SPACE GEOLOGIST

ACTIVITY BOOK

wonderwise 4-H
Women in Science Learning Series

Space Geologist Activity Book

This book features five hands-on activities designed for 8- to 12-year-olds. Each activity includes one 30- to 45-minute project and extensions. Activities can be used in any order. Also included are objectives and learning outcomes, assessment questions, ideas for a presentation or exhibit and topics for further investigation. Wonderwise learning outcomes are based on national science education standards identified by McREL (Mid-continent Research for Education and Learning), the Nebraska Educational Standards, and the National Science Education Standards developed under the direction of the National Research Council. This book incorporates concepts of inquiry-based learning and the 4-H Youth Development experiential learning model.

Each youth participant should receive a copy of the activities. Copies of this book can be downloaded from the Space Geologist CD-ROM.

WONDERWISE
Women in Science Learning Series

Wonderwise introduces you to women who have made science their career. Each kit is a comprehensive instructional package that includes a video, CD-ROM, and activity book. With these materials, leaders and youth explore the world of women scientists and discover together the fun of learning about science. For more information about Wonderwise, including free samples, Web activities, resources, science education standards and ordering information, visit our Web site:

wonderwise.unl.edu

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INFORMATION FOR LEADERS

What You Will Need for Each Activity

Listed below are the materials and preparations you will need for each activity. Most of the materials can be purchased locally. The more difficult-to-find items can be purchased from Wonderwise. The symbol ⊙ indicates that an item can be ordered from the Wonderwise Web site or GPN, the Wonderwise distributor. To purchase supplies, kits, videos, or CD-ROMs contact:

GPN (Great Plains National)
P.O. Box 80669 ▪ Lincoln, NE ▪ 68501-0669
Phone: 1-800-228-4630 ▪ FAX: 1-800-306-2330
e-mail: gpn@unl.edu ▪ Web site: gpn.unl.edu

Activity 1
Meet Adriana

For the entire group:
- ⊙ 18-min. video *Adriana Ocampo, Space Geologist*
- Video player and television

For each team of 2:
- Tape and scissors

Activity 2
Crater Maker

For each team of 2-4:
- 3 marbles
- flour (about 2 liters will fill a paper bag tray 6 centimeters deep)
- cocoa powder in a shaker (about 10 milliliters or 1 tablespoon per team)
- 2 meters measuring string
- washer or other weight
- tape
- centimeter ruler
- recording sheet and pencil
- newspaper
- tray (a cut-off grocery bag works best)
- scissors
- paper towels (plain white)
- spray bottle with water

Activity 3
Vanishing Craters

For each team of 2-4:
- small bowl (use disposable bowls for easy cleanup or if you want to save your crater model)
- powdered sugar (100 milliliters, or enough to fill a bowl about 4 centimeters deep)
- cocoa powder in a shaker (10 milliliters or 1 tablespoon per crater)
- a small stone (to simulate a rocky asteroid)
- spray bottle filled with water
- newspaper to cover the table
- metric tape measure

Activity 4
Big Time Tour

For each team of 2:
- pencil or pen
- sticky notes
- fine point water-soluble marker
- a sheet of paper a little longer than arm's length (tape together lengths of legal-size paper)

Activity 5
Digging into the Past

For every 10-12 kids:
- ¾ liter brown sugar
- ½ liter white sugar
- 1 jar dark sprinkles
- 1 small bottle each red and green food colors
- 5 plastic spoons
- 5 containers for the sugar mixtures (about 250 ml each)

For each team of 2:
- 1 plastic spoon
- one small opaque cup (150-200 ml styrofoam or paper)
- 1 clear plastic straw
- 1 set of colored pencils to match the layer colors
- 1 paper plate
- newspapers (to cover work space)

To prepare the sugar mixtures:

Prepare 5 different colors and textures of sugar. One container of each color should be enough for 4 or 5 groups.
- brown sugar
- orange sugar (brown sugar plus drops of red food color)
- fossil sugar (brown plus tiny sprinkles)
- white sugar
- green sugar (white sugar plus drops of green food color)

MEET ADRIANA

Watch the 18-minute video on Adriana Ocampo. Then examine a photo of an impact crater on the Moon.

Before You Begin

Work as teams of 2

Length:
Part I- 30 minutes
Part II- 15 minutes

What You Need

For the entire group:

- ⊙ 18-min. video *Adriana Ocampo, Space Geologist*
- ▪ Video player and television

For each team of 2:

- ▪ Tape and scissors

What We Know. Adriana Ocampo is a space geologist. Like most people on Earth, she has never visited another planet, but she has studied thousands of photos and maps of planets. Her study has made her an expert in reading the marks on a planet's surface. At a meeting of scientists she looked at a map of Southern Mexico and saw something nobody had noticed. The map showed a series of deep water-filled pits. Adriana noticed that the pits formed a giant arc hundreds of kilometers long. She wondered if they could be part of a huge ring showing impact marks of a giant space rock (meteorite) that hit Earth. Her hunch turned out to be correct and confirmed the presence of the huge Chicxulub crater. More research showed Earth had taken this giant impact about 65 million years ago, which was just about the time the dinosaurs vanished, along with half the life forms on Earth. Scientists estimated the meteorite (space rock) that hit Earth was about 10 kilometers wide and left a crater about 200 kilometers wide. Adriana's discovery turned out to be big in many ways.

MEET ADRIANA

Part One: Meet Adriana

Watch the video about space geologist Adriana Ocampo. Then discuss what it is like to be a geologist who studies the planets.

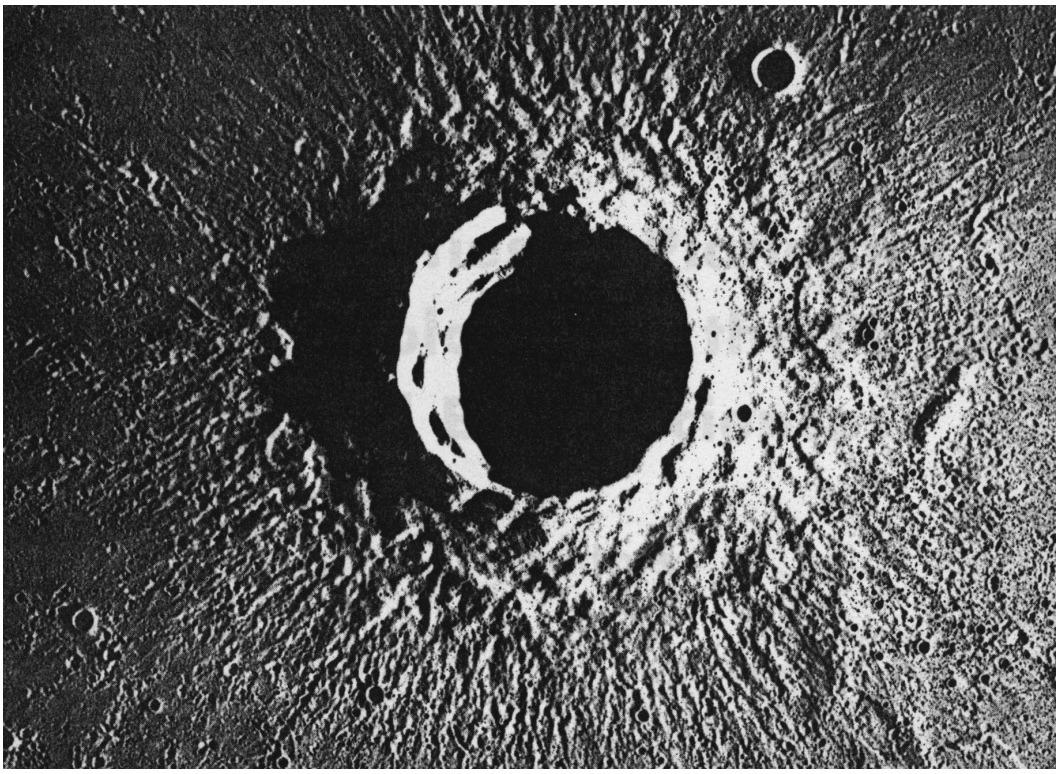
MEET ADRIANA

Part Two: Anatomy of an Impact

Whether an impact event happens on the Moon, on Earth, or on your tabletop, impact craters have some similar features. Geologists use special words to describe the features of an impact event.

1 Cut out the words and definitions at the bottom of this page.

2 This is a photo of an impact crater on the Moon. Label each feature in the photo with the correct term. Tape the labels into position. Note: You will need to guess where the meteorite might be.



CRATER: a hole blasted by the impact of a meteorite (space rock)

CRATER FLOOR: the bottom of the crater

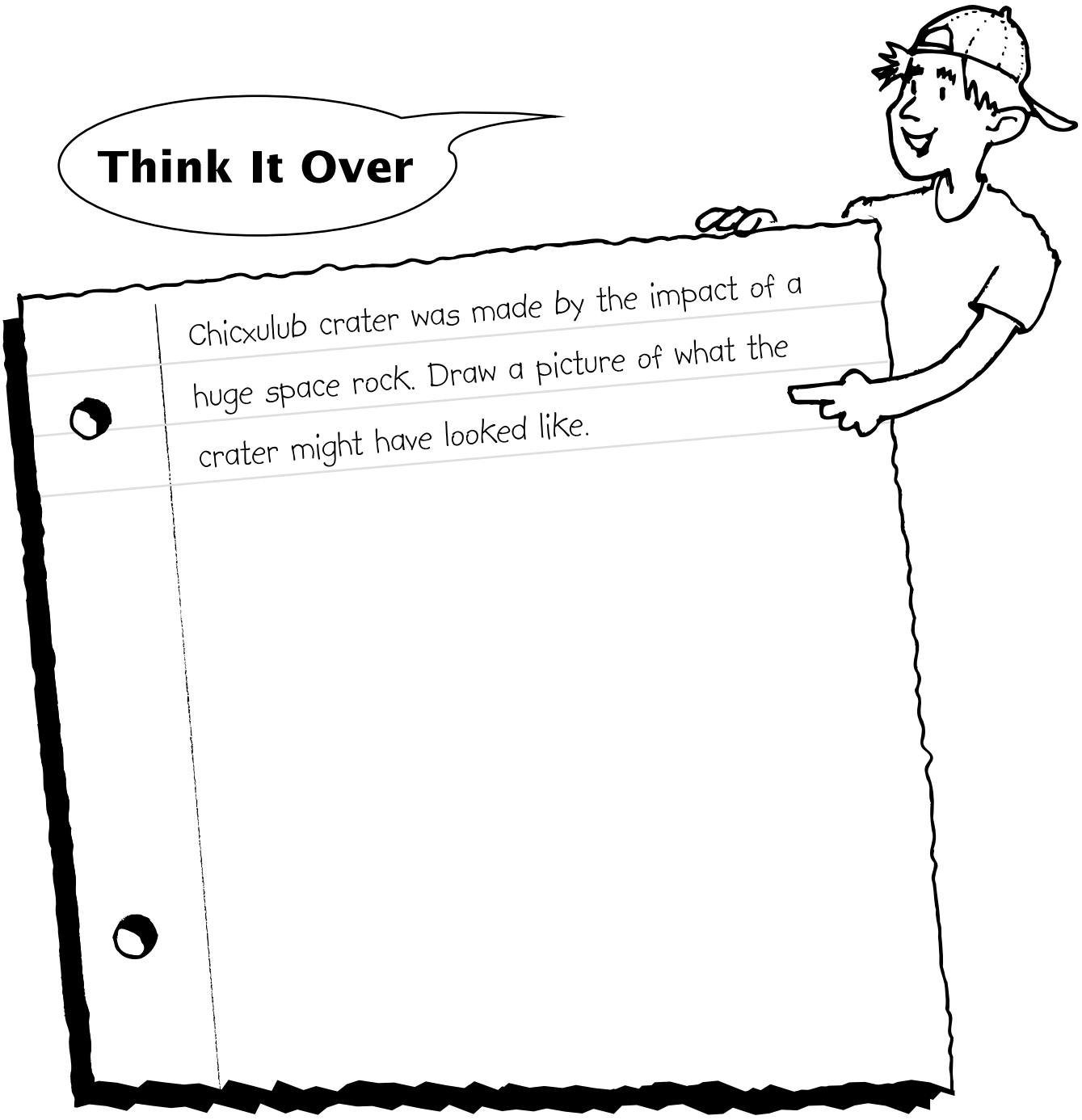
EJECTA: material thrown from the crater on impact

RIM: the raised edge of a crater

RAY: a long, thin streak of ejecta radiating from the center of a crater

METEORITE: a space rock that burns through the atmosphere and lands on Earth

MEET ADRIANA



Think It Over

Chicxulub crater was made by the impact of a huge space rock. Draw a picture of what the crater might have looked like.

CRATER MAKER

ACTIVITY
TWO

Make some impact events, study the craters, and develop your own expertise in how impact craters take shape and the patterns they make.

Before You Begin

Teams of 2-4

Length:

Part I - 45-60 minutes.

What You Need

For each team of 2-4:

- 3 marbles
- flour (about 2 liters will fill a paper bag tray about 6 cm deep)
- cocoa powder in a shaker (about 10 ml or 1 tablespoon per team)
- 2 meters measuring string
- washer or other weight
- tape
- centimeter ruler
- recording sheet and pencil
- newspaper
- tray (a cut-off grocery bag works best)
- scissors
- paper towels (plain white)
- spray bottle with water

What We Know. In 1995 Adriana and a team of scientists were searching the Mexican jungles for blankets . . . blankets of ejecta. Ejecta is material that is splashed from the impact of a meteorite big enough to dig a crater. Chicxulub crater, estimated to be 200 kilometers wide, was definitely a big one. The scientists knew the crater's location, but being buried hundreds of meters underground made it hard to study. Drilling for samples was very expensive, so they decided to study the rocks ejected from the crater by the force of the impact. If the team found ejecta near the surface, they could skip the expensive drilling.

But where to look? In her work as a planetary geologist Adriana Ocampo has studied the features of many impact craters. She is an expert in how they form . . . and splash. Her expertise helped her team guess where to look for the ejecta blankets. After some searching the team found layers of ejecta more than 300 kilometers away from the original impact site in the neighboring country of Belize.

CRATER MAKER

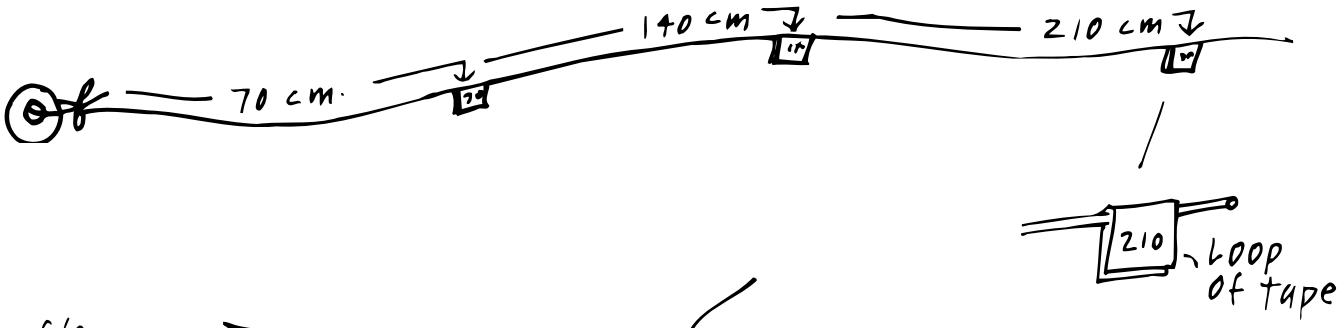
Part One: Impact Testing

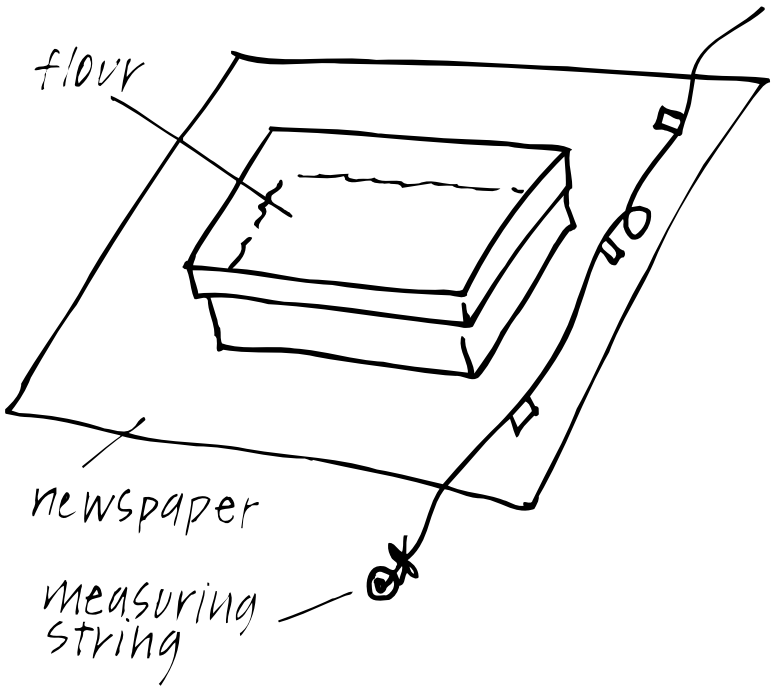
Work in a team to investigate how craters are formed. First you will make a "planet surface" with a layer of flour. Next you will drop several meteorites (marbles) from different heights to make impact craters, then study the crater patterns they leave.

Make an Impact Site

1 Assemble your materials.

2 To make a measuring string, cut a length of string 250 centimeters long. Tie a washer onto one end. Mark the string at 70 centimeter intervals with tabs of tape.





3 Set the tray on a sheet of newspaper. If you are using a grocery bag, cut it off and fold back the top so the sides are about 12 centimeters tall.

4 Fill the tray so the flour is about 6 centimeters deep. Jiggle the flour to spread it evenly across the container. Move the tray and paper onto the floor.

Good work! Your planet surface is ready for craters.

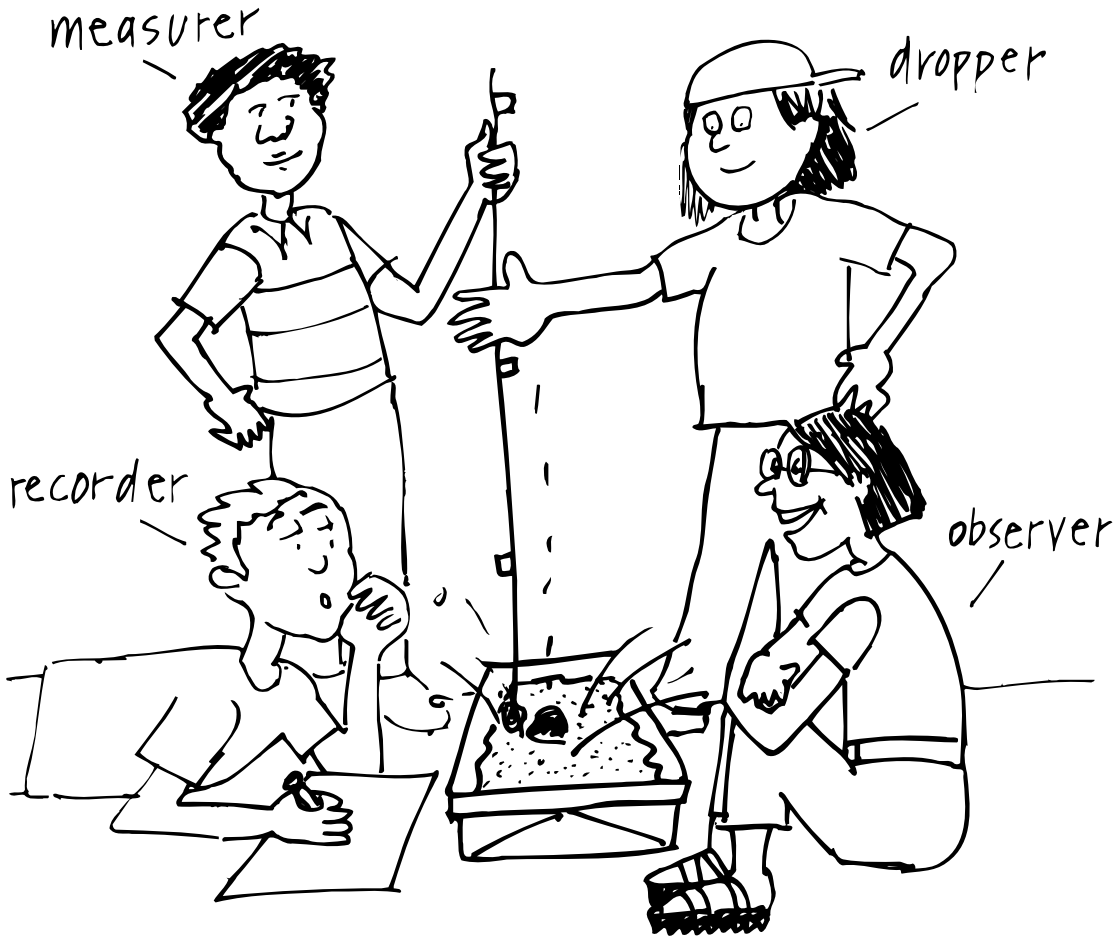
CRATER MAKER

Part One: Impact Testing (cont'd)

Making an Impact

1 Choose members of the team to be the recorder, measurer, observer and dropper.

2 Put your team in testing position. (See the picture.) Everyone might want to try a couple of test drops to get the hang of crater making.



3 Repair the flour surface by jiggling and smoothing it. Create a layer (strata) of darker rocks by sprinkling the surface with cocoa. Add enough dark to cover the white.

CRATER MAKER

Part One: Impact Testing (cont'd)

Test Craters

4 Predict what will happen to the craters as the marbles fall from greater heights. Write your prediction here:

5 To make the first crater, drop a marble from the height of 70 centimeters. (Leave all marbles in place.) Measure the width of the impact and record the size and your observations on the Experiment Sheet below for **Test 1**.

TRACK YOUR IMPACTS EXPERIMENT SHEET

Height of Drop	**Test 1 Crater Size** (width in cm)	**Test 1 Observations** (what you noticed before and after impact)	**Test 2 Crater Size** (width in cm)	**Test 2 Observations** (what you noticed before and after impact)
70 centimeters				
140 centimeters				
210 centimeters				

CRATER MAKER

Part One: Impact Testing (cont'd)

6 Choose another marble. Drop it from 140 centimeters. Observe and record what happens on the Experiment Sheet on p. 9.

7 Drop test the third marble from 210 centimeters. (You will need a chair to do this. Be careful.) Observe and record on the Experiment Sheet what happens.

8 Observe all the impact craters. Did the results match your predictions? Write your answer below.

9 If there is time, repair the surface and take another set of measurements for **Test 2**.

10 Make a print of your impact crater: Gather a white paper towel and a spray bottle of water. Cut the towel so that it fits into your crater tray.

11 Carefully lay the paper towel over the surface without disturbing the craters. Spray the towel with a mist of water until it is damp (not soggy).

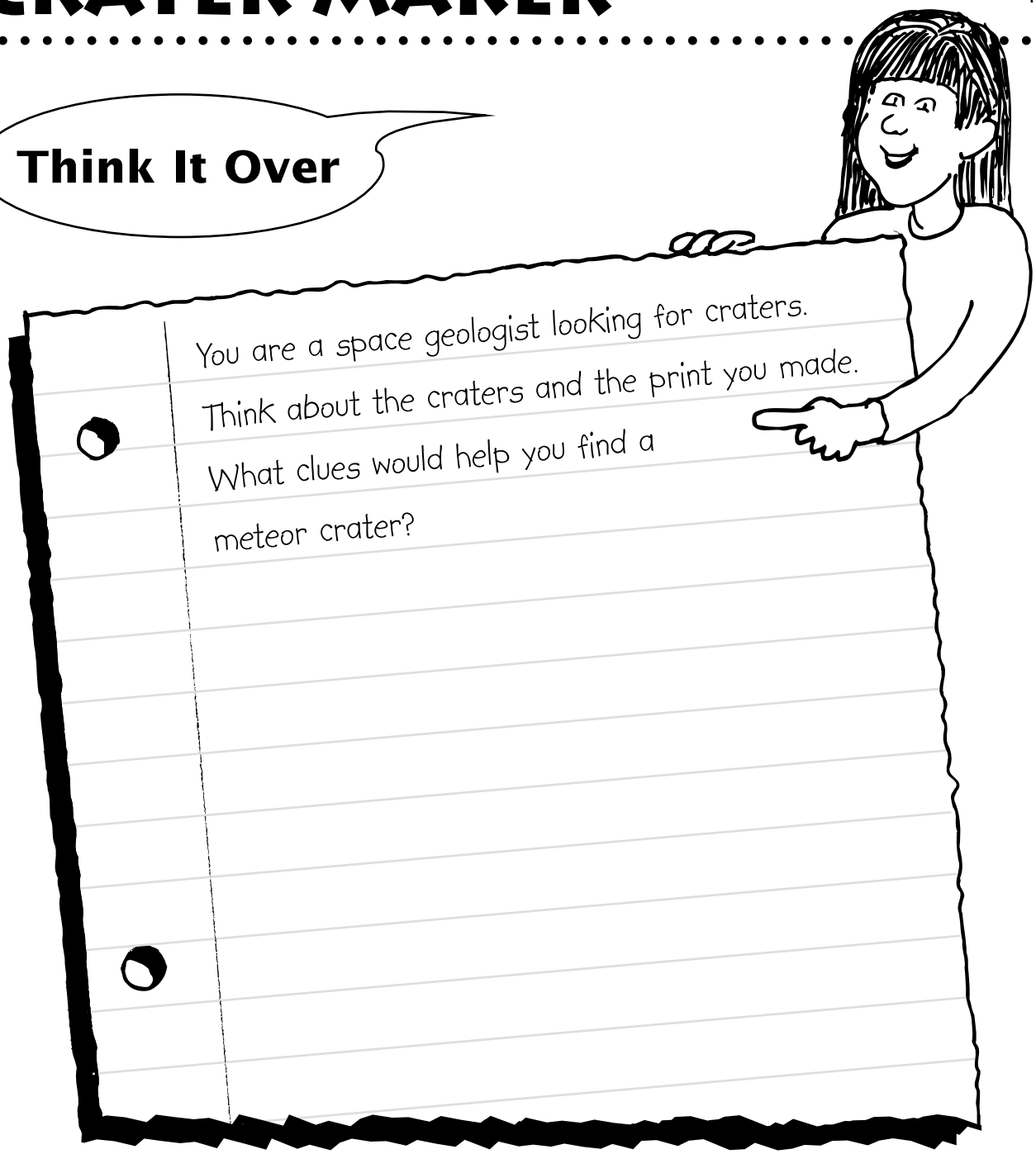
12 Press the towel down on the surface and carefully pull it away. An impression of the craters will stick to the towel.

13 Tape your paper towel print to a sheet of paper. Place it somewhere flat to dry. Later, when your impact print is dry, compare it to the prints made by other teams.

Good Work!

CRATER MAKER

Think It Over



You are a space geologist looking for craters. Think about the craters and the print you made. What clues would help you find a meteor crater?

VANISHING CRATERS

ACTIVITY THREE

Make a crater model and test the effects of weather (rain) on its surface.

What We Know. The study of how planets are formed (and deformed) is called planetary geology. Few people have set foot on another planet, yet we know a lot about other worlds in our universe. Much of this information comes from launching probes into space and sending images back to Earth. Huge amounts of information about a planet can be learned from studying pictures of its surface. A big part of Adriana Ocampo's work as a planetary geologist is analyzing these images.

In many ways it is easier to study impact craters on faraway planets. Finding clear, crisp crater marks on the Moon and Mars is easy. On Earth it is not. There are several reasons why Earth craters are rare. For one thing a thick blanket of gases protects Earth. Most meteors burn up as they fall through this protective atmosphere and never reach Earth's surface. Only the biggest rocks make it through. Most of these disappear into the oceans, which cover three-fourths of our planet's surface. Even if a space rock hits land, the crater it leaves is likely to be covered with vegetation or ice. To make crater hunting even more difficult, Earth's crust is constantly bombarded with a lot of weather. The action of wind and water constantly reshapes Earth's surface. Craters get erased!

Before You Begin

Teams of 2-4

Length:
Part I - 40 minutes.

What You Need

For each team of 2-4:

- small bowl (use disposable bowls for easy cleanup or if you want to save your crater model)
- powdered sugar (about 100 ml, or enough to fill a bowl about 4 cm deep)
- cocoa powder in a shaker (about 10 ml or 1 tablespoon per crater)
- a small stone (to simulate a rocky asteroid)
- spray bottle filled with water
- newspaper to cover the table
- metric tape measure

VANISHING CRATERS

Part One: Rain Check

First make a crater model with your team. Then make it rain on your model to test the effects of weather on the crater's surface.

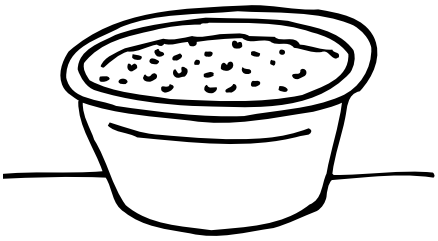
1 First make a crater. Fill a bowl with about 100 milliliters of powdered sugar or enough to make a layer 4 centimeters deep.

2 Spread some newspaper on the floor. Set the bowl on the newspaper.

3 Cover the sugar with a dark strata (layer of cocoa powder).

4 Drop a rocky asteroid (small stone) into the powder from about 2 meters away.

5 Remove the rocky asteroid to leave an impact crater.



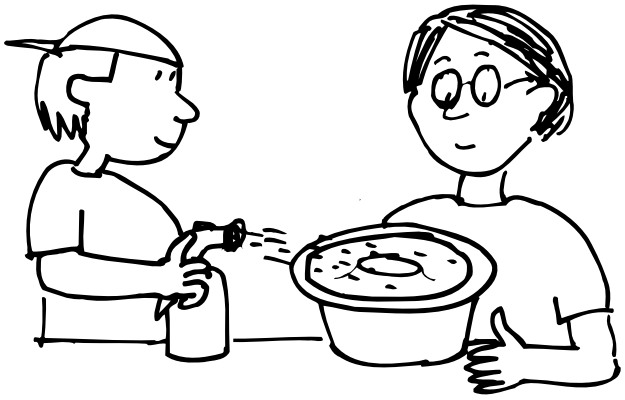
Good work! Now it is time to make some stormy weather.

VANISHING CRATERS

Part One: Rain Check (cont'd)

6 Get ready to observe what happens when it rains on your crater. Predict how your crater will change when it gets rained on. Write your prediction below.

7 **Adjust your spray bottle to make a fine spray.** Hold it at least a foot away from the crater and spray it 6-10 times or until you begin to get a few puddles around your crater.



8 Watch carefully. Each person on your team should list two things that he or she notices happening to the crater and surface as it rains.

Crater observation 1:

Crater observation 2:

9 How do your results compare to your predictions?

VANISHING CRATERS

Think It Over

Rain is not the only kind of weather that wears down craters. Imagine you were an impact crater in the desert or in the arctic. What kind of storms and weather events might wear you down in these locations?

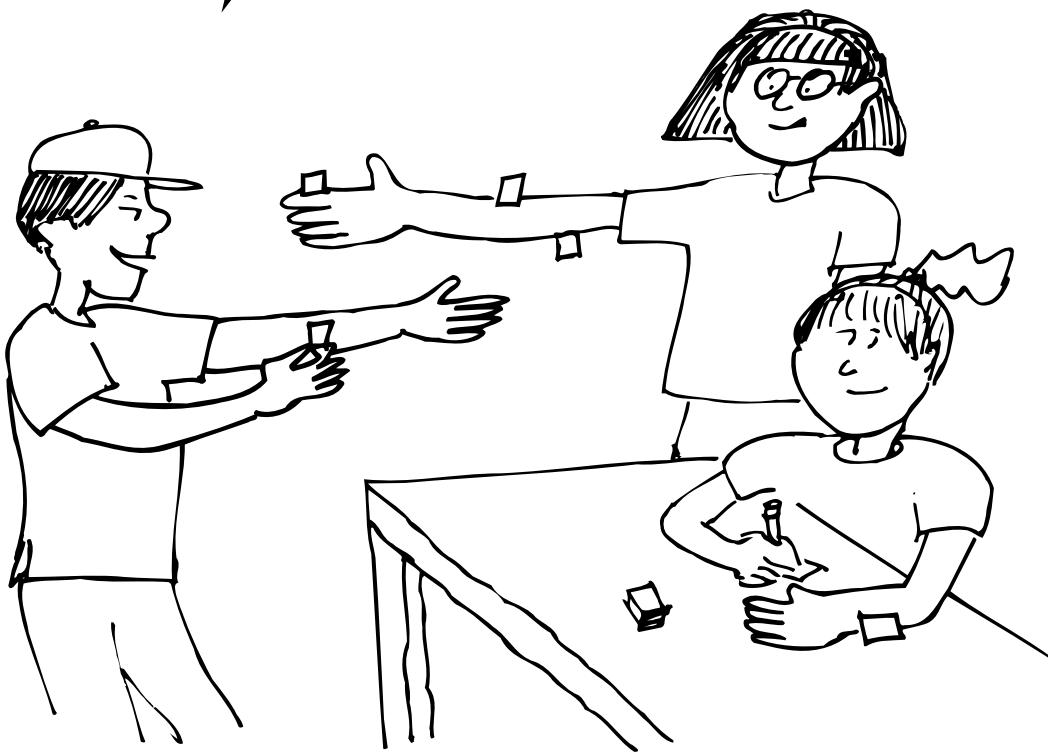
Imagine what kind of effect each weather event might have on a crater.

Weather Event	Effect on a Crater
1.	
2.	
3.	

BIG TIME TOUR

ACTIVITY
FOUR

Explore the vast span of geological time. First, consider big numbers. Then take some guesses about some important past events and locate them on an arm's length map of time.



Before You Begin

Teams of 2

Length:
Part I - 20-30 minutes
Part II - 45 minutes

What You Need

For each team of 2:

- pencil or pen
- sticky notes
- fine point water-soluble marker
- a sheet of paper a little longer than arm's length (tape together lengths of legal-size paper)

What We Know. Our home planet Earth has been through many changes. Giant elephants once grazed the North American plains. Before that, dinosaurs roamed the Earth for millions of years, then disappeared. Many kinds of organisms lived in the early oceans of Earth. Much earlier, Earth was a fiery ball of molten rock. How do scientists know these things? They have learned to read the rocks. Geologists know that different rock types are formed in different ways, giving clues to different conditions in Earth's past. Studying the layers of rocks and the order in which they were formed gives clues about the changing climate and conditions. Fossils in the rocks help scientists actually see what life was like in the past. Scientists still have a lot to learn, but they do know that conditions and life forms have undergone huge changes over time . . . and that Earth is very, very old. How old? Today you will take an arm's length tour of all time.

BIG TIME TOUR

Part One: Million Appreciation Lesson

Summertime, halftime, daylight savings time . . . we measure kinds of time in hours, days, and months. We measure Earth's past in geological time. This kind of time is measured in millions and billions of years. To really appreciate geological time you need to get a sense of just how big a million is. You might want to get out your calculator and do your own figuring. Otherwise, just check your guess. The math hints and answers are at the bottom of p.18.

1 Suppose you need to get your Mom's attention to ask her something really, really important, but she's on the phone. Usually Moms say something like "I'll be off in just a second." What if she said, "Wait just a million seconds, dear"?

Guess how long it would take for a million seconds to go by. Check one:

____an hour ____a day ____a week ____more

2 How much space does a million names take in phone book pages? The white pages of a big city phone book hold about 500 names on each page. How many pages would you guess it takes to hold a million names? Check one:

____10 pages ____100 pages ____1000 pages ____more

3 You have decided to take a hike . . . of a million steps. How far will you travel? Hint: one step equals 1 meter. There are 1,000 meters in 1 kilometer. Check one:

_____ around the Great Pyramid in Egypt (.8 kilometer)

_____ along the length of the Panama Canal (88 kilometers)

_____ across Florida from top to bottom (880 kilometers)

4 A pinch of salt is about 1,000 grains. Would you guess a million grains of salt would fill a . . .

_____cup _____bathtub _____your bedroom

BIG TIME TOUR

Answer 1. You would be really annoyed. It would take 11.7 days for your mom to get off the phone if you had to wait a million seconds.

Answer 2. Hint: Divide 500 into a million. It takes about 2,000 pages to hold a million names. Big city phone books like San Francisco's are 1,000 pages. You would need two fat phone books worth of pages.

Answer 3. A million steps will take you about 900 kilometers. That is the length of Florida from top to bottom. A fair hiker covering ten kilometers a day would take about three months to walk this distance.

Answer 4. A cup holds about a million grains. You can pour a billion grains into a bathtub and pack a trillion into your bedroom.

BIG TIME TOUR

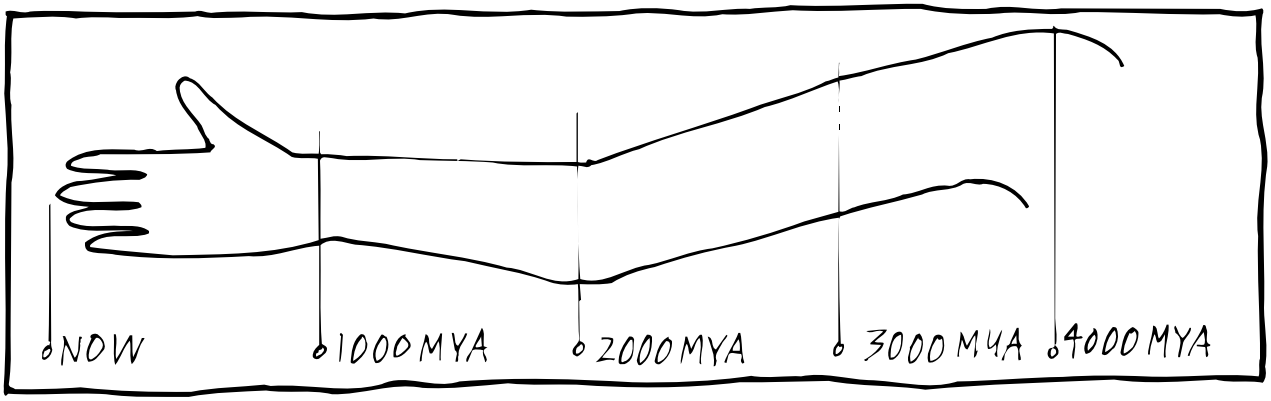
Part Two: Investigating All Time

Earth is old. It was formed about 4.5 billion years ago (4,500 million is another way to write this big number). Work in teams of 2 to investigate big time.

Take a Guess . . .

1 Imagine your arm is 4.5 billion years long. On your arm timeline imagine that now is located at your fingertips. Then imagine the beginning of Earth is located at your shoulder. MYA is another way of writing "a million years ago."

2 A lot has happened since Earth began. Just for fun, take a few guesses about where on the timeline some key events in Earth's history happened.



3 Bacteria were the first signs of life on Earth. Write "first life form" on a sticky note. Place it on one teammate's arm where you think bacteria first appeared.

4 Dinosaurs "ruled" the Earth for millions of years before they became extinct. Write "first dinosaurs" on a sticky note. Place it on your teammate's arm where in time you think dinosaurs first appeared. Write "last dinosaurs" on the next note and place it where you think the dinosaurs became extinct.

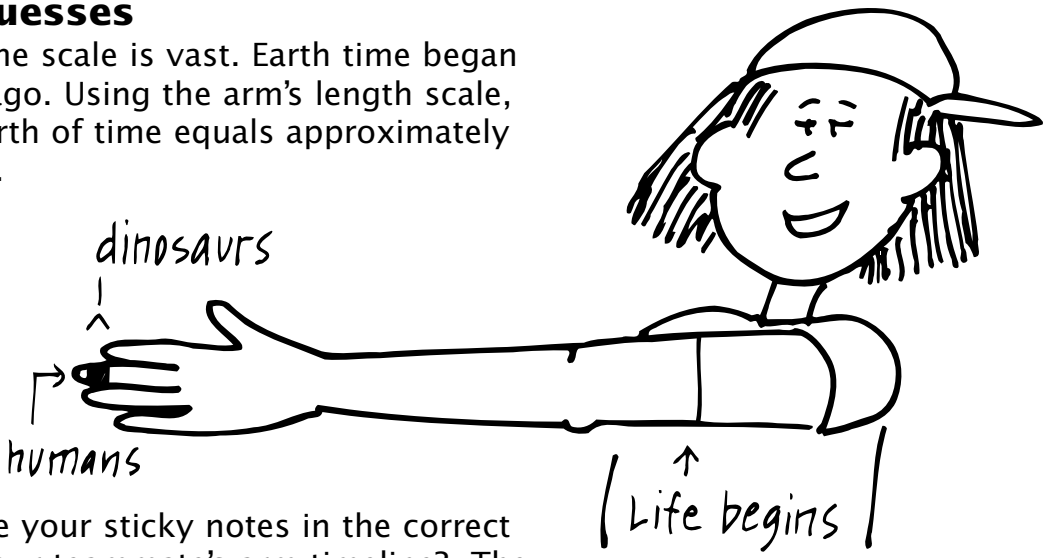
5 How far back do humans go? Write "first humans" on a note and place it to show where you think the first humans appeared.

BIG TIME TOUR

Part Two: Investigating All Time (cont'd)

Check your Guesses

The geological time scale is vast. Earth time began 4.5 billion years ago. Using the arm's length scale, one fingernail worth of time equals approximately 100 million years.



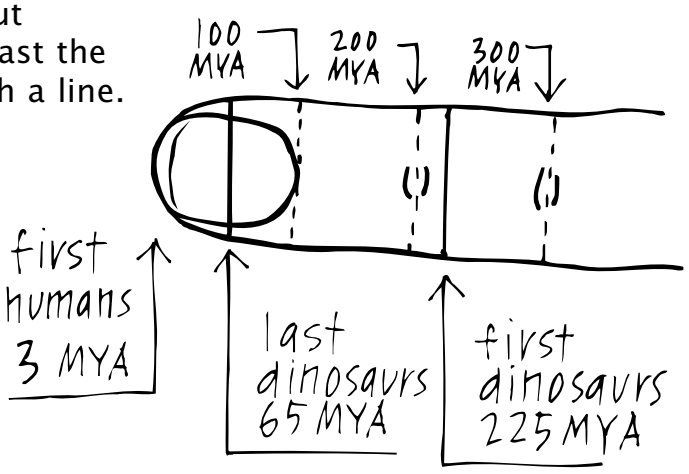
6 Ready to place your sticky notes in the correct place along your teammate's arm timeline? The first life forms (bacteria) appeared about 3,500 million years ago (mya). Place your sticker midway between the elbow and the shoulder.

7 Most life forms happened at your fingertips. Using a water-soluble marker, draw a line at the base of the fingernail of the third finger. This is 100 mya (million years ago.) Draw a line across the first knuckle to mark 200 mya. Draw another line across the next knuckle to mark 300 mya.

8 The dinosaurs appeared 225 million years ago. This is one quarter of the way between your nail and knuckle. Draw a line here.

9 The dinosaurs became extinct about 65 million years ago. This is just past the halfway mark on your nail. Mark it with a line.

10 Humans appeared over 3 million years ago. Draw a thin line on the tip of the nail. (This fraction of time probably takes up less space on the timeline than the dirt under your fingernails.)



BIG TIME TOUR

Part Two: Investigating All Time (cont'd)

11 Work with your partner to make an arm's length timeline. Label your timeline with some important events in Earth's history. You need paper and a marker or pen. Choose one person to be the tracer, the other will be the arm model.

12 Find a flat surface for your paper. Lay an arm on the paper. Position it so there will be room to write around the arm. Let your partner trace around the arm to make an outline.

13 Mark the time zones along the bottom of the page:

Present time	fingertips
4,000 mya	shoulder
2,000 mya	elbow
1,000 mya	midway between fingertips and elbow
3,000 mya	midway between elbow and shoulder

14 Now place these events on your timeline:

MYA (Million Years Ago)	**Event**
over 3 mya	first humans
65 mya	dinosaurs become extinct
225 mya	first dinosaurs, first mammals
500 mya	first fish
570 mya	first shelled animals
3,500 mya	bacteria (first life forms)
4,500 mya	Earth begins as a mass of melted rock

BIG TIME TOUR

Think It Over

Some moments in the geological record show surprising changes. One of these places is at 65 mya. It is called the K-T boundary and marks the end of one era and the beginning of another. Mark this boundary on your timeline. What other events are close to this boundary?

DIGGING INTO THE PAST

ACTIVITY FIVE

Today you will make history! Work with a partner to make a set of geological layers (strata) and take notes. Then you will swap strata, take a core sample, read the layers and write a history of what happened.

What We Know. Chicxulub is a gigantic crater 200 kilometers wide. Despite its huge size no one noticed it until a few years ago. It was hard to notice because it is buried under at least 300 meters of earth. How do you study a rock formation you can't see? One method geologists use is a precise kind of drilling called core sampling. They drill into the earth and remove a neat core or column of rocks. The core is carefully handled and then taken back to the lab for study.

What can a scientist learn from a tube of dirt and rocks? Lots. When a core is opened it usually shows different layers of rocky materials. The order of the layers helps create a history of what happened there. Fossils in the layers help scientists estimate the age of the rocks. One of the ways Adriana Ocampo's team explored the Chicxulub crater was by taking some core samples. You can try a version of it yourself, right on your table.

Before You Begin

Teams of 2

Length:

Part I - 30 minutes
Part II - 30 minutes

What You Need

For every 10-12 kids:

- ¾ liter brown sugar
- ½ liter white sugar
- 1 jar dark sprinkles
- 1 small bottle each red and green food colors
- 5 plastic spoons
- 5 containers for the sugar mixtures (about 250 ml each)

For each team of 2:

- 1 plastic spoon
- one small opaque cup (150-200 ml styrofoam or paper)
- 1 clear plastic straw
- 1 set of colored pencils to match the layer colors
- 1 paper plate
- newspapers (to cover work space)

To prepare the sugar mixtures:

Prepare 5 different colors and textures of sugar. One container of each color should be enough for 4 or 5 groups.

- brown sugar
- orange sugar (brown sugar plus drops of red food color)
- fossil sugar (brown plus tiny sprinkles)
- white sugar
- green sugar (white sugar plus drops of green food color)

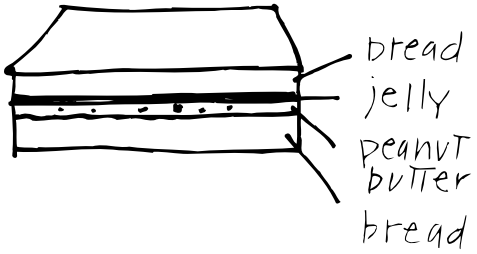
DIGGING INTO THE PAST

Part One: Make History

A lot of things are made one layer at a time . . . birthday cakes, ice cream sundaes and brick walls. Bakers and bricklayers are not the only people who are interested in layers. Geologists often think about layers.

Imagine peanut butter and jelly on toast. Now imagine looking at it like a geologist.

How many layers do you see?



1 What is the sequence of the layers, starting from the bottom?

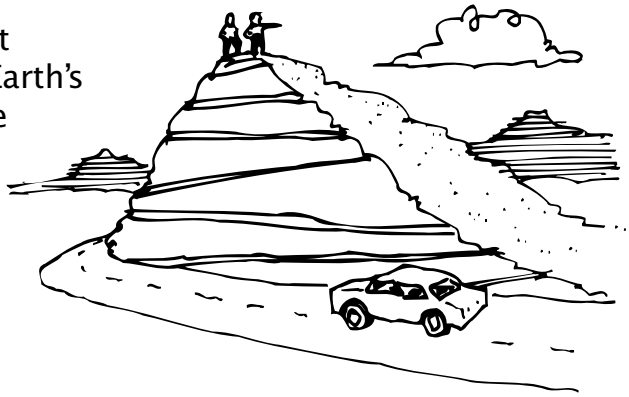
a. _____

b. _____

c. _____

d. _____

2 Which layer would have been laid down first (or be the oldest)? Sometimes you can see Earth's rock layers or strata clearly. One place to notice layers is where banks are cut along a river. Another place is where a road cuts through a hillside. How do you know whether the people in this picture are standing on the newest or oldest layer?



Part One: Make History (cont'd)

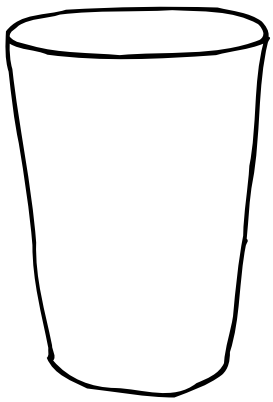
3 With a partner, create a "geological history" in a cup. First make a plan of the layers in your cup on the chart below. Consider the following:

- rock that includes fossils (brown sugar with sprinkles)
- different rocks that have a few fossils (brown or white or orange sugar)
- iridium. This is a metal that is very rare on Earth but common in rocks from space. It suggests evidence of a meteor impact. (green sugar)

4 Cover your workspace with newspaper. Get your empty cup and plastic spoon and set them aside. Then get a paper plate and carefully spoon out the sugars that you will need for your geological history in a cup. Be careful not to mix the different sugars until you are ready to layer them in your cup.

5 Starting with layer 1 on your plan, spoon the colored sugar into the cup. Make the layer at least one centimeter thick (more is fine). Continue with the rest of the layers on your plan.

TRACK THE LAYERS PLAN

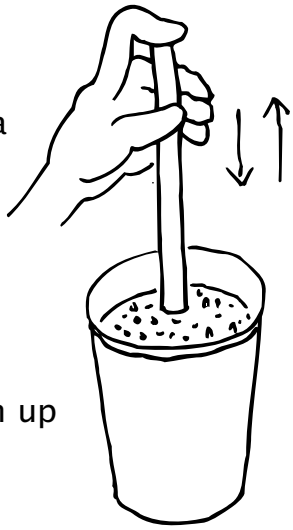
Layer	Material	Draw the layers (use color)
6		
5		
4		
3		
2		
1		

DIGGING INTO THE PAST

Part Two: Read the Past

Now your team will take a core sample of another team's cup. Your challenge is to figure out what rocks they used and the order (or the history) of how the layers were formed.

Trading History



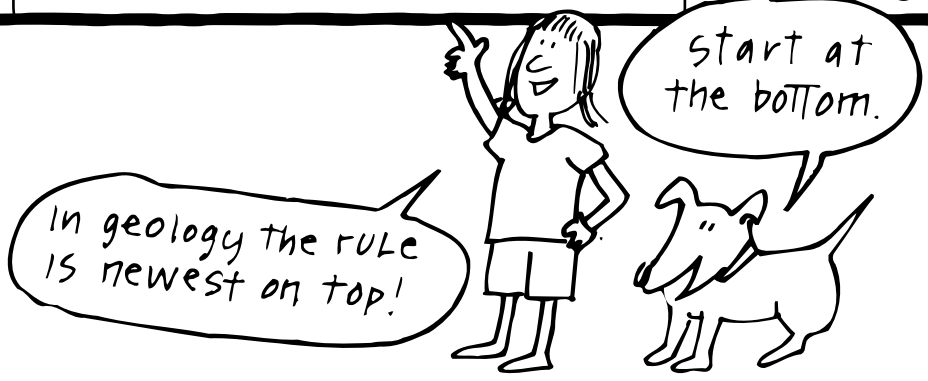
1 Swap cups with another team. Take a core sample by pushing a straw straight down through the layers.

2 Remove the core by putting your finger on the open end of the straw and pulling up. **Keep your finger on the straw to keep the material inside.** If needed, dust off the outside of the straw so you can see the layers.

3 Read the core's history by recording the layers from the bottom up using both words and a drawing.

READ THE CORE

Layer	Material	Draw the sample (use color)
6		
5		
4		
3		
2		
1		



DIGGING INTO THE PAST

Think It Over

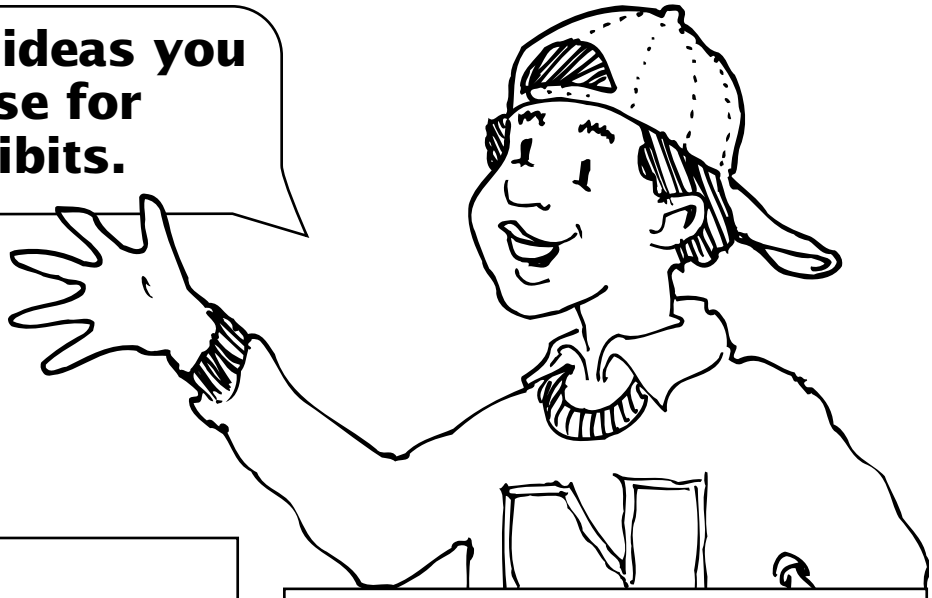
What do the Earth's rock layers show you about the history of the Earth?

PULLING IT ALL TOGETHER

Create a story about a scientist who studies space geology.

NEW WONDERS

Here are some ideas you might like to use for projects or exhibits.



1. FILM CRITIC

"Deep Impact," "Armageddon," and "When Worlds Collide" are movies based on stories of a big object from space crashing into Earth. Many of the details in these films are highly accurate . . . some are not. Play movie reviewer. Watch one of these films. Then write a review about where these films go wrong, based on what you know about asteroids and meteor impacts.

2. METEOR SHOWERS

The Earth is constantly being bombarded with space junk. These bits of dust and rocks appear as falling stars or meteors as they blaze through the atmosphere. Every year Earth travels through areas of space debris or meteor belts. During these nights your chances of spotting falling stars are very good. An almanac will list the dates. Some research will tell you the best hours and conditions for meteor spotting. Organize a late night Shower Power Party for your family or friends.

3. MYTHS OF THE FALLING STAR

The Romans believed a falling star was a soul returning to heaven. The Chinese called meteorites "thunderstones" and believed they were signs of an angry god. People from across cultures and time have invented explanations for meteors. Ferret out as many cosmic myths as you can find to explain meteors. Write them down and illustrate a book about them.

4. THE MILLION MUSEUM— EXPLORING BIG NUMBERS

A million, a billion, a trillion . . . most people throw these BIG numbers around but have no idea how big they are. Figure out a way to collect, show or demonstrate a million of something. How many pages does it take to display a million question marks? How long to take a million breaths? How much would a million pennies weigh? Work it out. Then create a way to demonstrate your million.