period of immigration.

Name: **Date:**

Handout 1: Immigration source areas



Colour the map using the colour key.

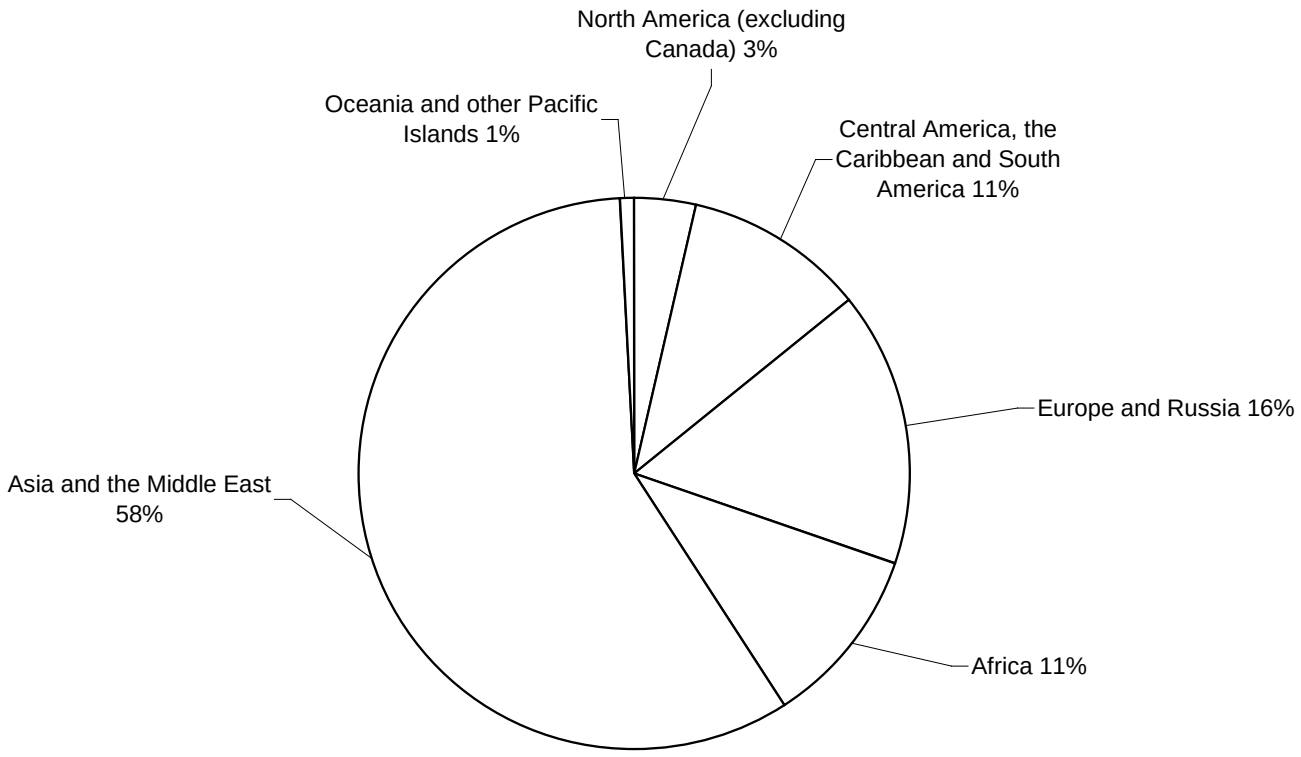
Colour key legend

1. North America (excluding Canada)	red
2. Central America, the Caribbean and South America	green
3. Europe and Russia	yellow
4. Africa	blue
5. Asia and the Middle East	orange
6. Oceania and other Pacific Islands	purple

Name: **Date:**

Handout 2: Place of birth of the immigrant population of Canada

2001-2006 Place of birth of the immigrant population of Canada



Colour the pie chart using the colour key in **Handout 1**.

Handout 3: Immigrant population of Canada, paper chain

North America (excluding Canada)

North America (excluding Canada)

North America (excluding Canada)

Central America, the Caribbean and South America

Central America, the Caribbean and South America

Central America, the Caribbean and South America

Central America, the Caribbean and South America

Central America, the Caribbean and South America

Central America, the Caribbean and South America

Central America, the Caribbean and South America

Central America, the Caribbean and South America

Central America, the Caribbean and South America

Central America, the Caribbean and South America

Central America, the Caribbean and South America

Europe and Russia

Europe and Russia

Europe and Russia

Europe and Russia

Europe and Russia

Europe and Russia

Europe and Russia

Europe and Russia

Europe and Russia

Europe and Russia

Europe and Russia

Europe and Russia

Europe and Russia

Europe and Russia

Europe and Russia

Europe and Russia

Africa

Africa

Africa

Africa

Africa

Africa

Africa

Africa

Africa

Africa

Africa

Oceania and other Pacific islands

Asia and the Middle East

Asia and the Middle East

Asia and the Middle East

Asia and the Middle East

Asia and the Middle East

Asia and the Middle East

Asia and the Middle East

Asia and the Middle East

Asia and the Middle East

Asia and the Middle East

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Asia and the Middle East

Asia and the Middle East

Asia and the Middle East

Asia and the Middle East

11 Simulation

Divide the class into teams of two or three students. Each team will generate a hypothetical map of geographical ground features in an imaginary country. Each team must keep its map zones secret from all the other classroom teams. A sample map is shown in Figure 12.

Teams are then allowed to see each other's maps ONLY under a source of red light.

Materials

- A clean sheet of white paper.
- A red lamp or flashlight with a red filter over the lens.
- Assorted coloured markers.

Procedure

1. Create a simulated map of an imaginary country by drawing a border outline of the country on the page. Use as much of the page as possible.
2. Using the coloured markers, create the following zones, using a different colour for each zone.
    - Hardwood forests
    - Softwood forests
    - Mountains
    - Deserts
    - Farmland
    - Rivers
    - Dense urban areas
    - Wetlands
    - Invent your own
3. Keep your map secret. Do not let other students see your map under white light. They should only be allowed to view it under red light.
4. Label your map with a zone legend and number each zone (see Figure 12 for a sample map, but do not use the same colour scheme).
5. Challenge other teams to match the "ground truth" legend with numbered zones on your map while viewing the map under red light.

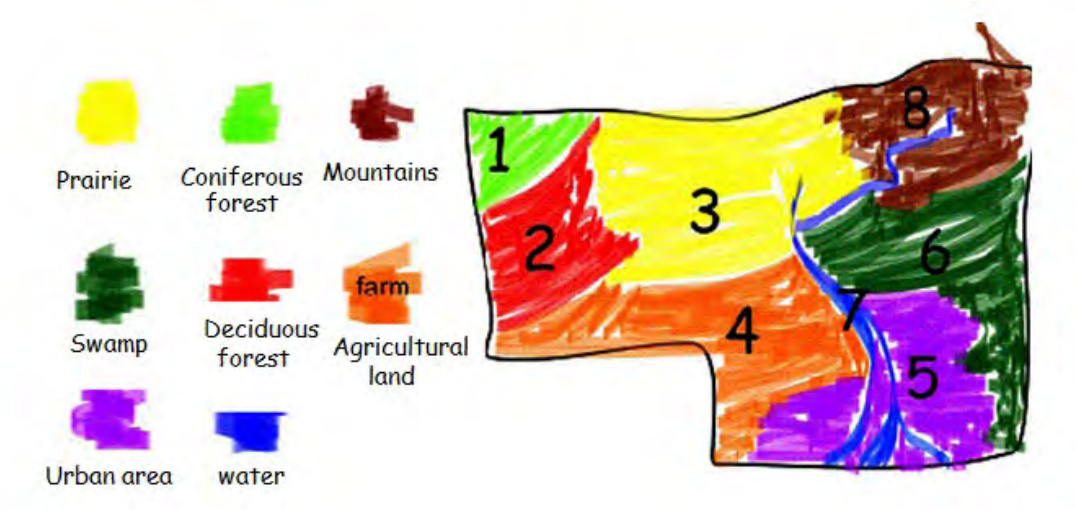
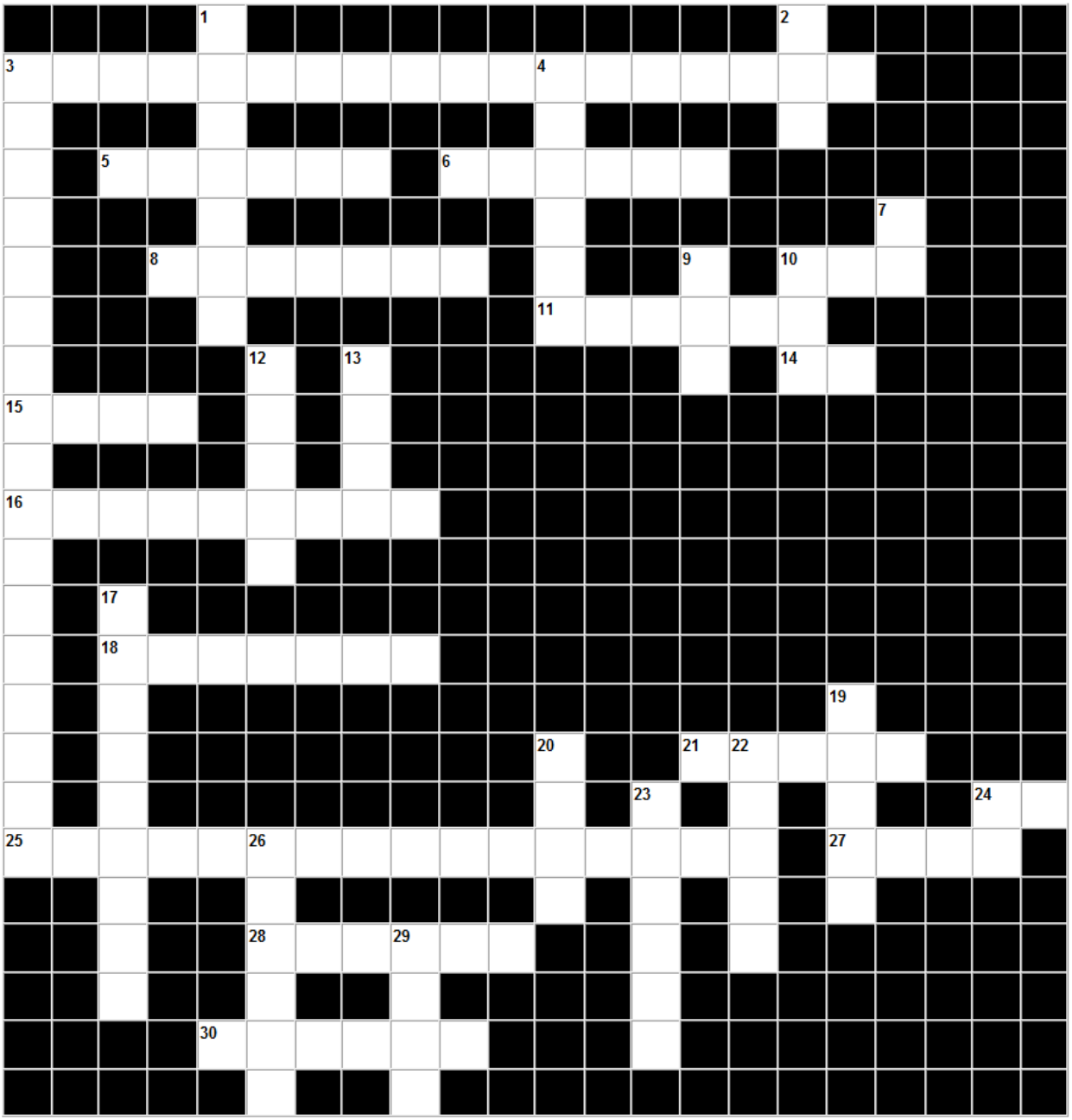


Figure 12: A hypothetical map with the "ground truth" legend shown on the left. Students are challenged to identify each zone by viewing the map under a source of monochromatic light.

Analysis

Determining the ground features requires some method of matching up the shades of the reflected radiation (red light on your map and microwaves for RADARSAT-2) with known ground features. The alignment of features on the satellite image with the features on the ground requires a "ground truth" assessment that involves scientists on the ground and the scientists who are doing the images processing.

12 Statistics Canada Terms Crossword



Across:

3 Inflation(3).

5 Country.

6 A multidimensional database.

8 Production and consumption of goods and services.

10 Census metropolitan area (abbr.)

11 With 15 across, observations over _____.

14 Abbreviation for dissemination area, the smallest standard geographic area for which census data are disseminated.

15 See 11 across.

16 There are ten of these in Canada.

18 Part of the Environment.

21 A dynamic tool for the education community.

24 Census tract (abbr.)

25 Canada's central statistical agency (2).

27 Geographic area.

28 A type of rounding.

30 Well-being.

Down :

1 Criminal System.

2 A decennial census occurs every _____ years.

3 Free information for all Canadian communities (2).

4 Survey of the entire population.

7 Census agglomeration (abbr.)

9 Metropolitan influenced zone (abbr.)

10 Census subdivision (abbr.)

12 Tally.

13 A quinquennial census takes place every _____ years.

17 The land's features.

19 Statistics Canada's official release bulletin.

20 The arithmetic average of a set of numbers.

22 Nation.

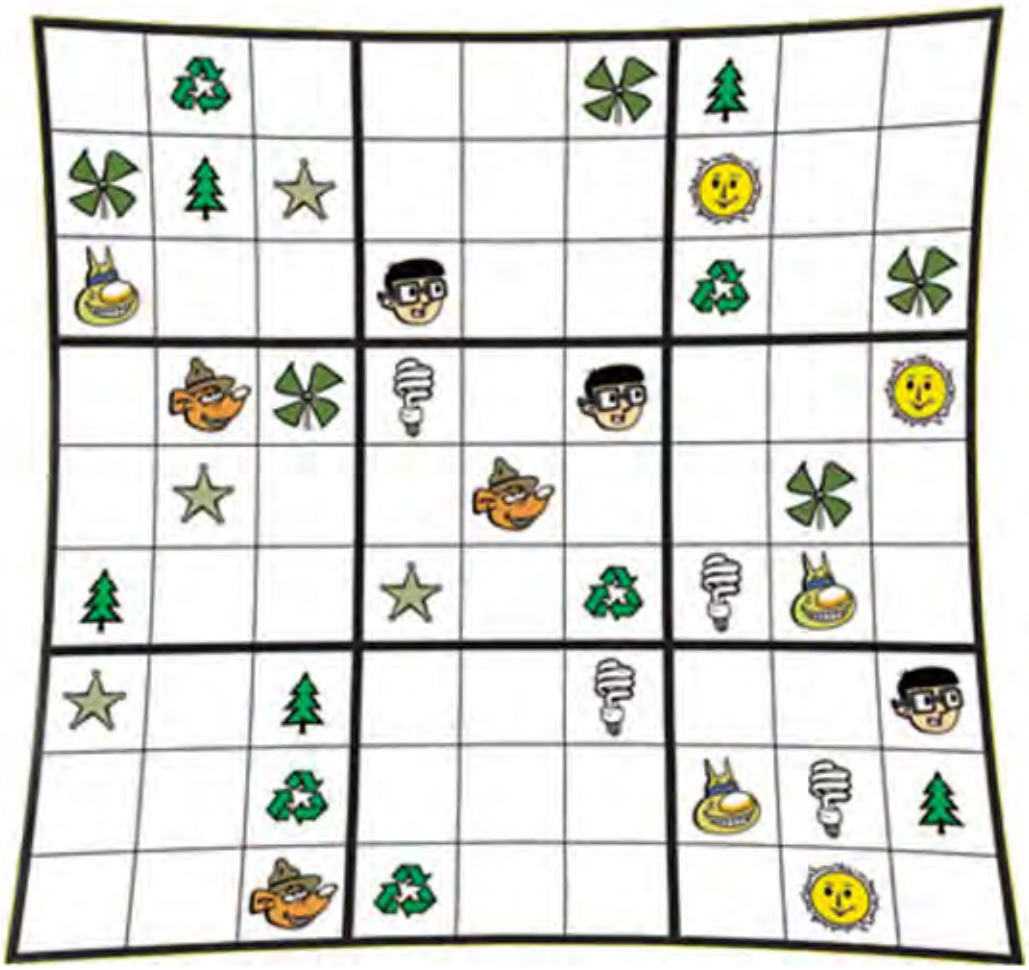
23 Work.

24 Census division (abbr.)

26 A method of collect information.

29 Facts or figures from which conclusions can be drawn.

13 Sudoku



Instructions

To solve this puzzle, you must fill in the grid so that each row, each column, and each 3 x 3 area contains all the energy symbols.

Be careful!

The same symbol can appear only once in each row or column!

3 Secondary Level

The activities in this section are applicable for individuals aged 16 and up.

1 Electrolysis

Learning Objectives:

Students will:

- Perform electrolysis of brine (a solution of sodium chloride)
- Write the electrode and balanced oxidation-reduction equations for electrolysis of a brine solution
- Identify the tools and materials used and show the direction of flow of electrons during electrolysis of brine
- Explain the process of electrolysis

Teaching Strategies:

- Construct electrical circuits
- Experimentation involving data collection and analysis
- Balancing oxidation-reduction equations

Materials Needed (Per Group)

- Distilled water – 150 mL
- Table salt (NaCl) – 15 mL
- 5 mL measuring spoon - 1
- 250 mL glass beaker – 1
- Platinum-coated electrodes (or carbon electrodes) – 2
- Electrical wire with alligator clips – 3 black, 3 red
- Power supply (rectifier) or 9-volt battery – 1
- Voltmeter - 1
- Watch with a second hand or stopwatch - 1
- Safety goggles – 1 pair per person

Question: Can a salt solution be taken apart by electricity?

Procedure

Step 1

Copy the observation chart on the next page in your science journal or notebook.

	Voltage (V)
Step 3	
Step 4	
Step 6 - 5 mL	
Step 7 - 10 mL	
Step 7 - 15 mL	

Step 2

Put on safety goggles.

Step 3

Pour 150 mL of distilled water into the glass beaker. Connect the voltmeter and power source to the electrodes so that they form parallel circuits. Put the electrodes into the water. They can be resting gently on the bottom. Set the voltmeter to the 0-20 VDC range.

Do not switch on the power supply yet. What voltage is observed? Record your observations on the chart.

Step 4

Next, switch on the power supply. What voltage is observed? Record your observations on the chart.

Step 5

Switch off the power supply and hold the electrodes out of the water. Slowly add 5 ml of table salt to the water and stir gently to dissolve the salt. The water will be cloudy at first, but should eventually clear. This is now brine (a salt solution).

Step 6

Put the leads into the brine and switch on the power supply once more. Now what voltage is observed? Record your observations on the chart. Describe what is happening at the cathode and at the anode. Record your observations in your science journal or notebook.

Step 7

Without switching off the power supply, add an additional 5 mL of salt and stir. Now what voltage is observed? Add the remaining 5 mL and repeat the observations.

Step 8

In your science journal or notebook, write the electrode and balanced oxidation-reduction equations for the chemical reactions which occurred in this activity.

Observations and Conclusions

1. Why is salt added to the water?
2. Why do you think that no bubbles were produced before the salt was added?
3. What do you observe happening in the beaker after the salt has been added?
4. How does the higher concentration of salt affect the voltage? Why do you think this is?
5. What are the bubbles made of? Why do you think this?
6. How could you determine experimentally what the gases are that are produced at the cathode and anode?
7. Did you smell something during the experiment? What could that have been?
8. Label the drawing of the apparatus to the right. Be sure to include the cathode, anode, electrodes, electrolyte (brine), voltmeter and power supply. Also show on your diagram the direction of flow of electrons.

Discussion

1. What evidence is there that water can be taken apart by electricity?
2. Explain the process of electrolysis, using this experiment as an example.
3. Define oxidation and reduction. What is being oxidized and what is being reduced in this experiment?
4. How do the oxidation-reduction equations explain what you observed during the experiment?
5. Is distilled water a good electrolyte? Why or why not? What about tap water?
6. What are the potential applications of electrolysis?

Extended Activities

Repeat the experiment using different liquids, such as diluted orange juice (or other citrus juice), tap water, tap water and sulfuric acid, vinegar, etc. How do the voltages compare to those of the salt solution? Write the balanced oxidation-reduction equations for each liquid tried.

2 Fuel Cell

Learning Objectives:

Students will:

- Create an elementary fuel cell from a brine solution
- Write the electrode and balanced oxidation-reduction equations for reverse electrolysis of a brine solution
- Explain the process of reverse electrolysis
- Explain how electrical energy is produced in a hydrogen fuel cell

Teaching Strategies:

- Experimentation involving data collection and analysis
- Balancing oxidation-reduction equations

Materials Needed (Per Group)

- Distilled water – 150 mL
- Table salt (NaCl) – 15 mL
- 5 mL measuring spoon - 1
- 250 mL glass beaker – 1
- Platinum-coated electrodes (or carbon electrodes) – 2
- Electrical wire with alligator clips – 3 black, 3 red
- Power supply (rectifier) or 9-volt battery – 1
- Voltmeter - 1
- Watch with a second hand or stopwatch - 1
- Safety goggles – 1 pair per person

Question: **Can gas molecules react to produce electricity?**

Procedure

Step 1

Switch off the power supply. Try not to bump the beaker so that as many gas bubbles as possible remain attached to the electrodes.

Step 2

Now that the power source is no longer supplying electrons, electrolysis is no longer occurring. Is electricity being produced? Complete the chart below in your science journal or notebook.

Time (s)	Voltage (V)
0	
30	
60	
90	
120	
150	
180	
210	
240	
270	
300	

Record the voltage immediately after turning off the power source (0 s) and at 30 second intervals for 5 minutes. You may need to switch the voltmeter to a more sensitive setting as this is happening.

Step 3

Write the electrode and balanced oxidation-reduction equations for reverse electrolysis of brine in your science journal or notebook.

Step 4

After recording your observations, remove the electrodes from the brine and detach them from the alligator clips. Disconnect all wires and pour out salt solution. Wash glassware and put all materials away.

Observations and Conclusions

1. What is happening at the cathode and the anode?
2. What did you observe about the voltage over time? Why do you think that this pattern occurs?

Discussion

1. What evidence is there that electricity is produced when water is put back together?
2. Explain the process of reverse electrolysis, using this experiment as an example.
3. What is being oxidized and what is being reduced in this experiment?
4. How do the oxidation-reduction equations explain what you observed during the experiment?
5. What type of electrochemical cell is this gas battery?
6. How is a fuel cell different from a storage battery?
7. What are some of the potential applications of this experiment?

Extended Activities

1. Repeat the experiment using different metals for electrodes, such as iron nails, rolled up aluminum foil or graphite pencil leads. How do the voltages compare to those of the salt solution?
2. If you tried different electrolytes in the previous experiment, remove the power source from the electrolytes to find out if they produce electricity and, if so, how much?
3. What are the benefits and drawbacks to this type of energy source?
4. Where can people obtain hydrogen to use in fuel cells?
5. The National Research Council has an institute dedicated to fuel cell research. To find out more about this research and to help with the Fuel Cell Challenge, go to http://www.nrc-cnrc.gc.ca/eng/ibp/ifci.html
6. Where else is fuel cell research happening in Canada?
7. What would be the advantages of hydrogen fuel cells over other sources of energy?
8. How will technology need to change in order to make fuel cells a practical source of energy?
9. If a power source is needed to produce the hydrogen which is used for the fuel cell, then how does this make any ecological sense? How could hydrogen be produced in a renewable way?

3 Exploring Acids and Bases

Frequently, chemists refer to materials as being either an acid or a base.

In order to determine if a material is acidic or basic (alkaline), chemists use a pH Indicator -- pH stands for "potential of hydrogen". A pH Indicator expresses how acidic (like an acid) or basic (like a base) a substance is. pH is indicated by a numbered scale: A pH of 7 is neutral. A pH below 7 denotes acidity while one above 7 denotes alkalinity.

In these experiments, students will make a pH indicator using red cabbage and investigate the properties of several materials found around the home.

Materials:

- one red cabbage
- water
- white vinegar (acetic acid)
- window cleaner (ammonia)
- baking soda (sodium bicarbonate)
- washing soda (sodium carbonate)
- lemon juice (citric acid)
- antacids (calcium carbonate, calcium hydroxide, magnesium hydroxide)
- seltzer water (carbonic acid)
- soft drink

Preparation of the Red Cabbage Indicator:

1. Place about half a red cabbage cut into 2.5-centimeter (1-inch) cubes into a pan and add about 750 millilitres (3 cups) of water
2. Boil on high heat for about 10 minutes.
3. After the water has cooled, strain the mixture through a sieve.
4. The resulting strained liquid, from the red-cabbage extract, is our pH Indicator that we will used to explore the world of acids and bases.

Establish the pH range:

1. Pour 50ml (1/4 cup) of vinegar (acetic acid) into a colourless drinking glass. Add 1/2 teaspoon of red cabbage extract, stir the mixture, and note the colour.
2. Pour 50ml (1/4 cup) of window cleaner (ammonia) into a colourless drinking glass. Add 1/2 teaspoon of red cabbage extract, stir the mixture, and note the colour.

approximate pH:	2	4	6	8	10	12
colour of extract:	red	purple	violet	blue	blue-green	green

Procedure:

Add 1/2 teaspoon of red cabbage to the following and record your observations:

1. baking soda (sodium bicarbonate, $NaHCO_3$)
2. washing soda (sodium carbonate, Na_2CO_3)
3. lemon juice (citric acid, $C_6H_8O_7$)
4. antacids (calcium carbonate, calcium hydroxide, magnesium hydroxide)
5. seltzer water (carbonic acid, H_2CO_3)
6. soft drink

Scientific Note:

The pH number is the negative exponent of 10 representing hydrogen ion concentration in grams per litter. For instance a pH of 7 represent 10-7 grams per litter. i.e. pH = (log10{1/[H+]}).

Consequently each whole pH value below 7 is ten times more acidic than the next higher value. For example, a pH of 4 is ten times more acidic than a pH of 5 and 100 times (10 times 10) more acidic than a pH of 6. The same holds true for pH values above 7, each of which is ten times more alkaline—another way to say basic—than the next lower whole value. For example, a pH of 10 is ten times more alkaline than a pH of 9.

Note: Activity adapted from multiple sources by NRC scientist Dr. Mike Day.

4 Polymers as Molecules

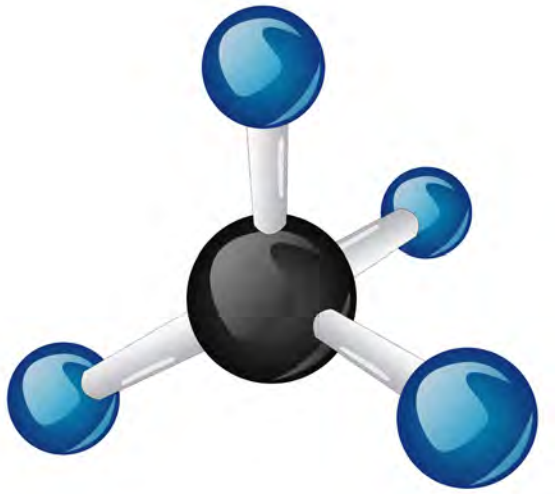
Before you begin, ask your students the following questions:

1. "What are Polymers?"
2. Have the students look around the room and see what materials they can recognize as polymeric or plastic materials.
3. Help them in distinguishing between natural polymers and synthetic polymers.

Demonstration: Build a series of polymer molecules

Materials:

1. Polystyrene craft balls (large and small sizes)
2. Toothpicks or skewers



   a. Construct a simple molecule of methane (CH4) using one large ball and 4 small balls. Explain that methane is made up of one simple single carbon atom and four hydrogen atoms. STSE link: methane is natural gas used to heat many homes in Canada.

   b. Add 3 balls to your methane molecule to construct a simple molecule of ethane (C2H6). STSE link: ethane is a still a simple molecule and is still a gas.

   c. Add 3 more balls to create the molecule propane (C3H8). STSE link: propane is still a gas and is used as the Fuel in many BBQs.

   d. Add 3 balls again to create the molecule butane (C4H10). STSE link: butane is now a liquid, and is commonly used in BBQ lighters.

Using the large balls that represent carbon atoms, you can illustrate the structure of many other molecules based upon carbon and hydrogen. Explain to the students the importance of chain length on properties and what they represent in every day life.

carbon balls = octane, the major component in gasoline
8 carbon balls = octadecane, a grease used in Vaseline
8 carbon balls = octaosane, a solid that is the main component in candle wax

To become a polymer, anywhere from 1,000 to 10,000 balls need to be joined to this chain. You can use a long beaded necklace or length of beaded string to illustrate this concept. A polyethylene garbage bag would have polymer chain that is at least 10 times this length.

5 Make a Slimy Polymer

What are Polymers?

A polymer is a large molecule composed of repeating structural units, connected by chemical bonds. While many people think of polymers as plastics, the term actually refers to a large class of natural and synthetic materials with a variety of properties. The word "polymer" comes from Greek: "poly" means many and "mer" means parts. Most polymers are based upon carbon.

This is a hands experiment in which the students make their own slime.

Materials:

1. Borax laundry booster
2. Warm water
3. White glue
4. Green food colouring
5. Container or jar with tight-fitting lid
6. ZipLock® baggies

    a. Make a borax solution by adding 1/8 cup of borax to a 1/2 litre of warm water in a jar(smaller quantities 1/2 teaspoon borax in 2 tablespoons of warm water). Shake until most of the borax dissolves and let cool

    b. Place 2 teaspoons of white glue into a baggie. Add 2 drops of green food coloring.

    c. Add 2 teaspoons of water close the baggie tight and mix to give a uniform colour.

    d. Now add to the baggie 1 spoonful of the borax solution, close the baggie tight and then squish the baggie to mix once again.

You have now prepared green slime…how revolting!

Recommendation: When working with larger groups, it is helpful to prepare the solution and baggies ahead of time.

6 Balloon Trick

Materials:

1. Balloons
2. Wooden skewers
3. Cooking oil
4. Black magic marker

    a. Inflate a balloon until it's nearly full size and then let about a third of the air out. Tie a knot in the end of the balloon.

    b. Carefully examine the balloon. Notice the thick area of rubber at both ends of the balloon (where the knot is tied and at the opposite end).

    c. Dip the tip of a wooden skewer into the cooking oil, which works as a lubricant.

    d. Place the sharpened tip of the skewer on the thick end of the balloon and push the skewer into the balloon. Be careful not to jab yourself or the balloon with the skewer. Just use gentle pressure (and maybe a little twisting motion) to puncture the balloon.

    e. Push the skewer all the way through the balloon until the tip of the skewer touches the opposite end of the balloon (at the other thick portion.) Keep pushing until the skewer penetrates the rubber.

    f. Breathe a huge sigh of relief and take a bow! Ta-Dah!

    g. Gently remove the skewer from the balloon. Of course, the air will leak out of the balloon, but the balloon didn't pop.

Repeat the experiment again, this time illustrating the hidden "stress" in a balloon.

1. Before blowing up the balloon, draw about 10-15 dots on the balloon with the magic marker. The dots should be about the size of the head of a match. Be sure to draw them at both ends and the middle of the balloon.

2. Inflate the balloon half way and tie the end. Observe the various sizes of the dots all over the balloon. Judging from the size of the dots, where on the balloon are the latex molecules stretched out the most? Where are they stretched out the least?

3. Carefully examine the wooden cooking skewer. Dip the tip in the vegetable oil and use your fingers to coat the skewer with oil.

4. Use the observations that you made previously with the dots on the balloon to decide the best spot to puncture the balloon with the skewer without popping it.

How does it work?

The secret is to uncover the portion of the balloon where the latex molecules are under the least amount of stress or strain. After drawing on the balloon with the marker, you probably noticed that the dots on either end of the balloon were relatively small. You've just uncovered the area of least stress... the ends of the balloon. When the point of the skewer is positioned at the ends of the balloon, the solid object passes through the inflated balloon without popping it.

If you could see the rubber that makes up a balloon on a microscopic level, you would see many long strands or chains of molecules – a polymer!. The elasticity of these polymer chains causes rubber to be stretchy. Blowing up the balloon stretches these strands of polymer chains. Even before drawing the dots on the balloon, you probably noticed that the middle of the balloon stretches more than either end. You wisely chose to pierce the balloon at a point where the polymer molecules were stretched out the least. The long strands of molecules stretched around the skewer and kept the air inside the balloon from rushing out. When you remove the skewer, you feel the air leaking out through the holes where the polymer strands were pushed apart. Eventually the balloon deflates… but it never popped.

Just to prove the point, try pushing the skewer through the middle part of an inflated balloon. The experiment will go out with a bang!

Note: All activities adapted from multiple sources by NRC scientist Dr. Mike Day.

7 A Simulated Martian Greenhouse

Begin by reviewing the following steps, paying close attention to any special instructions and warnings.

Set up a journal in which to record all details related to the construction of your simulated Martian greenhouse and in which to record any observed changes that occur in your greenhouse from day to day and week to week.

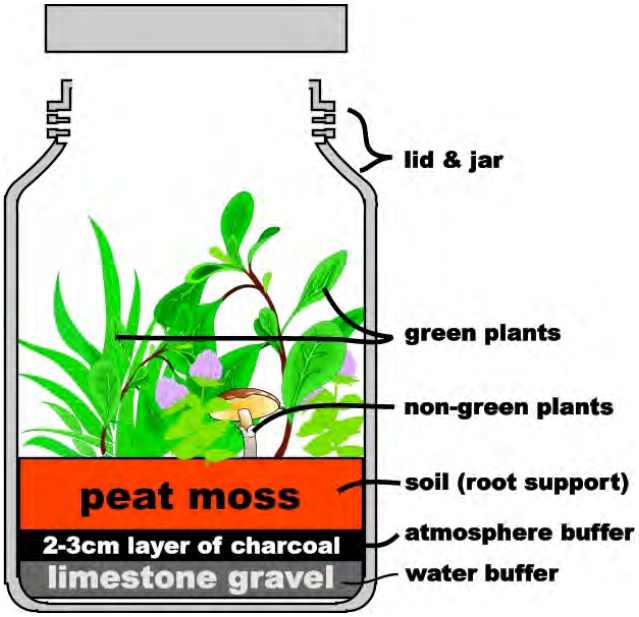
Step 1

To build a simulated Martian greenhouse we need to find a large empty wide-mouth jar (with a lid), like the kind used by restaurants for Heinz ketchup and mustard.

Begin by preparing the soil. The bottom layer should consist of a thin layer of gravel covered with a layer 2-3cm thick of charcoal. These layers act as soil and air buffers to help reduce large swings in the moisture content, and chemical composition, of the atmosphere in your simulated Martian greenhouse.

For root support the top layer of the soil should consist of a layer of peat moss. (For a more realistic Martian soil-simulation, a mixture of sterile sand and clay can be substituted, but its water retention properties are much less than that of peat moss).

Finally, plant an assortment of small green plants, or alternately, plant a few tomato seedings.

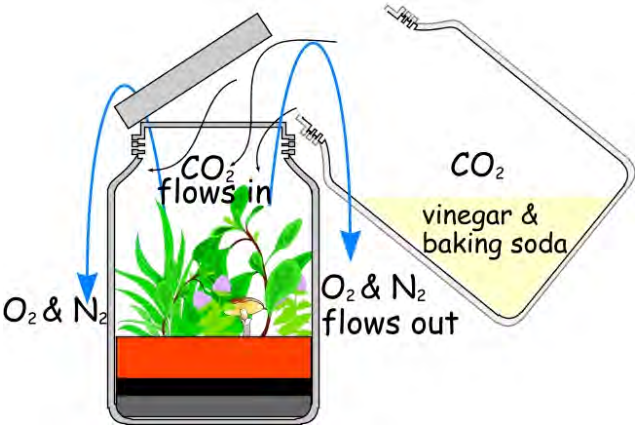


Step 2

Once the plants are installed you may wish to wait a few days to allow the plant roots to establish themselves in their new environment before proceeding to this step.

Prepare the rim of the jar with a light coat of vacuum grease or with a strip of Teflon plumber's tape so that the lid can be installed immediately after the carbon dioxide has been poured into the jar.

To create a carbon dioxide atmosphere we will simply pour carbon dioxide (whose density is greater than that of air) into the jar.



A simple source of carbon dioxide can be obtained by reacting a generous quantity of ordinary baking soda (sodium bicarbonate) with a generous quantity of cold vinegar (diluted acetic acid) in a very large container. Allow the reaction to subside, then carefully pour the carbon dioxide (which is denser than air) into the greenhouse.

Step 3

The last step before screwing down the lid is to use a pair of tongs to insert a hot (120°C) bar of charcoal (which has been oven heated for at least one hour) into the jar. SEAL IMMEDIATELY!

Oven heating the bar of charcoal drives moisture and gases out of the bar. As the bar cools it will absorb an enormous quantity of carbon dioxide and will significantly reduce the gas pressure within the jar.

Step 4

The thin layer of vacuum grease (or Teflon ribbon) provides an airtight seal which preserves the low gas pressure within the jar, simulating a low pressure carbon dioxide Martian greenhouse atmosphere.

CAUTION: A sealed glass container should always be handled carefully.

Your simulated Martian greenhouse begins with a slight negative pressure of mostly CO2 but the pressure can drop dramatically because of carbon dioxide's very high solubility in water.

Water on the other hand evaporates very rapidly under low pressure conditions. If your jar is left in a sunny or hot environment the pressure inside can rise well above normal atmospheric pressure, resulting is an exploding jar!

Always wear eye protection and gloves when handling your micro-ecosystem.

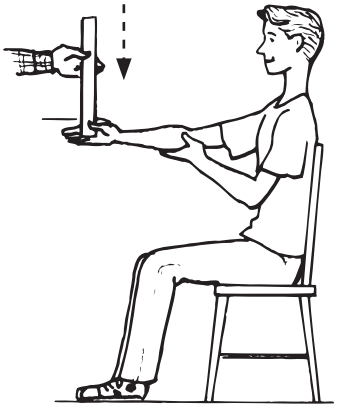
Alternative to Step 2

If a compressed CO2 cylinder is available then CO2 can be added directly into the jar to displace the oxygen and nitrogen inside.

8 Catch a Falling Ruler

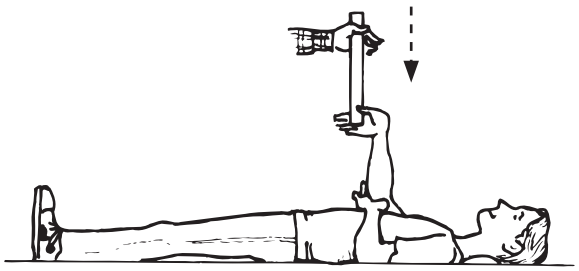
Work in a group of three. Choose a subject, a recorder and a team leader.

Trial #1



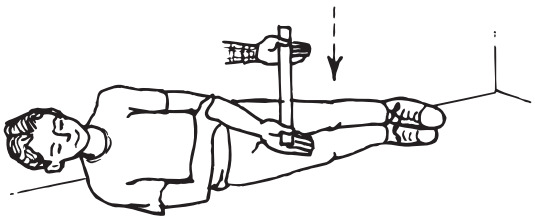
1. The subject sits in a chair, extends her/his arm forward and supports the elbow with the opposite hand.
2. The team leader places a 30 cm ruler upright between the subject's thumb and index finger so that the 0 mark on the ruler is at the upper edge of the subject's thumb.
3. Release the ruler. The subject catches it. The recorder records the measurement at the subject's thumb.

Trial #2



1. Repeat the procedure with the subject lyring on his/her back. Hold the dominant arm upright and extend the opposite arm across the body and support the elbow.

Trial #3



1. Repeat the procedure with the subject lyring on his/her side with the dominant side up and the arm bend at the elbow and extended outward. Support the arm with the opposite hand.

As a team, compare the results of the three trials.

- Which position felt most comfortable?
- Does the response time vary from position to another?
- What explanation can you suggest for the variance?

Since the astronaut does not have the opportunity to conduct all of his/her work in a typical body positions, how might this affect productivity?

What training can you suggest?

9 Census game

Overview

This activity uses a game format to encourage students to develop knowledge of Canada's demographic, social and economic features. Questions address the local, regional and national implications and are arranged by increasing difficulty to add to the challenge of the exercise.

Materials

- Teacher's Guide
- Handout 1: Census geography game sheets
- Handout 2: Canada's population distribution

Getting started

1. Before students participate in this activity, they will need background information. Discuss or photocopy the information on the census found in the Teacher's Guide, or use Quick Census Facts (also in the Guide). Explain that the census provides a wide range of information about Canada.

2. Each team should receive Handout 1: Census geography game sheets and Handout 2: map of Canada's population distribution. Allow students a few moments to look at the handouts. The map in Handout 2 will be useful for answering some of the questions in the activity.

3. Teams could suggest team names. Since each team begins with a score of zero (0), write one large zero for each team below the team names on the blackboard. Decide the order of play (e.g., alphabetical order of team names). You may want to limit the number of categories in play depending on the time available.

4. Describe how to play the game as detailed in the following "Census activity" section. In brief, a team picks any topic from the six categories on the game sheet, the teacher reads the "answer" and the team provides the "question." Points are awarded or removed depending on whether an acceptable response is given. The point values for the topics increase to reflect their difficulty. Do a practice round using the sample in Handout 1.

Census activity

1. Each team in turn has the opportunity to select a topic listed under one of the categories on the game sheet (Handout 1). From the Answers and questions, the teacher reads the appropriate answer to the team. Time is then allowed for the team to confer, reach a consensus and respond with the question (about one minute).

2. If the question is acceptable to the teacher, the team is awarded the number of points shown for the topic on the game sheet. The team's score is increased on the blackboard and the topic is eliminated. Incorrect questions reduce the team's score by the value of the topic and this topic remains in play. Any answer completes a turn and the play moves on to the next team. Eight topics have double points (bonus questions). These can be changed by the teacher.

3. The game is over when all the topics have been used or when time has run out. Leave time to tabulate the final score and announce the winning team.

Handout 1: Census geography game sheets

Game sheet 1

Team name: _____

Team members: _____

Categories: _____

Sample exercise

Topic: MONTH (5)

Answer: This is the month when all people living in Canada are counted.

Question: What is May 2011?

1. Census	2. Geography	3. Who am I?	4. Settlement	5. Results	6. At home
COUNT (5)	BIG (5)	ARRIVAL (5)	AREA (5)	WATER (5)	HOME (5)
TIME (10)	COMPLETE (10)	MOVE (10)	DOT (10)	METALS (10)	DRAW (10)
DATE (15)	ASIA (15)	CITY (15)	CLUSTER (15)	NARROWS (15)	MOVE (15)
FARM (20)	ORIGIN (20)	ROOTS (20)	DOUGHNUT (20)	DOUBLE V (20)	WORK (20)
SAMPLE (25)	ABORIGINAL (25)	FIRST (25)	GATEWAY (25)	LANDFALL (25)	PLACES (25)

Handout 1: Census geography game sheets

Game sheet 2

Team name: _____

Team members: _____

Categories: _____

Sample exercise

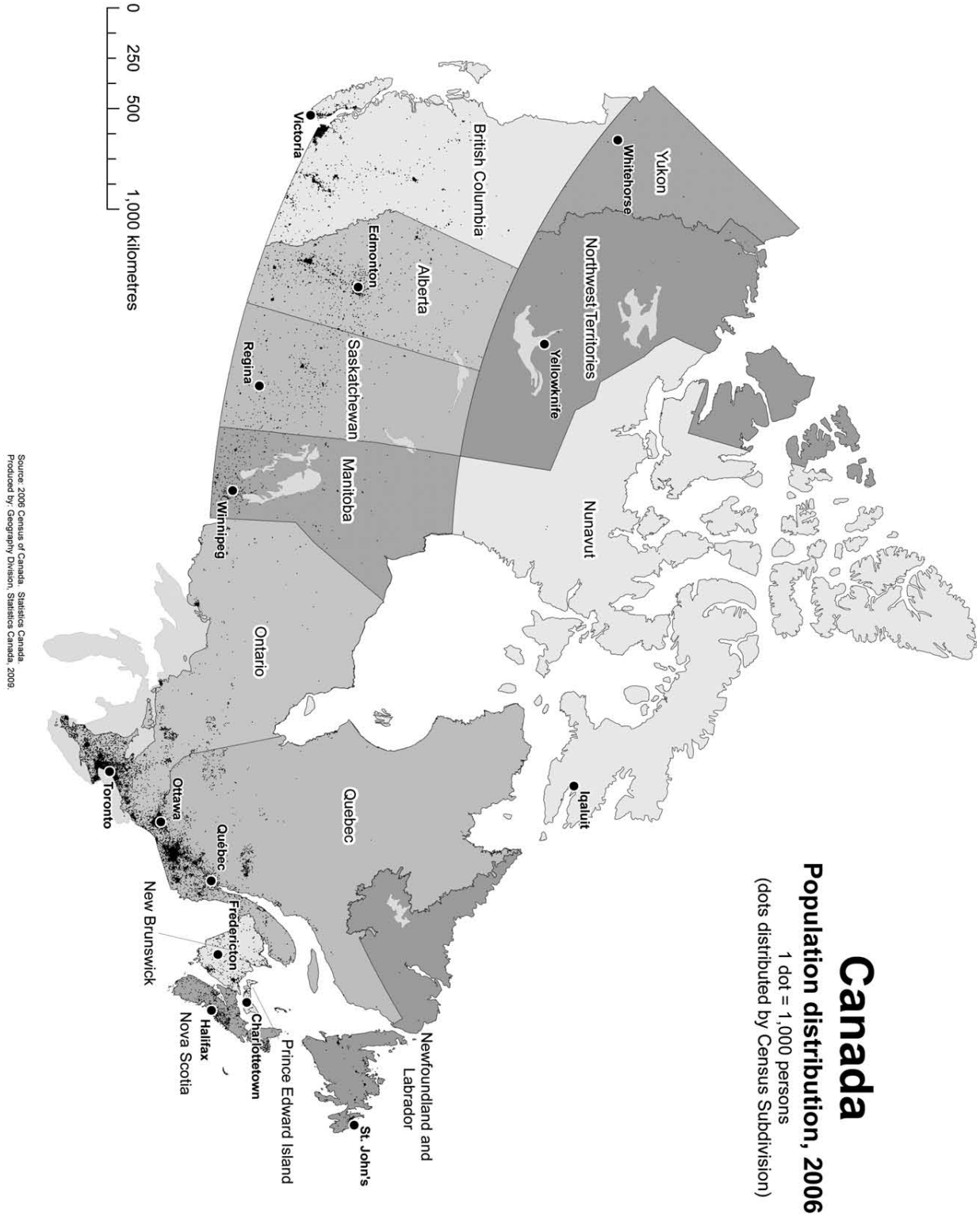
Topic: MONTH (5)

Answer: This is the month when all people living in Canada are counted.

Question: What is May 2011?

1. Census	2. Geography	3. Who am I?	4. Settlement	5. Results	6. At home
HOW (5)	NEW (5)	BIRTH (5)	FEW (5)	YOUTH (5)	SPOT (5)
LAW (10)	FOOD (10)	SMALL (10)	CLUSTERS (10)	ADS (10)	NEWS (10)
NEW (15)	URBAN (15)	NEW (15)	ISLAND (15)	GRANTS (15)	DWELLING (15)
FACTS (20)	NORTH (20)	WORK (20)	WATER (20)	SEATS (20)	GROUP (20)
TERM (25)	SEATS (25)	GUIDE (25)	COASTAL (25)	SECTIONS (25)	SPEAK (25)

Handout 2:


Canada
Population distribution, 2006
1 dot = 1,000 persons
(dots distributed by Census Subdivision)
Yukon
Whitehorse
Northwest Territories
Yellowknife
Nunavut
Iqaluit
British Columbia
Victoria
Alberta
Edmonton
Saskatchewan
Regina
Manitoba
Winnipeg
Ontario
Toronto
Ottawa
Quebec
Québec
Newfoundland and Labrador
St. John's
Prince Edward Island
Charlottetown
New Brunswick
Fredericton
Nova Scotia
Halifax
0 250 500 1,000 kilometres
Source: 2006 Census of Canada. Statistics Canada
Produced by: Geography Division, Statistics Canada, 2009.

10 That's easy for you to say

The population of Canada in 2006 was 31,612,897. That was easy to say wasn't it? In a few breaths you have just stated what took years to produce. Have you ever tried to count 31,612,897 people? It's a big job!

It is difficult to describe how big a job it really is to take a census in Canada. In 2006, 25,000 temporary employees were sworn in under the Statistics Act to work for the census. These people were trained, equipped and supervised so that the portrait of Canada from the 2006 Census would be as accurate as possible.

Once all the completed census forms were received in the data processing centre, information from the questionnaires had to be scanned and the long task of analysing, interpreting and publishing the data could begin.

A good way to understand the many aspects of planning, conducting and reporting a survey is to take one yourself. If you want to conduct a survey in your school, take a look at the checklist of questions that must be answered before you can get it off the ground. Once you've answered these questions, it will be easy to walk up to someone and say, "Hi! I have a few questions to ask you."

Defining the task

- Do you have permission to conduct a survey?
- How much time do you have for the whole project? (days, class periods)
- Will this be a class project or something larger?
- Will this be a census covering the entire school or a survey of a portion of the school population?
- Will you collect facts or is this an opinion poll?
- When and how will you collect the information?
- What are the major topics you will research and why? (for example, youth issues, school issues)

Designing the questionnaire

- What type of questions will you use? (for example, multiple choice, fill-in-the-blank)
- How many topics do you want to include?
- How many questions will you ask? (If two topics, how many questions per topic?)
- How many possible answers will there be for each question?
- Are the questions concise and easy to understand?
- Do you want to include background questions like name, age, sex, grade, or where the person lives?
- Will your questions provide the data you are seeking?
- How are the questions arranged on your form?
- How will your forms be printed? (Could the school newspaper / office print them?)

Collecting the data

- Who will answer the questions?
- Is this a personal interview or is it a self-completed survey?
- How will you deal with the privacy of the respondent's information if you ask for their names?
- How will you get everyone to respond?
- Do you need publicity?
- What will you do if someone is away or does not answer?
- How will you make sure that everyone is counted only once?
- How will you know that all the forms were returned?

Processing the data

- How will you check the returned questionnaires for completeness?
- How will you summarize the data? (For example, will you use tables, graphs, or charts?)
- Is the questionnaire designed to make this easy?
- Will you be using a computer or tallying by hand?
- How does the use of one or the other affect the amount of time you need or how much you can ask?
- How will you check to make sure there are no errors in the processing?
- If processing is done on a computer, how will you construct the database?
- If it is done by hand, how will you record the data (on a form, on the chalkboard, something else)?

Reporting the data

- How will you report the data?
- What tables do you want to make?
- Do you want to include graphics, like a bar or pie chart?
- Would percentages help you communicate the data better?
- Do you want to write a report about the findings?

Handout 2: Student survey on future plans

Directions: For each question, select 1 response. Your answers will be completely confidential; only summary data will be reported.

Thank you for taking the time to complete this survey. Getting your answers and those from others is important in producing accurate data.

1. How old are you?

- **a.** less than 12
- **b.** 12
- **c.** 13
- **d.** 14
- **e.** 15
- **f.** 16
- **g.** 17
- **h.** 18
- **i.** 19
- **j.** Older than 19

2. What is your sex?

- **a.** Male
- **b.** Female

3. What languages do you speak well enough to have a conversation? Write in the "other" language on the line provided.

- **a.** English only
- **b.** French only
- **c.** other(s)
- **d.** English and French
- **e.** French and other(s)
- **f.** English and other(s)
- **g.** English, French and
- **h.** other(s)

4. How many hours did you spend last week working for pay?

- **a.** under 5 hours
- **b.** 5 to 9 hours
- **c.** 10 to 19 hours
- **d.** over 19 hours
- **e.** none (go to question 6)

5. In what type of business, industry or service did you work? Write in your answer on the line provided. (Give details. For example: food service industry, childcare, retail sales)

_____

6. After high school, which of the following do you plan to do?

- **a.** attend a trade school
- **b.** attend a college or university
- **c.** join the police / firefighters / member of the military
- **d.** get a full-time job
- **e.** travel
- **f.** none of these

7. Rank the top three occupations you would MOST like to pursue after school. Enter "1" beside your first choice; "2" beside your second and "3" beside your third.

- ___ truck driver
- ___ salesperson
- ___ teacher
- ___ administrative assistant
- ___ nurse
- ___ social worker
- ___ farmer
- ___ tradesperson — carpenter / mechanic / electrician
- ___ web designer
- ___ childcare worker / babysitter / nanny
- ___ doctor
- ___ homemaker
- ___ fisherperson
- ___ police officer / firefighter / member of the military
- ___ stockbroker
- ___ computer analyst / programmer
- ___ lawyer
- ___ artist / cultural worker
- ___ engineer
- ___ civil servant
- ___ businessperson
- ___ forest ranger
- ___ chef
- ___ hairdresser / esthetician
- ___ writer
- ___ other

8. Rank the top three occupations you would LEAST like to pursue after school? Enter "1" beside your first choice; "2" beside your second and "3" beside your third.

- ___ truck driver
- ___ salesperson
- ___ teacher
- ___ administrative assistant
- ___ nurse
- ___ social worker
- ___ farmer
- ___ tradesperson — carpenter / mechanic / electrician
- ___ web designer
- ___ childcare worker / babysitter / nanny
- ___ doctor
- ___ homemaker
- ___ fisherperson
- ___ police officer / firefighter / member of the military
- ___ stockbroker
- ___ computer analyst / programmer
- ___ lawyer
- ___ artist / cultural worker
- ___ engineer
- ___ civil servant
- ___ businessperson
- ___ forest ranger
- ___ chef
- ___ hairdresser / esthetician
- ___ writer
- ___ other

Statistics Canada

11 Breads of the world

People make bread in every country of the world. They mix flour or meal with water or other liquids. They may add a little fat (like oil or butter) and a rising agent (such as yeast) and cook the mixture in a pan or oven. Sharing bread with guests can be a way to make them feel welcome.

Below are the names of some of the breads we eat here in Canada which come from all over the world. Can you match the name of the bread to its description?

Home-made breads	Answers	Country of origin
A. Baguette		Ethiopian bread, very thin (teff grain, or millet and barley)
B. Bannock		bread from the Caribbean and India (whole wheat)
C. Challah		a long thin loaf of French bread (wheat)
D. Injera		First Nations' bread, of Scottish origin (oatmeal or barley)
E. Naan		Italian fruit bread for Christmas (wheat or millet)
F. Johnnycake		corn bread (corn), an early American staple food
G. Panettone		dark rye bread from Eastern Europe (rye)
H. Pita		Mexican bread (corn or wheat)
I. Pumpernickel		Mediterranean pocket bread (wheat)
J. Roti		Jewish egg bread (wheat)
K. Tortilla		white bread from India (wheat)

12 Land size conversions and comparisons

The metric system became standard in Canada in 1977. The metric unit for measuring farmland is hectares.

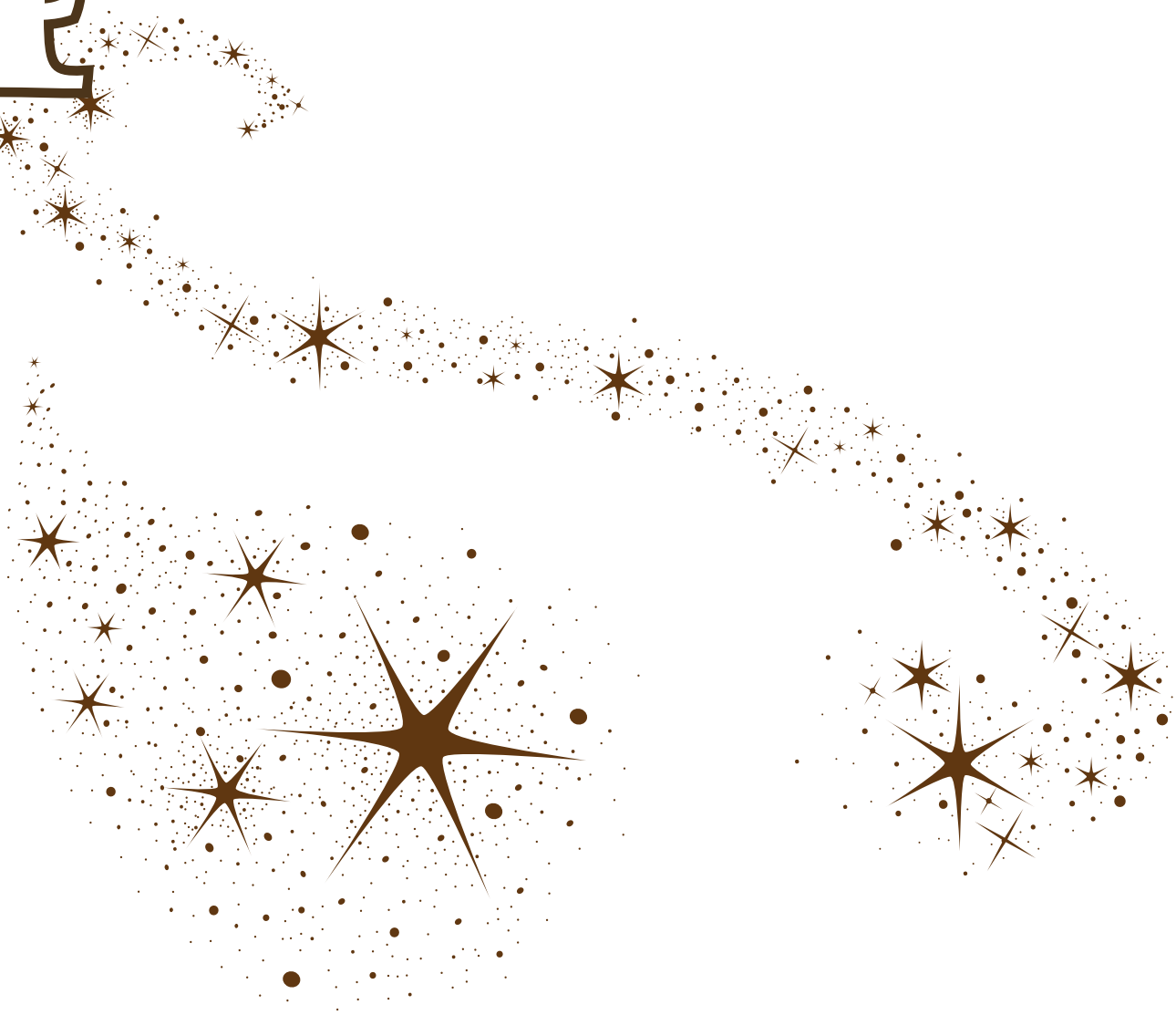
Using the information below, complete the following table by converting the measurements into hectares and/or square metres. Measure your classroom in square meters. Is the measurement of your school grounds available? If so, enter the number in square meters. Convert both the classroom and the school grounds measurement into hectares.

1 hectare [ha] = 10,000 square metres [m^2])

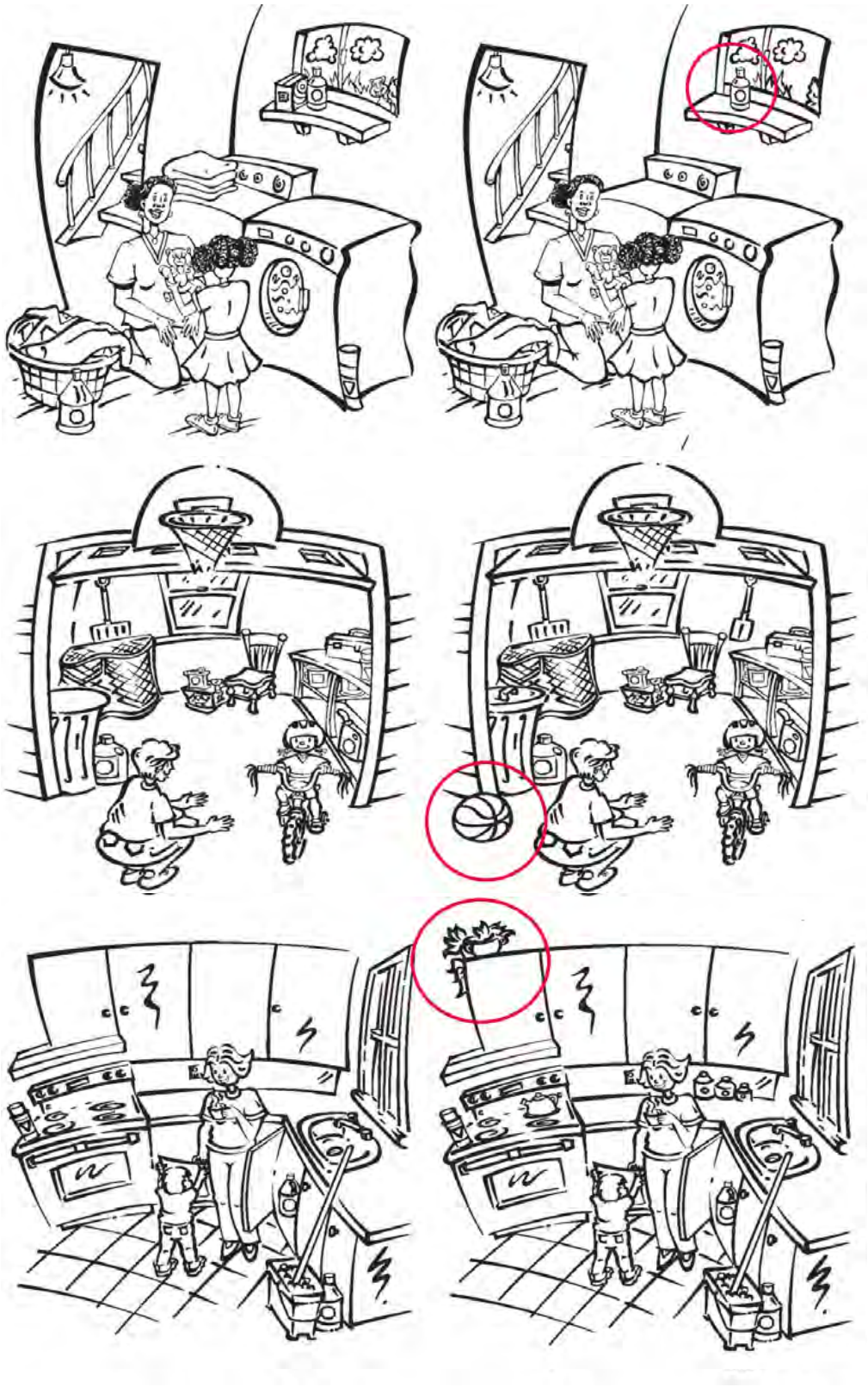
	Hectares (ha)	Square meters (m^2)
Standard prarie field	64.78	
Urban lot for a house		
Average size of a farm in Canada in 2006	294.74	
Average size of a farm in Newfoundland and Labrador in 2006	64.78	
Average size of a farm in Saskatchewan in 2006		5,866,400
Your school grounds		
Your classroom		

How many classrooms, the size of your current classroom, would fit into 1 ha?

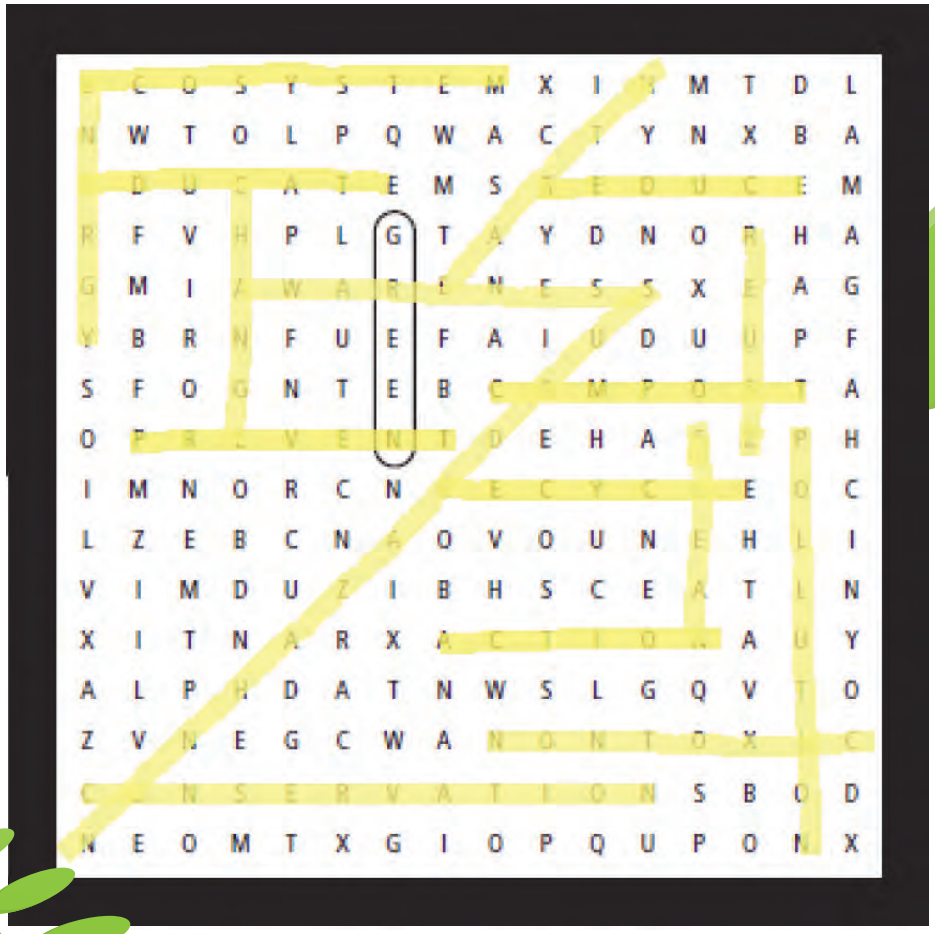
4 Answer Key



1 Spot the difference



2 Environmental Word Search



Circle the Word

Circle all the words listed below in the puzzle.

Look carefully as some words can overlap and run in any direction.

action	conservation	~~green~~	recycle
awareness	earth	nonhazardous	reduce
change	ecosystem	nontoxic	reuse
clean	educate	pollution	
compost	energy	prevent	

3 Recycling Maze

Help Steve, the student recycle the cans on his way to school.

Find a path which enters the maze and goes through all the cans an recycling boxes, without using any part of the path more than once. He must collect two cans before going to each recycling box.

4 Definition Match and Symbol Identification

Definition Match

Draw a line from the word to its meaning.

1. **Flammable**
2. **Corrosive**
3. **Poison**
4. **Explosive**
5. **Quick skin-bonding adhesive**

Licking, eating, drinking, or sometimes smelling this product can cause illness or death.

These "super glues" can glue skin with skin.

This product, or its fumes can catch fire easily if it is near heat, flame or sparks.

This container can explode if it is heated or punctured

This product can burn skin or eyes, or throat and stomach, if you drink it.

Symbol Identification

Explosive

Corrosive

Flammable

Poison

5 Jumble Words

Unscramble the following words and, using the highlighted letters, find the **secret word!**

1. **Y G R E N C L C I**
   R E [C] Y C L I N G

2. **I T A N - G D L N I I**
   A N T I - I D [L] I N G

3. **G G T H I L I N**
   L I G H T [I] N G

4. **M S T C O P O**
   C O [M] P O S T

5. **R O T H S E T M T A**
   T H E R M O S T [A] T

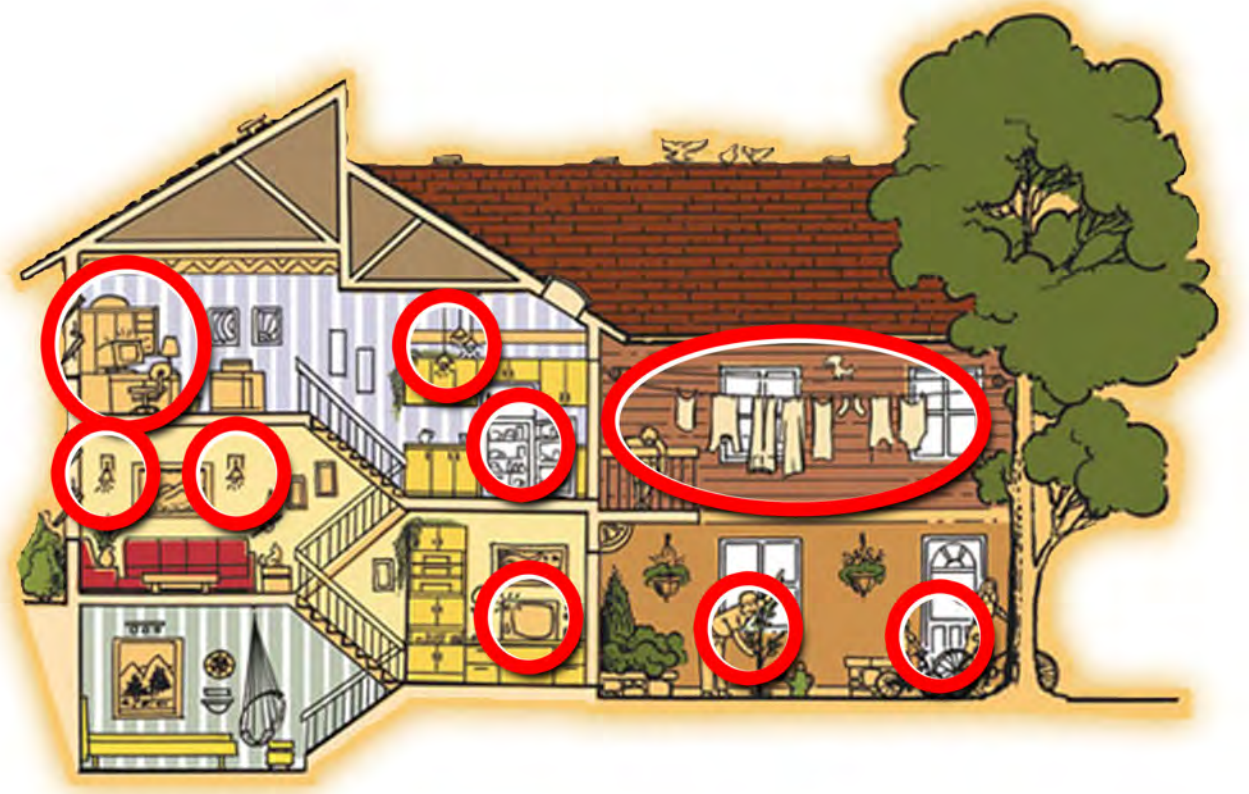
6. **R U N T F O F**
   [T] U R N O F F

7. **Y E R E G N**
   E N [E] R G Y

Secret word: [C] [L] [I] [M] [A] [T] [E]

6 Find them

In this picture, there are four "energy wasters" and three "energy savers." Can you FIND THEM?



7 Crossword

Word Search

F	A	R	M	B	A	E	N	V	F
L	P	F	F	A	T	N	U	E	O
A	R	R	N	G	G	E	T	G	O
W	O	U	M	E	R	R	R	E	D
A	T	I	E	R	A	G	I	T	P
S	E	T	A	M	I	Y	E	A	L
H	I	C	T	S	N	E	N	B	A
D	N	D	A	I	R	Y	T	L	N
V	I	T	A	M	I	N	D	E	T
E	A	T	I	A	N	I	M	A	L
B	A	C	T	E	R	I	A	E	T

The words listed below are hidden in the word search puzzle. Some are written across and some are written down. Can you find them all?

- ANIMAL
- BACTERIA
- EAT
- ENERGY
- FARM
- FAT
- FOOD
- FRUIT
- GERMS
- GRAIN
- MEAT
- NUTRIENT
- PLANT
- PROTEIN
- VEGETABLE
- VITAMIN
- WASH

Use the remaining letters to complete the sentence below:

I must eat a balanced diet **to be healthy.**

8 Mystery Phrase!

How to play:

In the following table, each symbol represents two letters. Use this code to find the mystery phrase!

S	T	A	R	T		A	N
?	&	!	%	&		!	!

E	N	E	R	G	Y
%	!	%	%	&	£

C	O	N	S	E	R	V	A	T	I	O	N
#	@	!	?	%	%	+	!	&	+	@	!

P	R	O	G	R	A	M		I	N
#	%	@	&	%	!	¥		+	!

Y	O	U	R		S	C	H	O	O	L
£	@	*	%		?	#	*	@	@	£

!	@	#	$	%	?	&	*	+	=	¿	£	¥
A	B	C	D	E	F	G	H	I	J	K	L	M
N	O	P	Q	R	S	T	U	V	W	X	Y	Z

9 Find the Meaning!

How to play:

We've chosen some picture for you.

What do you think each one represents?

Answer by filling in the grid.

					[1]S				
[2]T				[3]O	C	E	A	N	
R					H				
[4]E	T	[5]H	A	N	O	L		[6]L	
E		Y			O			I	
		B			L			G	
[7]E	A	R	T	H				H	
		I						T	
[8]W	I	N	D	M	I	L	L	B	
			C					U	
[9]S	O	L	A	R	P	A	N	E	L
			R						B

Down:

2.

1.

6.

5.

Across:

4.

3.

7.

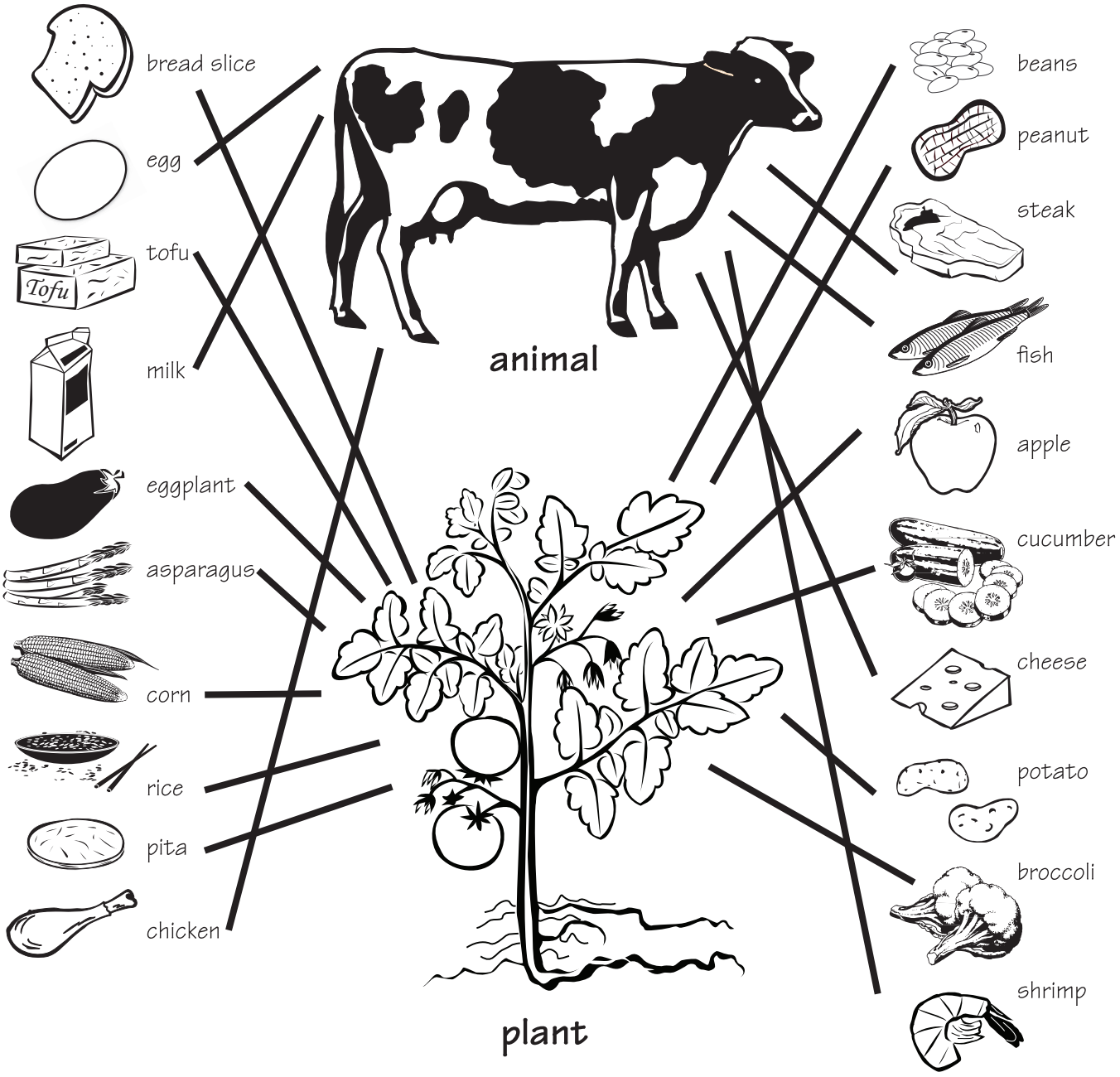
8.

9.

10 Plant or Animal?

Is it a plant or an animal?

If the food product comes from a plant, draw a line to the tomato plant. If the food product comes from an animal, draw a line to the cow.



11 Word Scrambles

Easy

HSFI	FISH
ASLE	SEAL
ELE	EEL
RABC	CRAB
NDAS	SAND
ISDUQ	SQUID
ENCAO	CANOE

Medium

LMCA	CLAM
LEPK	KELP
ONOL	LOON
FERE	REEF
LGLU	GULL
CORA	ORCA
TOBA	BOAT
NUTA	TUNA
RHKAS	SHARK
INLAS	SNAIL
ETROT	OTTER
HEWLA	WHALE
RCALO	CORAL
CBAHE	BEACH
BCASU	SCUBA
GEALA	ALGAE

HARD

LTREUT	TURTLE
RLASUW	WALRUS
IRMNAL	MARLIN
SMEULS	MUSSEL
NALSOM	SALMON
HPLINOD	DOLPHIN
HRNWALA	NARWHAL
GLABUE	BELUGA

12 Environment Week Quiz

1. Planting trees in your neighbourhood is one of the best things you can do for the local environment and for the planet because:

d. All of the above

Trees are like the lungs of the planet. They breathe in carbon dioxide and breathe out oxygen. Additionally, they provide habitat for birds and other wildlife. But that's not all! Trees help reduce ozone levels in urban areas. They absorb sound and reduce noise pollution. Planting trees can also help cool your home in the summer. Trees are essential to the planet and to humans, so plant a tree and reap in the many benefits!

2. Choosing ENERGY STAR-qualified products when replacing old equipment can cut your household energy bills by:

c. Approximately 30%

The more energy efficient a product is, the less it costs to operate – an important consideration for consumers in these days of rising energy costs. Choosing ENERGY STAR qualified products when replacing old equipment can cut household energy bills by about 30 percent.

3. Humans use at least 40,000 species of plants and animals every day for their different needs.

a. True

We rely on biodiversity for many things, including food, medicine, clothing and shelter. Some of the ways biodiversity is lost are through:

- Habitat destruction
- Introduced species
- Pollution
- Population growth
- Over-consumption

4. Which of the following species are at risk in Canada?

d. All of the above

According to the Committee on the Status of Endangered Wildlife in Canada, there are currently 487 plant and animal species at risk in Canada. The Prairie-Chicken, Grizzly Bear and Atlantic Walrus are just a few examples.

5. Biodiversity only includes the number of different species of plants, animals and microorganisms in existence.

b. False

Biodiversity is most often understood as the number of different species of plants, animals and microorganisms in existence. However, biodiversity also includes the specific genetic variations and traits within species, as well as the collection of these species within ecosystems.

6. The way to guarantee that a plugged-in electronic device is not consuming power is to:

c. Unplug device from the outlet

A growing number of household electrical devices are designed to draw power 24 hours a day, seven days a week. Even when turned "off," these appliances and home electronics continue to use electricity to operate features, such as clocks, timers and touch pads, or to receive signals from remote controls. Battery chargers (used by products such as cordless phones) or external power supplies (used by products such as laptops) also draw power when they are plugged in – even if the device they power is fully charged or disconnected. Some electronics (such as television set-top boxes) are always awake, waiting to receive information. If unplugging the device from the outlet is not convenient, you can use a powerbar and turn it off when not using the appliances.

7. Ocean ecosystems are able to:

d. All of the above

Ecosystems are incredibly productive and efficient--when there is sufficient biodiversity. Each form of life works together with the surrounding environment to help recycle waste, maintain the ecosystem, and provide services that others--including humans--use and benefit from.

8. It is better to have a larger, energy-efficient refrigerator than a smaller refrigerator of the same model.

a. True

A model that is too big wastes money and energy, and one that is too small could waste energy if it becomes overcrowded with food and drinks. It is better to have a larger, energy-efficient refrigerator than a smaller inefficient model.

9. If every driver of a passenger car or small truck avoided idling by three minutes a day, collectively over the year, we would save:

d. All of the above

Reducing idling is easy and has real environmental, health and financial benefits for drivers. Most of us are guilty of idling. So shut off your engine the next time you are in the drive-through lane or waiting to pick someone up. By reducing idling, you can save money on gas, and improve the quality of air you breathe!

10. Which of the following residential waste will green bins NOT turn into compost?

a. Plastics

Unless the plastic is specially designed to decompose in the soil, such materials can last a very long time because the chemical bonds that hold the molecules together are often stronger than nature's power to take them apart. This means that soil micro-organisms that can easily attack and decompose wood and other formerly living materials cannot break the various kinds of strong bonds that are common to most plastics. If you must use disposable bags, prefer paper ones.

13 Important Decisions Don't Just Happen

Overview

This activity gives students hands-on experience with census data, introduces them to data for small geographic areas, refines decision-making skills and demonstrates some of the actual uses of information collected by the census.

Duration: 1-2 class periods

Note: See the Teacher's Guide (http://census2011.gc.ca/ccr02/ccr02a/ccr02a_010-eng.htm) for general background on the census and census vocabulary.

Learning objectives

- Interpret a statistical table and a grid map.
- Sort and rank numeric values.
- Graphically display information on a grid map.
- Name at least one type of information collected in a census.

Vocabulary

census, census data, grid map

Materials

1. **Handout 1: Important decisions don't just happen!**
2. **Handout 2: Census data** — **Table 2: Population by neighbourhood.** (Optional to make an overhead rather than pass out individual copies.)
3. **Handout 3: Census grid map of Maple and "Student exercise" instructions.** (You may wish to make an overhead of this handout so that you can use it when explaining the exercise and when reviewing the answers with the class.)
4. Coloured pencils or markers (not included).

Getting started

Ask your students to imagine that they work for a company called Data-R-Us, which provides statistical data to the public. Data-R-Us will be looking at statistical data for a town called Maple, a community where 75% of the families have children younger than six years of age. What special concerns do they think the residents of this community have?

Ask your students to brainstorm ideas for the kinds of special services a town like Maple should offer. The answers will vary but will probably include schools, daycare centres, playgrounds, libraries, sports complexes and health centres.

Have students explain their recommendations. Ask what factors influenced their decisions. Did they consider the number of families with young children?

Share with the students, that in today's world, millions of dollars can be lost on a guess. That's why people need facts to make decisions. For example, retail businesses use data to help choose new locations or to add new products and they often turn to data that have been gathered by the census.

1. Explain to the students that real-life decisions require the support of this type of statistical information. The Canadian census is an important source of current statistical data and it is conducted by Statistics Canada every five years. The next census will take place in May 2011.

   Allot time to discuss the upcoming census with the class and how census data are used everyday in our communities. Census data are used at the local, provincial and federal government levels as well as by community organizations, businesses and individuals. (See "Who uses census data?" in the Teacher's Guide.)

2. Tell the students that, as employees of Data-R-Us, they are going to complete four requests that have come in from the town of Maple. They will use the statistical data provided to give their recommendations to the clients.

Teacher instructions

1. Distribute Handout 1. Explain to the students that they are going to be researchers at Data-R-Us. Their task will be to select the most appropriate neighbourhoods, in the fictional town of Maple, for new community services. Read Handout 1 aloud (or have student volunteers read it for you) and discuss Table 1.

2. This exercise lends itself to group work. Divide the class into groups of three to five students and tell them that they will be asked to work together to determine where to locate the services on a map.

3. Distribute Handout 2 and discuss Table 2. Column 1 lists each neighbourhood by number; column 2 the population aged 15 years and under; column 3 lists the population aged 65 years and over; and column 4 lists the total population including people who are older than 15 and younger than 65. To demonstrate how to interpret the data presented in Handout 2 Table 2, discuss the following with the class: The largest number of people 15 years of age and younger is in neighbourhood 1. Also in this neighbourhood you will see that there are more children than seniors (people – 65 years and over). Based on this information, neighbourhood 1 will be a neighbourhood to consider for a playground.

4. Students will use Handout 1 Table 1 and Handout 2 Table 2 to decide on the best neighbourhoods for each service. This will be determined by finding neighbourhoods with the largest number of people who need the service. For example, for the playground, they will choose the neighbourhoods with the greatest number of children.

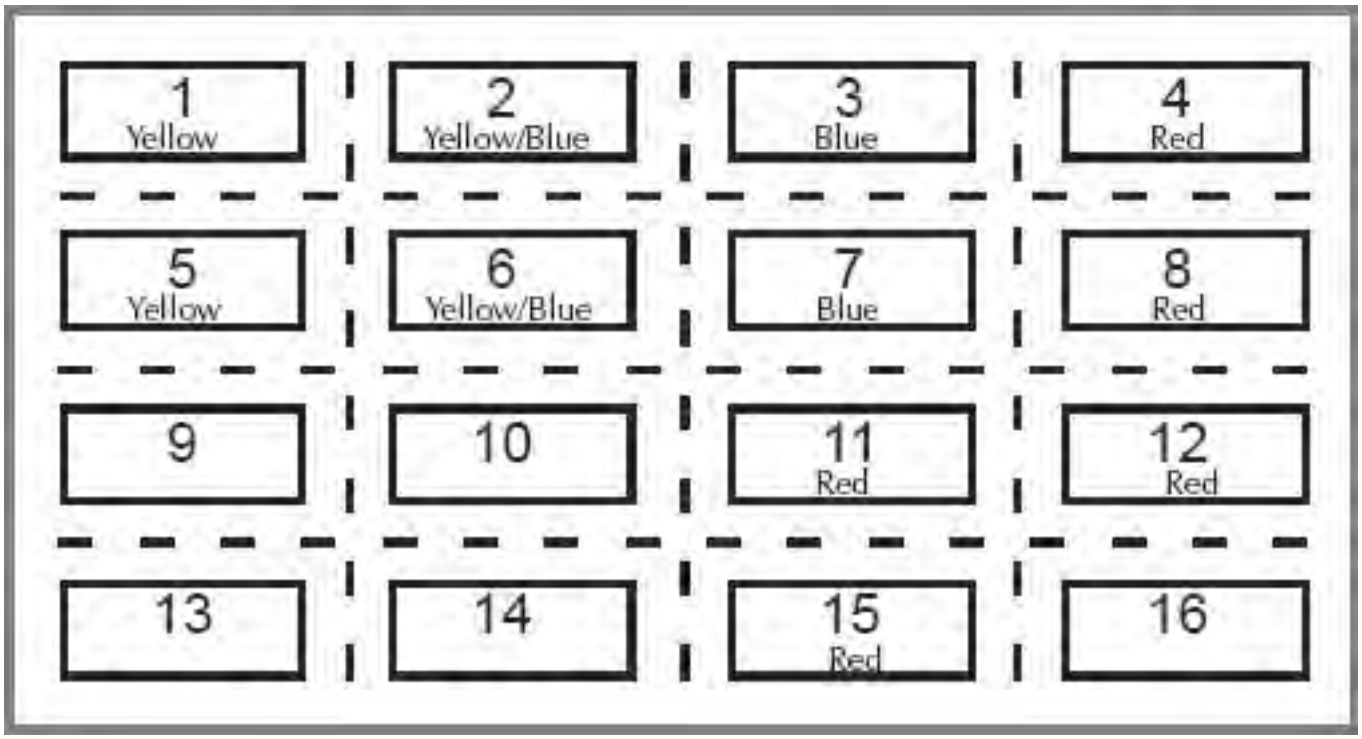
5. Distribute Handout 3 to each group or to each student. This handout is a grid map of Maple where each neighbourhood is identified by a number. It also contains the specific instructions the students should follow to complete the exercise — under the title "Student exercise."

Table 2: Population by neighbourhood

Neighborhood	People - 15 years and under	People -65 years and over	Total population
1	175 *	79	365
2	170 *	190 *	450
3	5	250 *	312
4	95	145	520 *
5	171 *	94	470
6	150 *	201 *	440
7	65	220 *	335
8	84	98	522 *
9	20	100	207
10	27	5	171
11	90	78	568 *
12	75	43	608 *
13	17	76	192
14	15	22	169
15	120	11	632 *
16	20	1	163

* largest number of people in each category

Census map of Maple



14 Where are we from?

Overview

This activity makes students aware of the countries in which people who immigrate to Canada are born. Students will gain an understanding of the multicultural nature of Canadaian society by examining the cultural diversity present within their classroom.

Duration: 1-2 class periods. As an enrichment exercise, they can look at how immigrants contribute to our society.

Note: See the Teacher's Guide for general background on the census and census vocabularly.

Learning objectives

- Develop an awareness of the countries in which people who immigrate to Canada are born.
- Help students locate their country of birth on a world map.
- Explore / express personal experiences of immigration to Canada through pictures or stories.
- Recognise contributions that immigrants have made and continue to make to Canadian society.

Vocabulary

diversity, immigrate, immigration, immigration source areas, place of birth

Materials

- Teacher's Guide (http://census2011.gc.ca/ccr02/ccr02a/ccr02a_010-eng.htm)
- Handout 1: Immigration source areas
- Handout 2: Immigrant population by co
- Handout 3: How immigrants contribute to Canada

Getting started

Using the background information provided in the Teacher's Guide, tell students about the census and let them know that Canada's next census takes place May 2011. Explain that immigration information is used to provide services for new immigrants Canada.

15 Simulation

Objective

To determine the characteristics of a surface (in this case colour) when the surface is illuminated by monochromatic radiation and by inference understand how "ground truth" information is used to analyze RadarSat2 images.

Overview

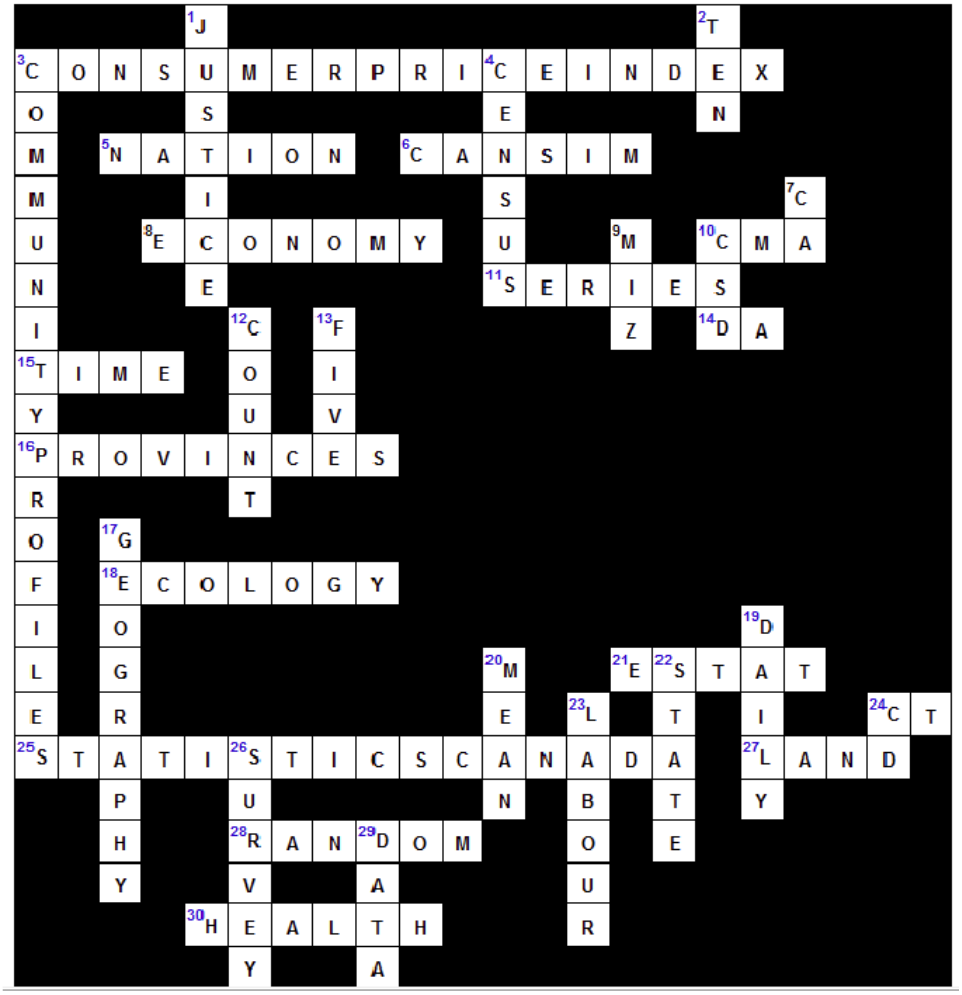
Viewing objects with reflected white light is not the best simulation of the view that RADARSAT-2 "sees" when it illuminates the earth with monochromatic microwaves. To get an idea of how RADARSAT-2 sees the world, try this simulation.

This simulation provides an optical analogy of the process that RADARSAT-2 scientists use to help them interpret monochromatic microwave radar images.

Extension activity

Instead of using coloured zones on the map, substitute various grades (coarseness) of sand paper to investigate how the surface texture affects the reflective properties of monochromatic radiation. What effect (if any) does the angle of the incidence have on the intensity of the reflected radiation?

16 Statistics Canada Terms Crossword



Across:

3 Inflation (3).
5 Country.
6 A multidimensional database.
8 Production and consumption of goods and services.
10 Census metropolitan area (abbr.)
11 With 15 across, observations over ___.
14 Abbreviation for dissemination area, the smallest standard geographic area for which census data are disseminated.
15 See 11 across.
16 There are ten of these in Canada.
18 Part of the Environment.
21 A dynamic tool for the education community.
24 Census tract (abbr.)
25 Canada's central statistical agency (2).
27 Geographic area.
28 A type of rounding.
30 Well-being.

Down:

1 Criminal system.
2 A decennial census occurs every __ years
3 Free information for all Canadian communities (2).
4 Survey of the entire population.
7 Census agglomeration (abbr.)
9 Metropolitan influenced zone (abbr.)
10 Census subdivision (abbr.)
12 Tally.
13 A quinquennial census takes place every __ years.
17 The land's features.
19 Statistics Canada's official release bulletin.
20 The arithmetic average of a set of numbers.
22 Nation.
23 Work.
24 Census division (abbr.)
26 A method to collect information.
29 Facts or figures from which conclusions can be drawn.

17 Sudoku

18 Future Fuels: Exploring Electrochemistry with Electrolysis and Fuel Cells

Fossil Fuels – Time for a Change

Today, most of the world's energy comes from fossil fuels such as coal, oil and natural gas, and our dependency on these fuels is a global issue. These fuels are not unlimited or renewable, yet demand for energy keeps increasing. In addition, the burning of these fuels fills the air with a cocktail of gases which lead to pollution such as smog and acid rain. Things cannot continue this way forever, which is one of the reasons that more and more researchers and engineers are now exploring various types of clean, renewable energy sources such as solar, wind, waves, biomass and hydrogen.

Hydrogen You Say?

Hydrogen fuel cells are the basis of an exciting and new energy system. The basic principle of a hydrogen fuel cell is a chemical reaction between hydrogen and oxygen which produces water, electricity and heat. One of the ways to obtain hydrogen for fuel cells is from water itself. Water (H2O) can be chemically separated in a process known as electrolysis. Electrolysis is the production of chemical changes by the passage of an electrical current through an electrolyte.

Electrolysis Terminology

- Electrolysis takes place in what is called an electrolytic cell
- The pieces of metal which connect the energy source to the electrolyte are called electrodes.
- The electrode which is attached to the negative pole of the battery (supplies electrons to the electrolyte) is called the cathode and the electrode which is attached to the positive pole of the battery (accepts electrons from the electrolyte) is called the anode.
- An electrolyte is an electrically conductive solution containing free ions. When an electric current is passed through an electrolyte, chemical reactions take place at the electrodes.
- When molecules or positive ions (called cations) come in contact with the cathode, they tend to gain electrons (i.e., they are reduced).
- When molecules or negative ions (called anions) come in contact with the anode, they can be stripped of electrons (i.e., they are oxidized).

Oxidation-Reduction Reactions

During electrolysis, oxidation and reduction reactions occur. An oxidation occurs when a molecule or negative ion gives up one or more electrons. This reaction occurs at the anode. A reduction occurs when a molecule or positive ion accepts one or more electrons. This reaction occurs at the cathode.

In this series of activities, students will perform simple electrolysis, as well as reverse electrolysis, to create an elementary fuel cell. Finally, students will be challenged to design and build a working fuel cell.

Electrolysis

Learning Objectives:

Students will:

- Perform electrolysis of brine (a solution of sodium chloride)
- Write the electrode and balanced oxidation-reduction equations for electrolysis of a brine solution
- Identify the tools and materials used and show the direction of flow of electrons during electrolysis of brine
- Explain the process of electrolysis

Teaching Strategies:

- Construct electrical circuits
- Experimentation involving data collection and analysis
- Balancing oxidation-reduction equations

Fuel Cell

Learning Objectives:

Students will:

- Create an elementary fuel cell from a brine solution
- Write the electrode and balanced oxidation-reduction equations for reverse electrolysis of a brine solution
- Explain the process of reverse electrolysis
- Explain how electrical energy is produced in a hydrogen fuel cell

Teaching Strategies:

- Experimentation involving data collection and analysis
- Balancing oxidation-reduction equations

Before performing these activities students should be familiar with the following concepts:

- Electrical circuits
- Oxidation-reduction reactions and skills:
- Setting up a circuit
- Using a voltmeter

Materials Needed (Per Group)

1. Distilled water – 150 mL
2. Table salt (NaCl) – 15 mL
3. 5 mL measuring spoon - 1
4. 250 mL glass beaker – 1
5. Platinum-coated electrodes (or carbon electrodes) – 2
6. Electrical wire with alligator clips – 3 black, 3 red
7. Power supply (rectifier) or 9-volt battery – 1

8. Voltmeter - 1
9. Watch with a second hand or stopwatch - 1
10. Safety goggles – 1 pair per person

National Research Council Canada

19 Polymers: Polymers as molecules and Make a Slimy Polymer

Before you begin, ask your students the following questions:

1. "What are Polymers?"
2. Have the students look around the room and see what materials they can recognize as polymeric or plastic materials.
3. Help them in distinguishing between natural polymers and synthetic polymers.

20 Martian greenhouse
Building a micro-ecosystem

Objective

Investigate the difficulties in building a stable ecosystem containing higher organisms, such as tomatoes and other green plants, in a relatively small space.

Some important concepts

An Ecosystem: An ecosystem is a community of living organisms interacting with each other and their non-living environment.

community + habitat = ecosystem

For this investigation we will provide a suitably prepared habitat within a sealed glass jar, into which we will place a small community of plants.

Dynamic Equilibrium

The micro-ecosystem in this project contains soil, an atmosphere, green plants, plus innumerable "stowaway" micro-organisms.

The only resource that enters and leaves the ecosystem is energy.

The energy balance is important to an ecosystem. When too much energy enters, the temperature will rise until the energy input is exactly balanced by the heat lost. Conversely, when the energy output (as heat) exceeds the energy input to the system, the temperature of the system will decrease until equilibrium is re-established.

In order to achieve stability an ecosystem must attain a state of "dynamic equilibrium". In this state the (average) rate at which resources, such as carbon dioxide, are consumed, is balanced by the rate at which that resource is replaced through the process of recycling.

A Stable Ecosystem

A stable ecosystem is one in which, on average, a state of dynamic equilibrium exists.

Environmental Conditions on Mars

Martian 'soil'

The Martian "soil" is about 40% SiO_2 (silicon dioxide), a fine sand-like material and about 20% Fe_2O_3 (iron oxide) "dust". This dust is very fine, its texture is similar to that of talcum powder.

The remainder of the Martian soil consists of clays, dust, gravel, pebbles, stones and rocks of both simple and complex minerals similar to those found on Earth.

As far as we know, the Martian soil is sterile.

How fertile is the Martian soil? It's hard to say, but based on the results of both Viking landers and the recent Mars

Pathfinder missions, the soil appears to be a much better medium for plant growth than most soils on the Earth, although Martian soils appear to be somewhat deficient in potassium.

Martian atmosphere

The atmospheric pressure on Earth is typically about 100kPa (kilopascals). On Mars it is less than 1kPa; far too low for either plants or humans.

Plants can survive with **a mere 5 kPa** atmosphere, 2kPa nitrogen, 2kPa oxygen, 0.6kPa water vapour, and less than 0.1kPa carbon dioxide and the remainder a mixture of gases such as argon and nitrogen; whereas, humans prefer at least 20kPa of oxygen and 10kpa nitrogen (as a buffer) to work and breathe comfortably (**about 30kPa**).

In a Martian greenhouse, astronauts will have to wear a space suit.

Temperature

On Mars, even in the equatorial zone, the temperature is perishingly cold; colder than anywhere on Earth, except perhaps during long polar winter nights near the South pole.

To grow plants on Mars a suitable warm environment will need to be created.

Martian greenhouse

Although plants can survive with less than 0.1kPa carbon dioxide they can survive with much more. In fact, most green plants prefer a carbon dioxide-rich atmosphere. On Mars, a greenhouse would not necessarily have to be a closed ecosystem. It is assumed that on Mars the atmospheric pressure and atmospheric composition within the greenhouse could be adjusted using outside resources. For example, excess methane gas could be vented outside of the greenhouse and perhaps more carbon dioxide could be added by extracting it from the Martian atmosphere, pressurizing it, and pumping it into the green house.

Similarly the amount of water and fertility of the soil could be adjusted using outside resources.

Tips for a successful martian greenhouse

- Since your greenhouse is on the Earth, solar irradiation is quite high, therefore it is best not to expose your greenhouse to direct sunlight for more than an 5 or 10 minutes or so per day.
- Stand or lay a small thermometer (the kind you see for attaching to coat zippers) in your ecosystem where it can be easily seen.
- Place a small piece of Litmus paper in your ecosystem so that you can monitor changes in the acid-base level of moisture within your ecosystem.
- A small amount (approximately 10-20 grams) of steel wool, washed with alcohol and rinsed with clean fresh water (to remove grease) and then mixed with the soil will not only remove excess oxygen from your greenhouse (rendering the atmosphere in the jar more Mars-like), it will also add iron oxides to the soil (making the soil more Mars-like too.)
- Plants adapt well to most light and temperature conditions (within a reasonable range), but they do not adapt well to frequent changes in their environment. Keep your Martian greenhouse in the same location, well lighted, and at a fairly constant temperature.
- Try to avoid "standing" water in your greenhouse. Before you add the carbon dioxide atmosphere check that the soil is moist, but not saturated, and that the inside bottom of the jar is just wet enough that water does not run from side to side within the jar when it is tilted.
- A few drops of liquid indoor-plant fertilizer added to the jar, according the manufacturer's directions, will help stabilize the plants in their new environment.

- If you use the vinegar and baking soda method to produce carbon dioxide you will notice that it produces a large amount of foam and mist. Be careful not to inadvertently allow any of the foam or mist to enter your greenhouse jar.

Plan an investigation

Experience has shown that in a sample of ten or twelve micro-ecosystems (a class set), some will survive only a few weeks, others will last a few months, and rarely, a few will survive more than a year.

The challenge is to determine, if possible, the reasons for the abrupt failure of some and the remarkable success of others.

A class discussion on this topic will elicit as many hypotheses explaining the failure/success of their greenhouse simulators as there are students. This provides an excellent opportunity to have students invoke the Scientific Method and to have them design further experiments to test their hypothesis.

21 Census game

Overview

This activity uses a game format to encourage students to develop knowledge of Canada's demographic, social and economic features. Questions address the local, regional and national implications and are arranged by increasing difficulty to add to the challenge of the exercise.

Duration: 1 class period

Note: See the Teacher's Guide (http://census2011.gc.ca/ccr02/ccr02a/ccr02a_010-eng.htm#a1) for general background on the census and census vocabulary.

Learning objectives

- Develop an awareness of the range of major demographic, social and economic information provided by previous censuses.
- Realize that all residents of Canada are part of the census and are represented by its findings.
- Understand that each census is a snapshot of the population and that by comparing current census data with previous census data, the dynamics of the population can be studied.

Vocabulary

census, cluster, confidentiality, federal electoral district, House of Commons, immigrant, rural area, sample, settlement, urban area

Activity 8: Answers and questions

Category 1 – Census

Game sheet 1

Topic: COUNT (5 points)
Answer: This survey counts the Canadian population.
Question: What is the census?

Topic: TIME (10 points)
Answer: This period of time separates each Canadian census so that census information stays up-to-date.
Question: What is five years?

Topic: DATE (15 points)
Answer: In this month every resident in Canada will be counted.
Question: What is May 2011?

Topic: FARM (20 points)
Answer: This survey asks farmers for detailed information on their agricultural operations.
Question: What is the Census of Agriculture?

Topic: SAMPLE (25 points)
Answer: This percentage or ratio of Canadian households will fill out a census questionnaire in the next census.
Question: What is 100%?

Game sheet 2

Topic: HOW (5 points)
Answer: This way of answering census questions results in improved data quality, time savings for respondents and less paper waste.
Question: What is the Internet?

Topic: LAW (10 points)
Answer: ***Double points*** This term means that your census information is kept secret.
Question: What is confidentiality?

Topic: NEW (15 points)
Answer: If this life-beginning event happened to you in June 2011 you would not be included in the 2011 Census. **Question:** What is birth?

Topic: FACTS (20 points)
Answer: This term refers to all the numbers or values calculated from the census.
Question: hat are data (or information points)?

Topic: TERM (25 points)
Answer: This term refers to the study of the spatial distribution of population.
Question: What is geography?

Category 2 – Geography

Game sheet 1

Topic: BIG (5 points)
Answer: This second largest country in land size had a population of 31.6 million people on May 16, 2006.
Question: What is Canada?

Topic: COMPLETE (10 points)
Answer: In 1951, this Canadian province was included in the census for the first time.
Question: What is Newfoundland?

Topic: ASIA (15 points)
Answer: ***Double points*** This major western Canadian city has the largest number of immigrants from Asia.
Question: What is Vancouver?

Topic: ORIGIN (20 points)
Answer: 86.9% of Quebec's immigrants live in this city.
Question: What is Montréal?

Topic: ABORIGINAL (25 points)
Answer: 85% of the population in this territory is of Aboriginal origin.
Question: What is Nunavut?

Game sheet 2

Topic: NEW (5 points)
Answer: This province has the largest population and is home to 55% of the country's immigrant population.
Question: What is Ontario?

Topic: FOOD (10 points)
Answer: These Quebec residents, members of the province's fourth largest ethnic group, are famous for their pasta.
Question: Who are people of Italian ancestry?

Topic: URBAN (15 points)
Answer: In 2006, 79% of Canadian residents lived in these non-rural areas.
Question: What are urban areas?

Topic: NORTH (20 points)
Answer: In Canada's three territories, we are the largest aboriginal group.
Question: Who are the Inuit?

Topic: SEATS (25 points)
Answer: ***Double points*** This national parliamentary chamber has always had the number of its members determined by the results of the decennial census.
Question: What is the House of Commons?

Category 3 – Who am I?

Game sheet 2

Topic: BIRTH (5 points)
Answer: The way I came to be living in Canada gives me something in common with approximately 82% of Canada's population.
Question: What is "born in Canada"?

Topic: SMALL (10 points)
Answer: I live in Canada's least-populated province, but my name is not Anne.
Question: What is a Prince Edward Islander?

Topic: NEW (15 points)
Answer: ***Double points*** I come from the continent that provides most of Canada's immigrants today.
Question: What is an Asian?

Topic: WORK (20 points)
Answer: I work for the Canadian government agency that develops and conducts the census.
Question: What is a Statistics Canada employee?

Topic: GUIDE (25 points)
Answer: There are 439,375 people in Canada who are employed in this occupation that directly impacts students.
Question: What are teachers?

Game sheet 1

Topic: ARRIVAL (5 points)
Answer: Although I came to live in Canada from another country, I am still counted in the census.
Question: What is an immigrant?

Topic: MOVE (10 points)
Answer: Like many Canadians, I migrated to and settled in this western province during the 1970s to work in the oil exploration business.
Question: What is an Albertan?

Topic: CITY (15 points)
Answer: I live in Canada's largest urban area (or metropolitan area points) which has a population of over 5 million.
Question: What is a Torontonian?

Topic: ROOTS (20 points)
Answer: We are some of Canada's earliest immigrants. Our great-grandparents came from the "Emerald Isle" during the potato famines in the 1800s.
Question: Who are the Irish?

Topic: FIRST (25 points)
Answer: We have always lived in Canada and speak over 50 different languages or dialects and belong to 10 different linguistic groups.
Question: Who are Aboriginal peoples?

Category 4 – Settlement

Game sheet 2

Topic: FEW (5 points)
Answer: This territory had 0.1% of Canada's population in 2006 and shares most of its southern border with British Columbia.
Question: What is the Yukon Territory?

Topic: CLUSTERS (10 points)
Answer: This broad and fairly flat region features a settlement pattern of scattered clusters of dots.
Question: What are the Prairies?

Topic: ISLAND (15 points)
Answer: This west coast island features a population pattern that is concentrated along its eastern side.
Question: What is Vancouver Island?

Topic: WATER (20 points)
Answer: Quebec features settlements concentrated along this major river.
Question: What is the St. Lawrence River ?

Topic: COASTAL (25 points)
Answer: These four provinces in Atlantic Canada feature settlement along their coastal borders.
Question: What are Nova Scotia; New Brunswick; Newfoundland and Labrador; and Prince Edward Island?

Game sheet 1

Topic: AREA (5 points)
Answer: They are 13 political divisions shown on the map of Canada.
Question: What are the provinces and territories?

Topic: DOT (10 points)
Answer: This is the number of people with whom I share a dot on Canada's 2006 population distribution map.
Question: What are 999 people?

Topic: CLUSTER (15 points)
Answer: ***Double points*** This area in Ontario is home to 1/4 of the population of Canada.
Question: What is the Extended Greater Golden Horseshoe Region?

Topic: DOUGHNUT (20 points)
Answer: This eastern province's population distribution map has its population clustered around its exterior.
Question: What is New Brunswick?

Topic: GATEWAY (25 points)
Answer: This western capital city's population appears on the population distribution map as a cluster of dots and is the gateway to Canada's western Arctic.
Question: What is Edmonton?

Category 5 – Results

Game sheet 2

Topic: YOUTH (5 points)
Answer: The location of these buildings, constructed for education, is determined through population counts for the census.
Question: What are schools?

Topic: ADS (10 points)
Answer: These television messages are aimed at certain segments of the population whose demographic characteristics were determined by the census.
Question: What are commercials?

Topic: GRANTS (15 points)
Answer: These political areas of Canada receive money (grants points) from the federal government based on their population as counted by the census.
Question: What are the provinces and territories?

Topic: SEATS (20 points)
Answer: ***Double points*** Information from the census divides voters into areas called ridings from which representatives are elected to this government body.
Question: What is the House of Commons?

Topic: SECTIONS (25 points)
Answer: Canada is divided into these units to enable the orderly count of the population at census time.
Question: What are collection units?

Game sheet 1

Topic: WATER (5 points)
Answer: The most striking concentration of population in Canada shown on the distribution map lies along these large bodies of water.
Question: What are the Great Lakes?

Topic: METALS (10 points)
Answer: The clusters of settlement north of the major population centres in Quebec and Ontario are communities built around this rock-based economic activity.
Question: What is mining?

Topic: NARROWS (15 points)
Answer: This provincial capital city is the centre of a large concentration of population. It is south of two large lakes but is north of an international border.
Question: What is Winnipeg?

Topic: DOUBLE V (20 points)
Answer: ***Double points*** These two west coast cities form their province's major population concentration and begin with the same letter.
Question: What are Vancouver and Victoria?

Topic: LANDFALL (25 points)
Answer: This provincial capital appears as the major cluster on the island and faces Europe.
Question: What is St. John's?

Category 6 – At home

Game sheet 1

Topic: HOME (5 points)
Answer: This name is used to identify our concentration of population as counted by the census.
Question: What is (name your community points)?

Topic: DRAW (10 points)
Answer: This natural feature was the principal attraction that drew population to our area.
Question: What is (local answer points)?

Topic: MOVE (15 points)
Answer: ***Double points*** This term is used to describe the movement of people to new areas in the same country.
Question: What is migration?

Topic: WORK (20 points)
Answer: This money-earning task is the principal reason why people migrate to different areas of the country.
Question: What is a job?

Topic: PLACES (25 points)
Answer: These concentrations of population offer the largest number and variety of work opportunities and therefore attract even more settlement.
Question: What are cities?

Game sheet 2

Topic: SPOT (5 points)
Answer: This is how a community of 2,000 persons would be shown on the population distribution map.
Question: What are two dots?

Topic: NEWS (10 points)
Answer: This reading material depends on a large daily readership in a concentrated area.
Question: What is a newspaper?

Topic: DWELLING (15 points)
Answer: This type of dwelling is the most common form of shelter in Canada.
Question: What is a house?

Topic: GROUP (20 points)
Answer: In 2006, the average size of this household unit was 2.6 persons.
Question: What is a family?

Topic: SPEAK (25 points)
Answer: This term refers to the first language you learned to speak.
Question: What is mother tongue?

22 That's easy for you to say

Overview

This activity uses hands-on experience to demonstrate many aspects of planning, conducting and reporting the results of a survey.

Students will learn what goes into the production of statistical information, how individual responses on a questionnaire are merged to create summary data, and how the summarized information is used.

This activity could take the form of a full count of the student body. If this is too ambitious, a small survey or an opinion poll of a sample of the student population or specific class may be more appropriate. Use topics of interest to students and teachers.

Since the census takes place in May 2011, schedule the completion of this activity or parts of it (data collection) in May. If you intend to have the students conduct a survey or census, remember to allow yourself enough lead time.

Duration:

Two or three class periods if students use the prepared questionnaire in Handout 2 (http://census2011.gc.ca/ccr02/ccr02a/ccr02a_007-eng.htm#a4).

or

Four or five class periods if students create their own survey using the information provided in Handout 1 (http://census2011.gc.ca/ccr02/ccr02a/ccr02a_007-eng.htm#a3). This would include:

- two class periods before conducting the survey;
- one period collecting the data; and
- one or two periods after collecting the data.

(Times will vary with the complexity of the questionnaire and the size of the group surveyed.)

Note: See the Teacher's Guide (http://census2011.gc.ca/ccr02/ccr02a/ccr02a_010-eng.htm#a1) for general background on the census and census vocabulary.

Learning objectives

- Understand the stages of designing, conducting and processing a survey.
- Learn how to design, conduct, process and report on a survey.
- Learn how to write a report analysing the results of a survey.
- Learn how to work as a team to reach mutually agreed decisions and to resolve issues.

Vocabulary

census, complete count, confidentiality, data, enumeration, questionnaire, sample, survey, undercount

Getting started

1. Ask your students to write down what they think the population of Canada was in 2006. Give them a moment to do so and then write the figure on the chalkboard. (Answer: In 2006, the population of Canada was 31,612,897.)
2. Ask several of the students to comment on how their estimates compared to the actual figure.
3. Ask students how they think the 2006 population figure for Canada was determined. (Answer: Every five years Statistics Canada conducts a census — a complete count of the country's population.)
4. Ask the class to concentrate again on the 2006 population figure. Ask them to estimate the time it took to produce this figure. Now distribute Handout 1 for all to read.

Note: The 2006 Census took place in May 2006. The population counts were available in March 2007.

Census activity

1. Discuss the stages of the survey process listed on Handout 1. You may wish to show a flow chart such as the one below, listing the questions from the handout underneath each stage.
    - Define
    - Design
    - Collect
    - Process
    - Report
2. This is the point at which the class should decide whether they want to plan and conduct their own survey or use the questionnaire in Handout 2. If the class decides to use the prepared questionnaire in Handout 2, continue with the rest of item 2 and end the lesson. If the class decides to create their own survey, skip to item 3.

    a. Distribute Handout 2: Student survey on future plans.

    b. Before students answer the prepared questionnaire, have them discuss how they will tabulate their results and what they will want to report. Ask them to consider what summary information they would like to analyse and what their tables (columns, rows, etc.) will look like.

    Ask students to identify interesting questions that summary data could answer. For example: "Do male and female students in the class have the same career goals?" To answer this question they must be able to cross-tabulate question 2 with question 7. This can be a long job if the tabulating is done by hand. Manual tallying may limit them to looking at the simple frequencies for single questions, such as "How many hours did you spend last week working for pay." Access to a computer will provide greater flexibility.

    c. Have the students answer the prepared questionnaire. Ask the class to follow through on their processing and reporting strategies for Handout 2.

d. The class may wish to conduct the same survey with a larger group to learn how the data compare with the whole grade or the whole school. How students process the data, what they report, and how much time they have will dictate the response here.

3.

a. If the class is conducting their own survey, have them re-examine the full range of questions in Handout 1. Some key questions to consider are:

- How big will the project be?
- Who will be surveyed?
- What will they be surveyed about?
- How much time will the class invest in conducting, processing and analysing the survey?
- Will the results be shared?
- How will you protect confidentiality?

b. Distribute Handout 2: Student survey on future plans. This prepared questionnaire may be used as a model for the survey form that the class will design. (c) Ask students to consider the merits of the prepared questionnaire by taking note of its concise questions, its multiple-choice format, and the low number of open-ended questions.

c. Ask students to consider the merits of the prepared questionnaire by taking note of its concise questions, its multiple-choice format, and the low number of open-ended questions.

Teacher hints

If the students design their own survey, limit the number of questions to about 10.

Avoid fill-in-the-blank (open-ended) type questions in favour of questions where answers may be checked or circled.

Include several "demographic background" items so that students can correlate data and make statements such as "Female students are most likely to say..."

Try to focus the survey on student and school concerns.

Take time to test the questionnaire through role-playing or a small sample test to ensure that the questions make sense and provide useful answers.

Try to make the survey part of some larger event such as a display, special assembly or open house so students can see that other people are interested in the survey results.

Note: Be sure that the survey has been approved / registered in advance by your school's administration.
http://census2011.gc.ca/ccr02/ccr02a/ccr02a_005-eng.htm

23 Breads of the world

Overview

This activity introduces students to the Census of Agriculture. Students will appreciate the value of agriculture in today's society and its effect on their lives. Three activities, which provide a detailed picture of Canada's most important primary industry, are available for various grade levels.

Students will examine sets of imaginary data associated with several community services, decide which neighbourhoods would benefit most from each service, and illustrate their findings on a grid map.

Note: See the Teacher's Guide for general background on the census and census vocabulary. More information on the Census of Agriculture is provided in this activity under the section Census of Agriculture. You may wish to review this information with you students before starting the activities.

http://census2011.gc.ca/ccr02/ccr02a/ccr02a_010-eng.htm

Getting started

Using the background information provided in the Teacher's Guide, tell students about the census and let them know that Canada's next census takes place in May 2011.

Explain to your students that there are two types of censuses: a Census of Population and a Census of Agriculture. The Census of Agriculture is taken at the same time as the Census of Population to find out about the country's farming and food production.

In May 2011, each agriculture operation in Canada will receive a Census of Agriculture questionnaire in the mail. The Census of Agriculture collects a wide range of data on the agriculture industry. More information on the Census of Agriculture can be found on pages 5-6.

Learning objectives

- Develop a knowledge of agriculture and its role as a primary industry.
- Understand the impact agriculture has on every resident in Canada.
- Appreciate that statistics represent real people and their actions.

Census activity

Distribute Handout 1: Breads of the world. Have students match the bread name to its grain and country of origin. This activity is suitable for elementary, intermediate and senior grade levels.

People make bread in every country of the world. They mix flour or meal with water or other liquids. They may add a little fat (like oil or butter) and a rising agent (such as yeast) and cook the mixture in a pan or oven. Sharing bread with guests can be a way to make them feel welcome.

Below are the names of some of the breads we eat here in Canada which come from all over the world. Can you match the name of the bread to its description?

Home-made breads	Answers	Country of origin
A. Baguette	D	Ethiopian bread, very thin (teff grain, or millet and barley)
B. Bannock	J	bread from the Caribbean and India (whole wheat)
C. Challah	A	a long thin loaf of French bread (wheat)
D. Injera	B	First Nations' bread, of Scottish origin (oatmeal or barley)
E. Naan	G	Italian fruit bread for Christmas (wheat or millet)
F. Johnnycake	F	corn bread (corn), an early American staple food
G. Panettone	I	dark rye bread from Eastern Europe (rye)
H. Pita	K	Mexican bread (corn or wheat)
I. Pumpernickel	H	Mediterranean pocket bread (wheat)
J. Roti	C	Jewish egg bread (wheat)
K. Tortilla	E	white bread from India (wheat)

Answers: D, J, A, B, G, F, I, K, H, C, E

To expand on this activity, ask the students to bring in samples of the grain products listed in Handout 1.

24 Land size conversions and comparisons

History

The Census of Agriculture is taken at the same time as the Census of Population to find out about the country's farming and food production.

Agriculture is an important part of our economy. Jean Talon's census of 1667 tells us that the colony had 11,448 arpents of land

(3,915 hectares) under cultivation, 3,107 cattle, and 85 sheep.

A mid-decade agricultural census was first held in Manitoba in 1896.

When the provinces of Saskatchewan and Alberta were created in 1905, the increasingly rapid settlement of the west made the quinquennial census a constitutional requirement. A new Census and Statistics Act called for additional censuses of population and agriculture to be taken in the provinces of Manitoba, Saskatchewan and Alberta in 1906 and every 10 years after that until the population of each of the three provinces reached 1.25 million. These censuses continued until 1956, when Canada began taking national censuses of population and agriculture every five years.

New in 2011

In May 2011, each agriculture operation in Canada will receive a Census of Agriculture questionnaire in the mail. The Census of Agriculture collects a wide range of data on the agriculture industry such as number of farms and farm operators, farm areas, business operating arrangements, land management practices, livestock numbers and crop areas, operating expenses and receipts, farm capital and farm machinery and equipment. These data provide a comprehensive picture of the agriculture industry across Canada every five years at the national, provincial/territoral and sub-provincial levels.

Users of Census of Agriculture data

Census of Agriculture data are used by various organizations for many reasons:

- operators use census data to make production, marketing and investment decisions. They can also keep abreast of trends in Canadian agriculture through the analysis of Census of Agriculture data published by the agriculture media.
- producer groups and marketing agencies use census data to tell Canadians and government how they are doing economically through their non-government organizations.
- companies supplying agricultural products and services use the data to determine where to locate their service centres.
- government policy advisors use the data to help develop programs related to safety nets and human resources for the agriculture sector.
- operators can keep abreast of trends in Canadian agriculture through the analysis of Census of Agriculture data published by the agriculture media.
- agriculture websites can target their information to current trends and needs in the sector based on census data.

Vocabulary

- **Census of Agriculture:** an enumeration of every farm, ranch or other agricultural operation with sales of agricultural products during the year prior to the census. Held every five years in conjunction with the Census of Population, the Census of Agriculture asks questions about land use, crops, livestock, agricultural labour, farm income, and land management practices.
- **Biotechnology:** a science that relates biology to technology
- **Census farm:** an agricultural operation producing at least one agricultural product for sale
- **Diversification:** giving variety to, expanding into different fields
- **Hectare:** the metric unit for measuring farmland. One hectare equals 10,000 square metres.
- **Net farm income:** net income (gross receipts from farm sales minus depreciation and cost of operation) earned by working for oneself (self-employment) as an owner/operator of his/her farm.
- **Non-farm work:** (formerly called off-farm work) the number of days farm operators worked away from the farming operation at paid agricultural and non-agricultural work.

Activity 5: Answers to Handout 4

	Hectares (ha)	Square meters (m^2)
Standard prarie field	64.78	647,800
Urban lot for a house	0.09	900
Average size of a farm in Canada in 2006	294.74	2,947,400
Average size of a farm in Newfoundland and Labrador in 2006	64.78	647,800
Average size of a farm in Saskatchewan in 2006	586.64	5,866,400
Your school grounds *		
Your classroom *		

* The size of the classroom and school grounds should be measured in square metres.