Name: _____

Grade 4

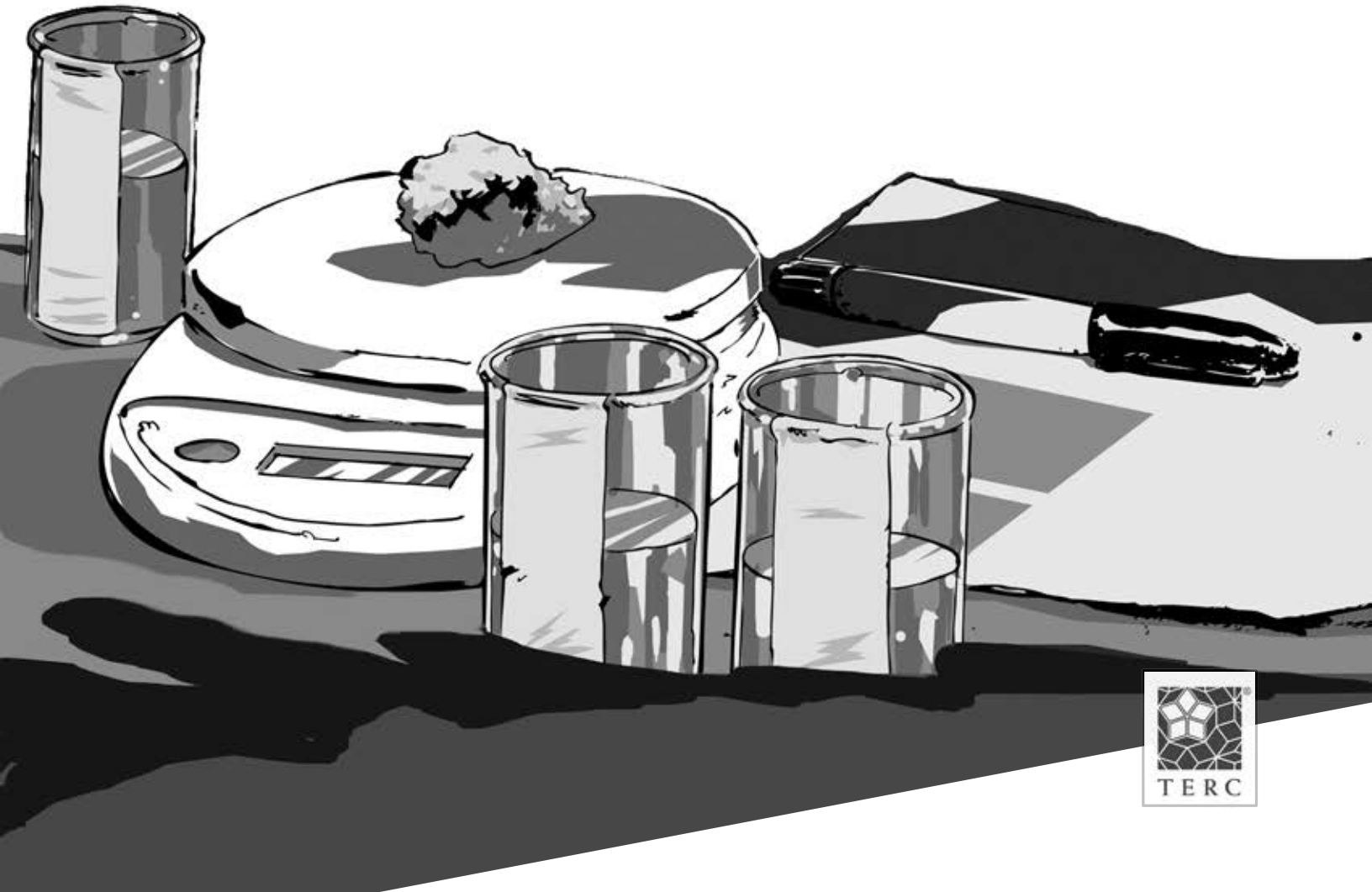
The Inquiry Project

Seeing the world through a scientist's eyes

Science Notebook

Investigating Earth Materials

Which Properties Change and Which Stay the Same?



TERC

Dear Student Scientist,

Scientists always keep a notebook open and at their side so they can record their ideas, questions, and findings as they work. You are about to do this too.

You might record an observation or some measurements, or jot down something you wonder about or questions you have so you don't forget them.

You might create a drawing with labels and notes to explain something you've observed and are trying to figure out. There's space for you to explain your thinking as you carry out investigations.

Your notebook is for you, to help you remember what you were thinking, what you did, what you found out. Science notebooks are for others too, in case they want to know more about your investigations or ideas.

When it's time for science, open your notebook and fill it up with your predictions questions, drawings, measurements, ideas and explanations! And don't forget to write the date.

Date _____

Date: _____

Observations of earth materials

Date: _____

Observations of a rock

Name of my rock: _____

Observations:

My questions about rocks:

Date: _____

Properties of rocks

Here are claims about rocks:

Date: _____

Observations of some minerals

Mineral				
	Color			
		Luster (shiny or dull)		
			Hardness Harder than fingernail? (Y/N)	
				Translucence Can light shine through? (Y/N)
				Friability Crumbles easily? (Y/N)

Under Foot 1.3: *What can we learn about minerals by observing them carefully?*

Date: _____

Can we find some minerals in our rocks?

Date: _____

Some properties of 8 minerals

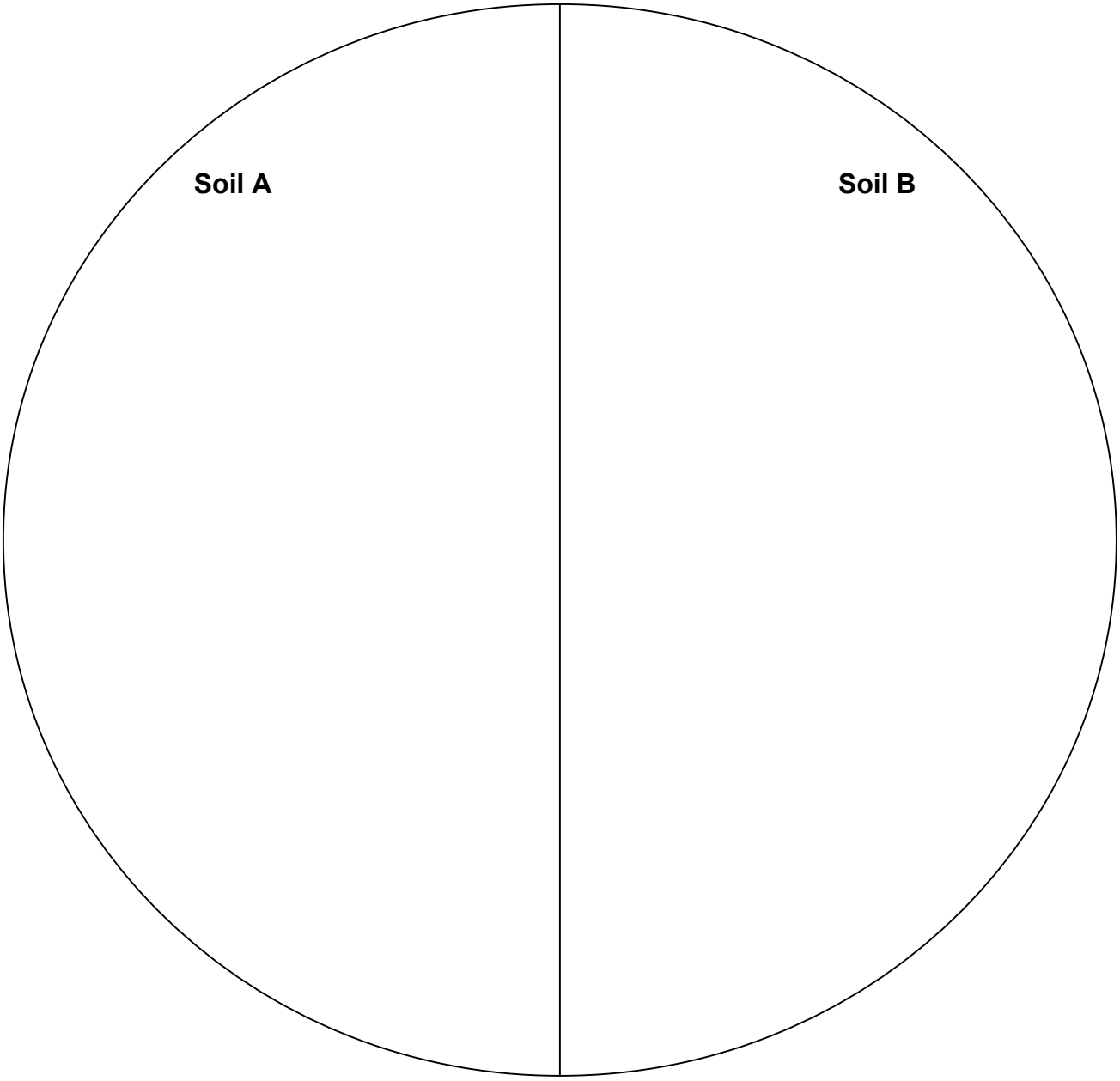
		Shiny or Dull			Harder than Fingernail?			Light Shines Through?			Friable?	
9												
8												
7												
6												
5												
4												
3												
2												
1												
		S	D		Y	N		Y	N		Y	N

Under Foot 1.3: *What can we learn about minerals by observing them carefully?*

Date: _____

Date: _____

Observing soil grains



Date: _____

Observing soil samples

1. Do you see pieces of soil made out of materials you recognize? Explain.

2. Do you think all soil grains are made of the same material? Explain.

3. When you look at a soil sample in its container, what do you think is in between the soil grains?

Date: _____

Soil and weathering

Here are some ways that soil and weathering are connected:

Date: _____

Date: _____

Observations of weights and volumes

Weight of container: _____

Material	Volume	Weight (g) material + container	Weight (g) container	Weight (g) material
Water (liquid)	40cc			
Mineral oil (liquid)	40cc			
Sand (granular solid)	40cc			
Organic (granular solid)	40cc			

Date: _____

Reflections on weights and volumes

Reflection

What surprised you? Explain.

_____

_____

_____

_____

_____

_____

_____

If you had tiny samples of these four earth materials, and they had equal volumes, how do you think the weights would compare?

_____

_____

_____

_____

_____

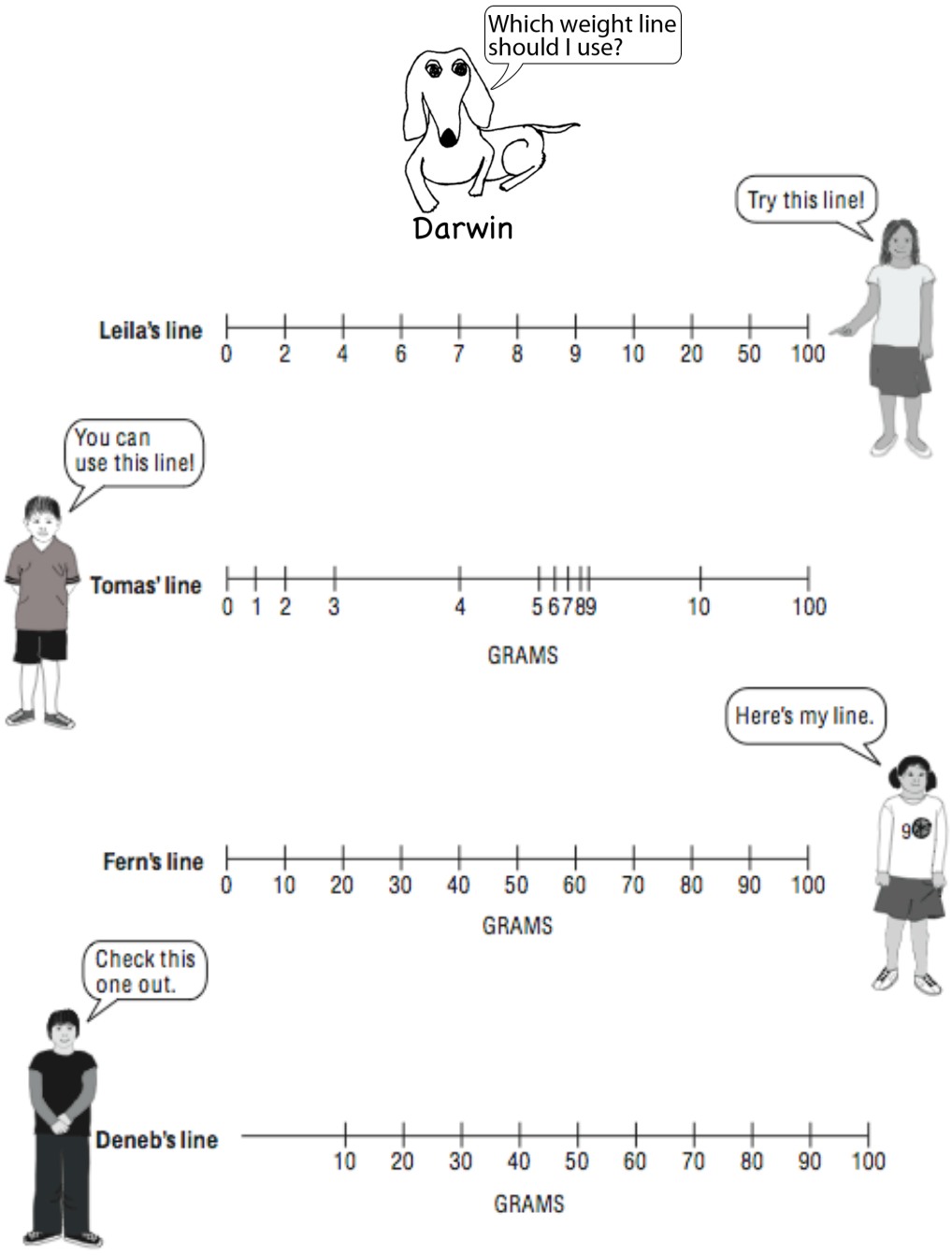
_____

_____

Date: _____

Which weight line?

Darwin has four dog biscuits. They are all the same size, but they have different weights: 5 grams, 10 grams, 20 grams, and 100 grams. Darwin wants to arrange the biscuits on a weight line so he can see how much more one biscuit weighs than another.



Heavy for Size 2.2: *What makes a good weight line?*

Date: _____

Dear Darwin

Tell Darwin what you think is good or not-so-good about each weight line using pictures and words.

Dear Darwin,

I'm going to tell you what I think is good or not-so-good about each character's weight line. You'll see a star* by the one I think is best to use.

Leila's line _____

_____

_____

_____

Tomas's line _____

_____

_____

_____

Fern's line _____

_____

_____

_____

Deneb's line _____

_____

_____

_____

Heavy for Size 2.2: *What makes a good weight line?*

Date: _____

Rules for good weight lines

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

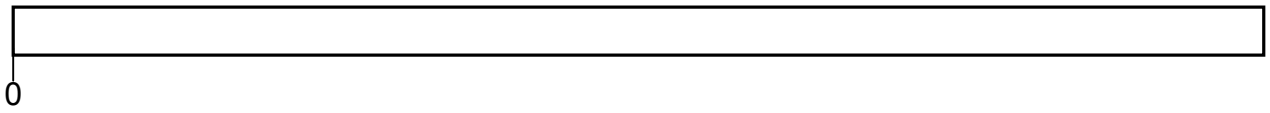
_____

Date: _____

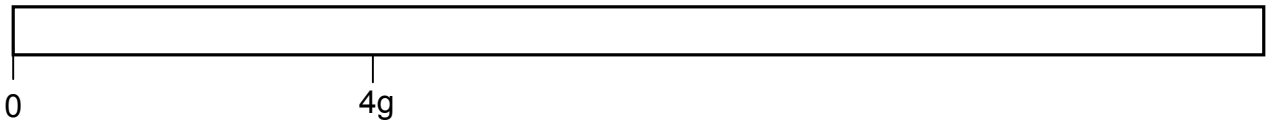
Date: _____

Weight line puzzles

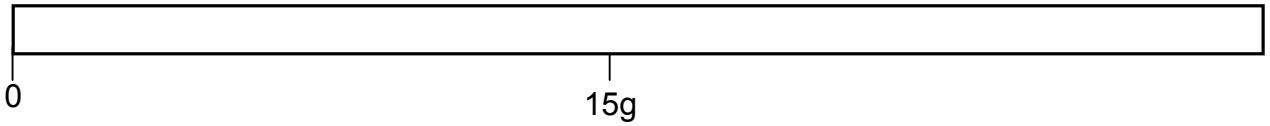
A. One rock weighs twice as much as another. Show where you would put those two rocks on this weight line.



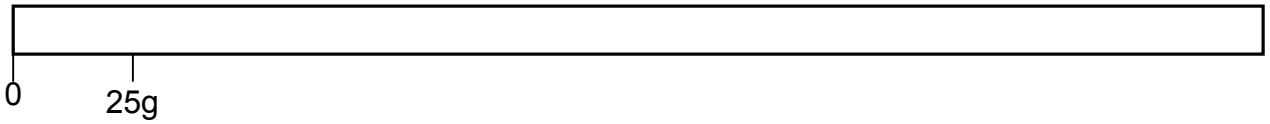
B. One shell weighs 2g, one shell weighs 8g, and one shell weighs 10g. Show where you would put each shell on this weight line.



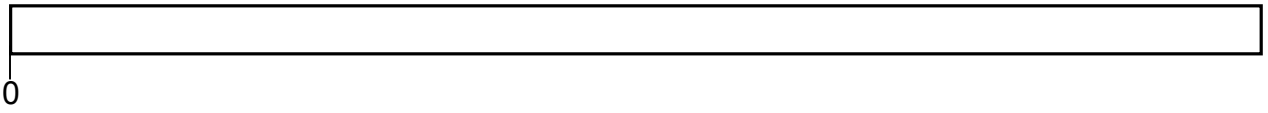
C. Where would you put a rock that weighs 25g?



D. What is the heaviest thing you can put on this weight line?



E. One rock weighs ½g, another weighs 3g. Show where you would put each rock on this weight line.



Date: _____

Date: _____

What's the volume of 40 grams of an earth material?

40 grams each of gravel, sand, water, mineral oil, organic soil

I predict that the volumes of these materials will look like this:

Observations after measuring 40 grams of each material:

Date: _____

Volume reflections

1. What surprised you when you compared the volumes of 40 grams of different earth materials?

2. Do some earth materials have similar volumes for equal weights? If so, which ones?

Do you think this is a coincidence or can you think of reasons why their volumes are similar?

3. If you bought a bag of 1000g of sand and a bag of 1000g of organic material, how do you think the sizes of the bags would compare?

Date: _____

Which water sample takes up more space?

Here's my prediction about how the volumes of the water samples compare:

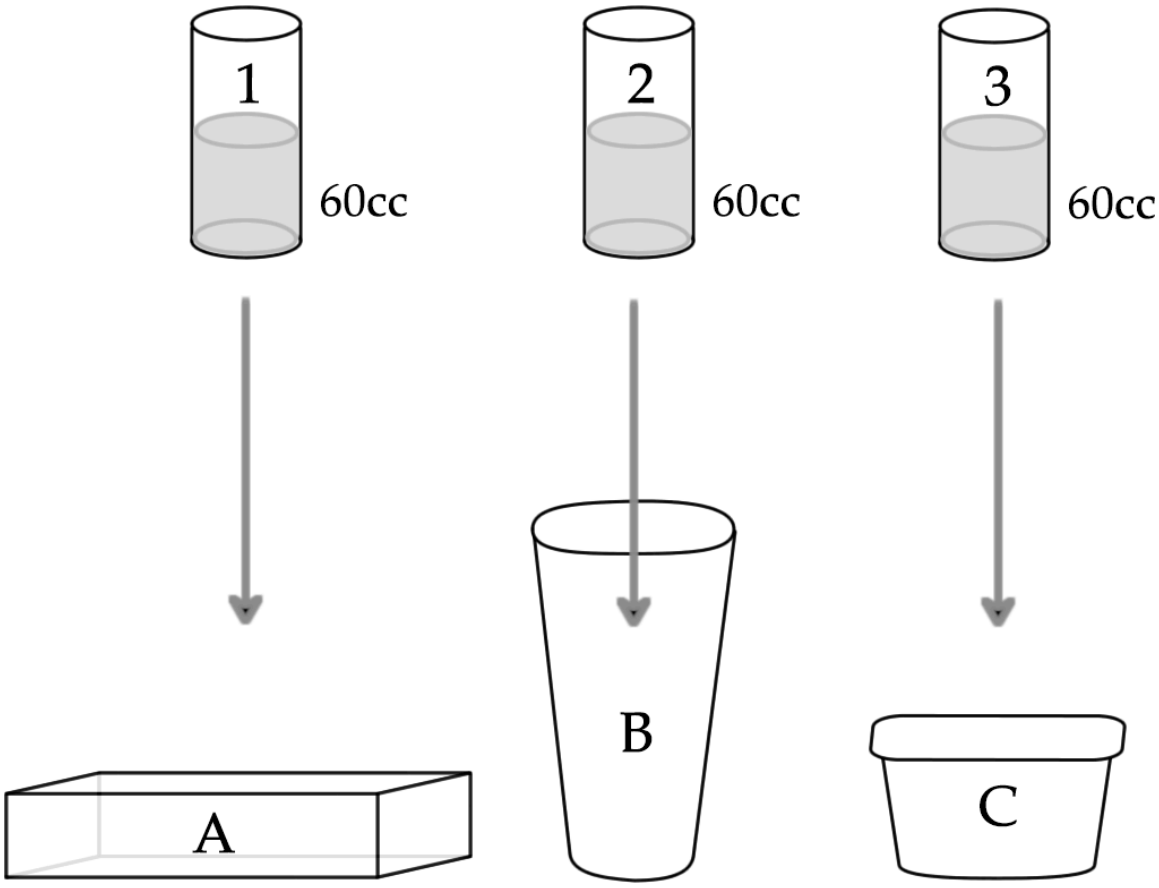
Least volume ←----------→ Most volume

Here's what we did to check our predictions:

Here's what we found out:

Date: _____

What is the volume?



The water is poured into container A, B and C. I think that the volumes of water in containers A, B and C will be:

_____

_____

_____

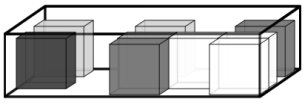
_____

_____

_____

Date: _____

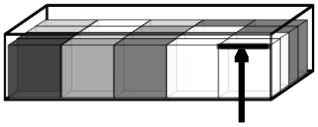
Challenge: Build a measuring cup!



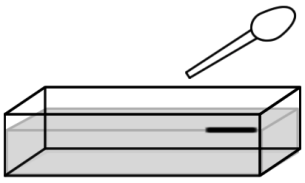
- Fill the box with a layer of cubes.

How many cubic centimeters did you use? _____

The volume of the space that the cubes take up is: _____

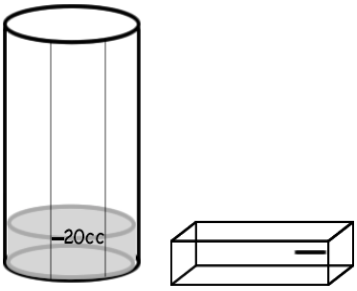


- Make a line at the top of the cubes.

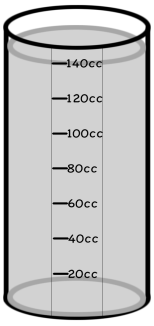


- Remove the cubes from the box.
- Fill the box with water up to the line.
- Use the dropper to help you get the right amount.

What is the volume of the water in the box? _____



- Pour 20cc of water from the box into the container.
- Make a mark on the tape at the top of the water.
- Label the mark 20cc.



- Measure 20cc of water in your measuring box.
- Pour 20cc of water from the box into the container.
- Make a mark on the tape at the top of the water.
- Label the mark 40cc.

- Continue to add 20cc of water to the container. Each time make a new mark and label it with the number of cubic centimeters.

Date: _____

Using our measuring cup

Measure the volumes of the two water samples:

Water Sample	Volume (cubic centimeters)
container 1	
container 2	

How much more water is there in one container than the other?

Reflection

How did you know where to put the 20cc mark on your measuring cup?

How did you know where to put the 40cc mark on your measuring cup?

Date: _____

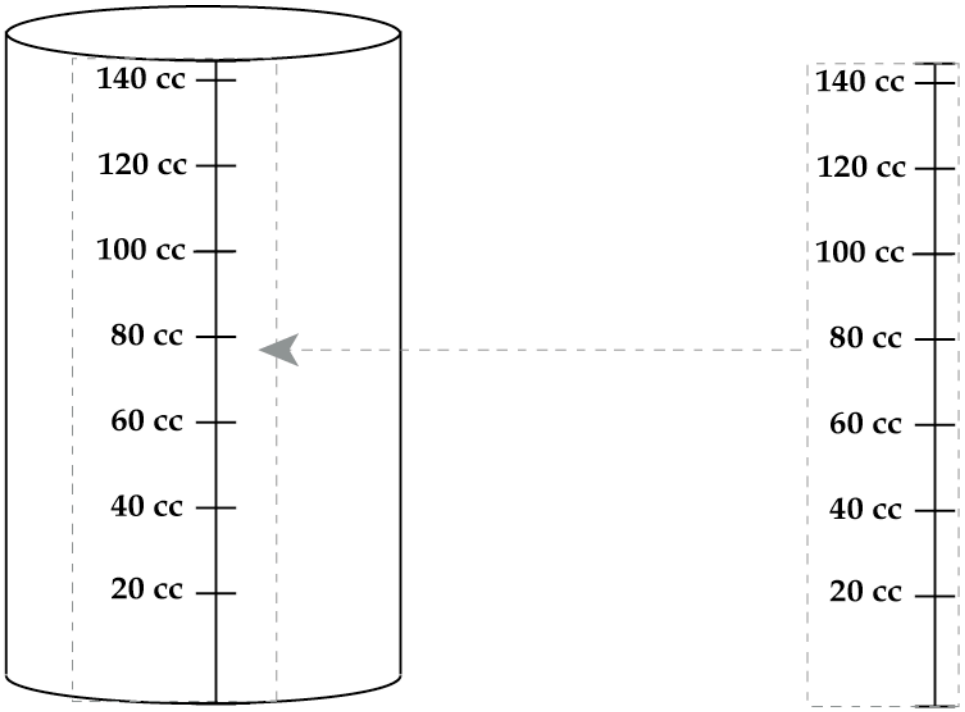
How do oil and water compare?

We compared the volumes of _____ grams of oil and water.

Here's a drawing to show how the volumes compare:

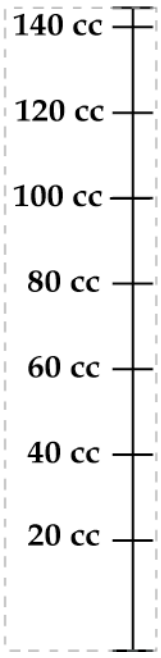
Observation of the movement of oil and water:

Date: _____



150cc container

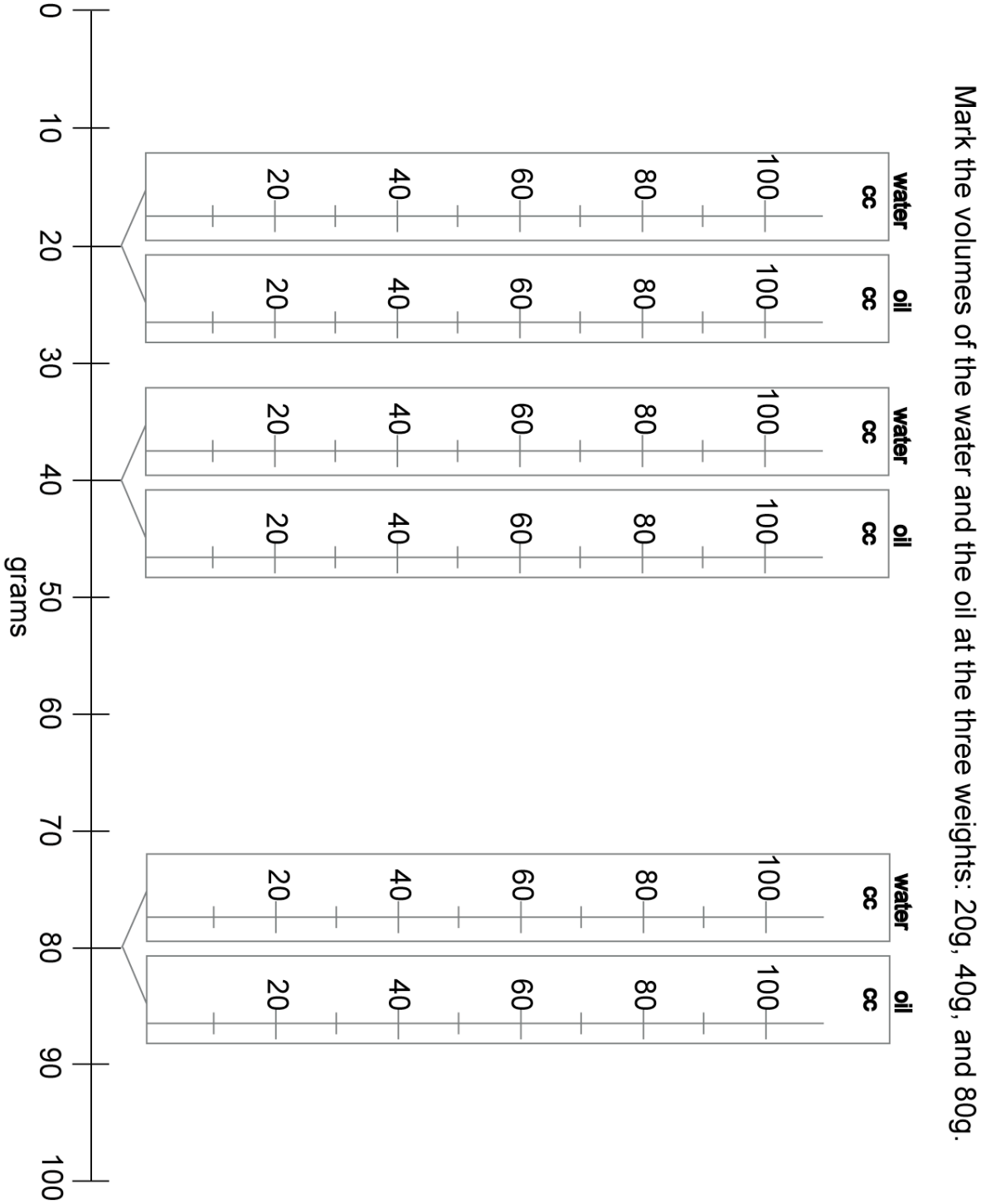
Carefully cut out the volume guide at right, along the dotted lines. Use this guide to measure the volume of liquids in the 150cc containers.



Date: _____

Date: _____

When the weights are equal, what's the volume?



Date: _____

How much will the water rise?

Predict
Which factor makes the water rise higher: weight, volume, or both?

I predict that:

_____

_____

_____

My reasons are:

_____

_____

_____

Data: Comparing Aluminum and Copper cubes

	Volumes	**Weights**	**Water level**
Aluminum cube			
Copper cube			

What do you think caused the water level to rise: weight, volume, or both? Why do you think so?

Date: _____

Data: Comparing Aluminum and Plasticene cubes

	Volumes	**Weights**	**Water level**
Aluminum cube			
Plasticene cube			

What do you think caused the water level to rise: weight, volume, or both? Why do you think so?

Drawing of our observations:

Date: _____

Which rock has more volume?

Estimating volumes
Here's how my group estimated the volume (number of cubic centimeters) of our rocks:

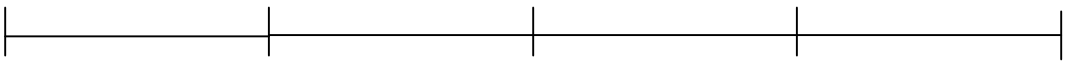
Checking our estimates
Here's what we did to check our estimates:

Date: _____

Measured volumes

Rock #	Estimated volume (cubic centimeters)	Measured volume (cubic centimeters)

Volume measure line
Here are our rocks on the volume measure line:



Date: _____

Volume reflection

Reflection Questions

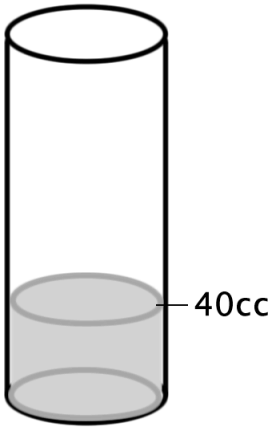
1. You observed that when you put a rock into a container of water the water level rises. Why do you think the water rises?

2. If you need to find the volume of rock would you (a) use centimeter cubes to build a replica, or (b) use displacement of water?
Explain your answer.

Date: _____

Date: _____

What happens when we add earth materials to water?



Always start with 40cc of water in your graduated cylinder.

Predict before you test.

Cubes

What if we put in 10 centimeter cubes?
What if we add another 10 cubes?

Water

What if we add 20 cubic centimeters (cc) of water?

Rock

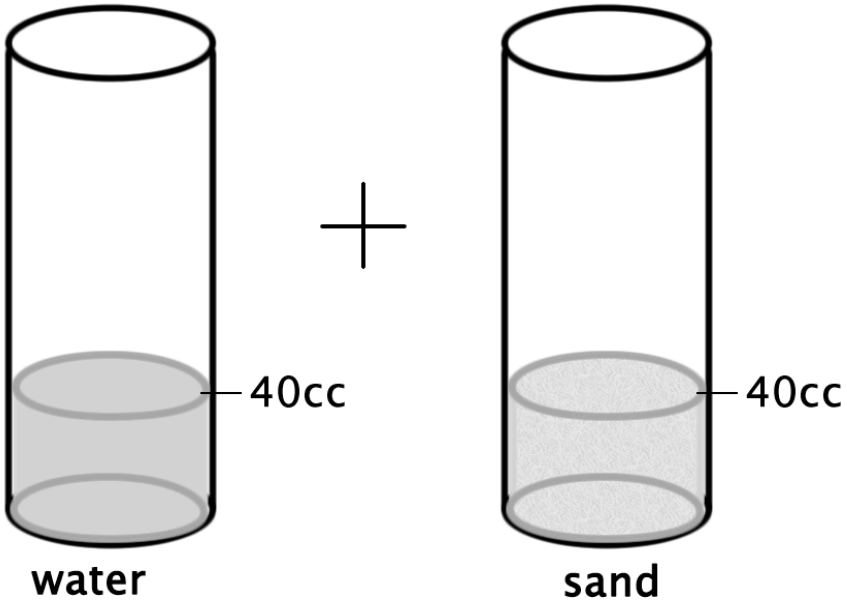
What if we add a rock?

Bulk Gravel

What if we add 40 cubic centimeters (cc) of bulk gravel?

Date: _____

Does 40cc plus 40cc equal 80cc?



What will happen when we add 40cc of water with 40cc of sand?

I predict:

_____

_____

_____

_____

I think so because:

_____

_____

_____

_____

Date: _____

What changes and what stays the same when we crush shells?

Prediction:

Data:

Before	After crushing

Date: _____

Crushing shells claims

I claim that when I crush some shells:

_____

_____

_____

_____

My evidence is:

_____

_____

_____

_____

My explanation for these findings is:

_____

_____

_____

_____

Date: _____

What happens to weight and volume when we reshape a ball of clay?

Predict:

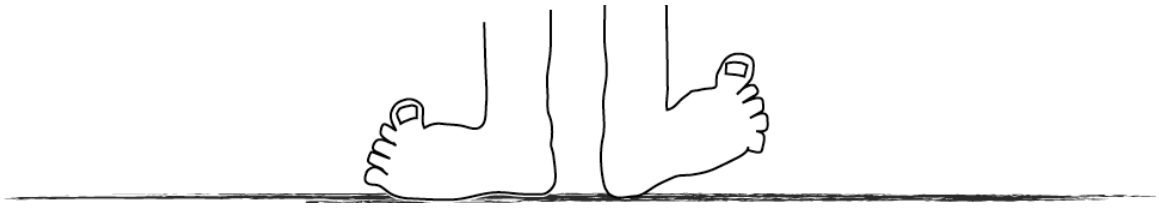
Data:

Claims:

Date: _____

Date: _____

What's under my feet?



Draw a picture of the place you selected.

Wrap-up: *What's under my feet?*

Date: _____

What are 2 earth materials that are under your feet? List 3 words that describe each material.

Imagine holding a 40cc sample of each material, how do you think their weights will compare?

Imagine how these materials could have been transformed? Describe at least one transformation.

Wrap-up: *What's under my feet?*

Date: _____

Reference

Weathering

When you look at sand, you may see tiny pieces of quartz in the sand that match large pieces of quartz rocks nearby, and you may see tiny pieces of shiny mica that match larger piece of mica. Small pieces of rocks and minerals are always wearing off and breaking off larger pieces, and those small pieces themselves wear down and break into smaller pieces.

Photo by Sara Lacy, 2008

What causes this to happen? Rivers and oceans roll rocks and minerals across one another thousands or millions of times, and wind and storms and other natural forces on earth keep moving and grinding earth materials into smaller and smaller pieces.

When rainwater gets into rocks and then freezes, it expands and can cause pieces of rock to break off. Plant roots may also expand in cracks and cause pieces of rock to break off.

When acid rain falls on limestone or chalk, over a long period of time, the material breaks down.

The name used to describe this wearing down of Earth materials on the Earth's surface is weathering, although weather is just one of the forces that makes things break down into smaller pieces.

http://libraryphoto.cr.usgs.gov/cgi-bin/show_picture.cgi?ID=ID.%20Gilbert,%20G.K.%203382

Earth materials that have been loosened by weathering may move, carried by air, water or ice, or carried downhill by gravity. The name used to describe this movement is erosion..

What is a mineral?

You've met seven minerals that we frequently find in rocks, including feldspar, mica, and quartz, the most common mineral on Earth. There are thousands of other minerals on Earth, including gems like diamonds and emeralds, and metals like gold and copper. People have found thousands of different ways to make use of Earth's minerals. We use talc in baby powder. We season our food with halite (salt). The clay mineral kaolinite is used in pottery, but you might also find kaolinite in the ingredients list for ice cream - it's used to keep ice cream from melting quickly.

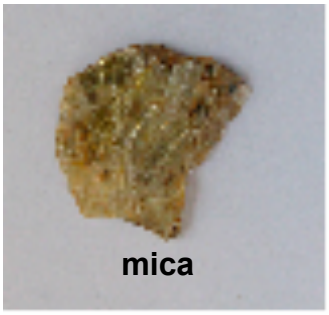
What makes a mineral a mineral?

All of the substances that we call minerals occur in nature. You can see feldspar, mica and quartz in granite rocks. If a substance is manmade, like plastic or steel, it's not a mineral. To be classified as a mineral, a substance must be a solid. That rules out water (a liquid) but ice (the same stuff in solid form) is a mineral. When a mineral crystallizes, its particles come together in a 3-dimensional pattern that's repeated in all directions, known as a crystal structure. The shape of the crystals may be intricate, like a snowflake, or may be as simple as a cube.

Mineral crystals

Mineral crystals form in several different ways. Water crystallizes when it freezes. Hot liquid magma crystallizes when it cools. Minerals crystallize in granite when magma cools slowly, deep underground. Salt minerals, on the other hand, form when salty water evaporates, leaving behind deposits of rock salt. Sometimes, when rock particles are heated they rearrange themselves to form a new crystal structure and become new minerals, with new properties.

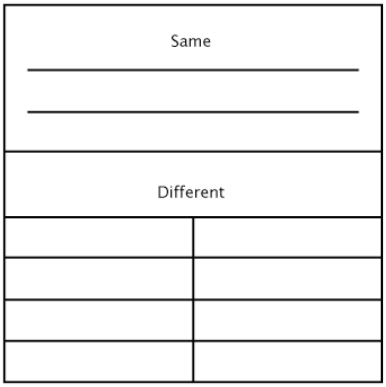
Properties of minerals

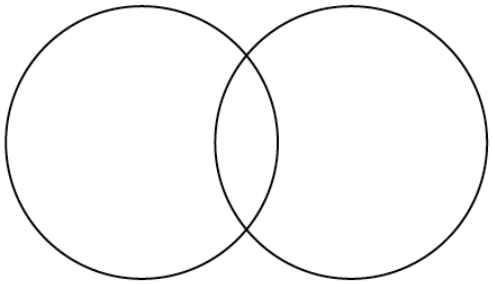

mica

The properties of minerals, such as hardness, color and heaviness for size, give us clues about their composition and their crystal structure and help us identify them. Diamonds are the hardest minerals by far and you cannot scratch them with other minerals. When you break off a piece of halite you may find squared-off corners, reflecting the repeating cubes of its crystal structure. Mica crystals, on the other hand, form in sheets, and you'll find that it breaks along flat surfaces. You can tell hematite apart from other dark colored minerals because it is heavy for its size and magnetic.

Data Representations

Compare





List

Ordered

1) _____
2) _____
3) _____
4) . . .

Bulleted

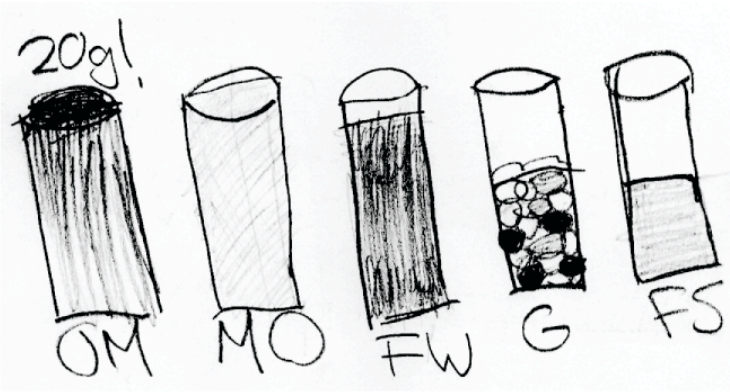
- _____
- _____
- _____
- . . .

Table

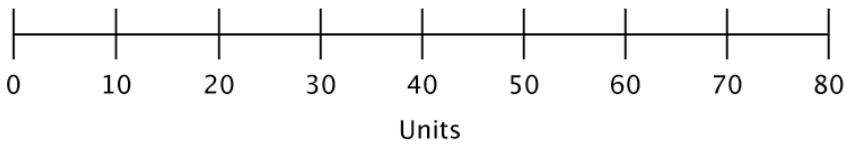
Case	property #1	property #2	...
case #1			
case #2			
case #3			
...			

Data Representations

Labeled Drawing



Measure Line



Graph