Literacy for Science

Research-based
Standards-aligned
Instruction

9 December 2013

National Academy of Science

Jacqueline Barber, Lawrence Hall of Science
University of California, Berkeley

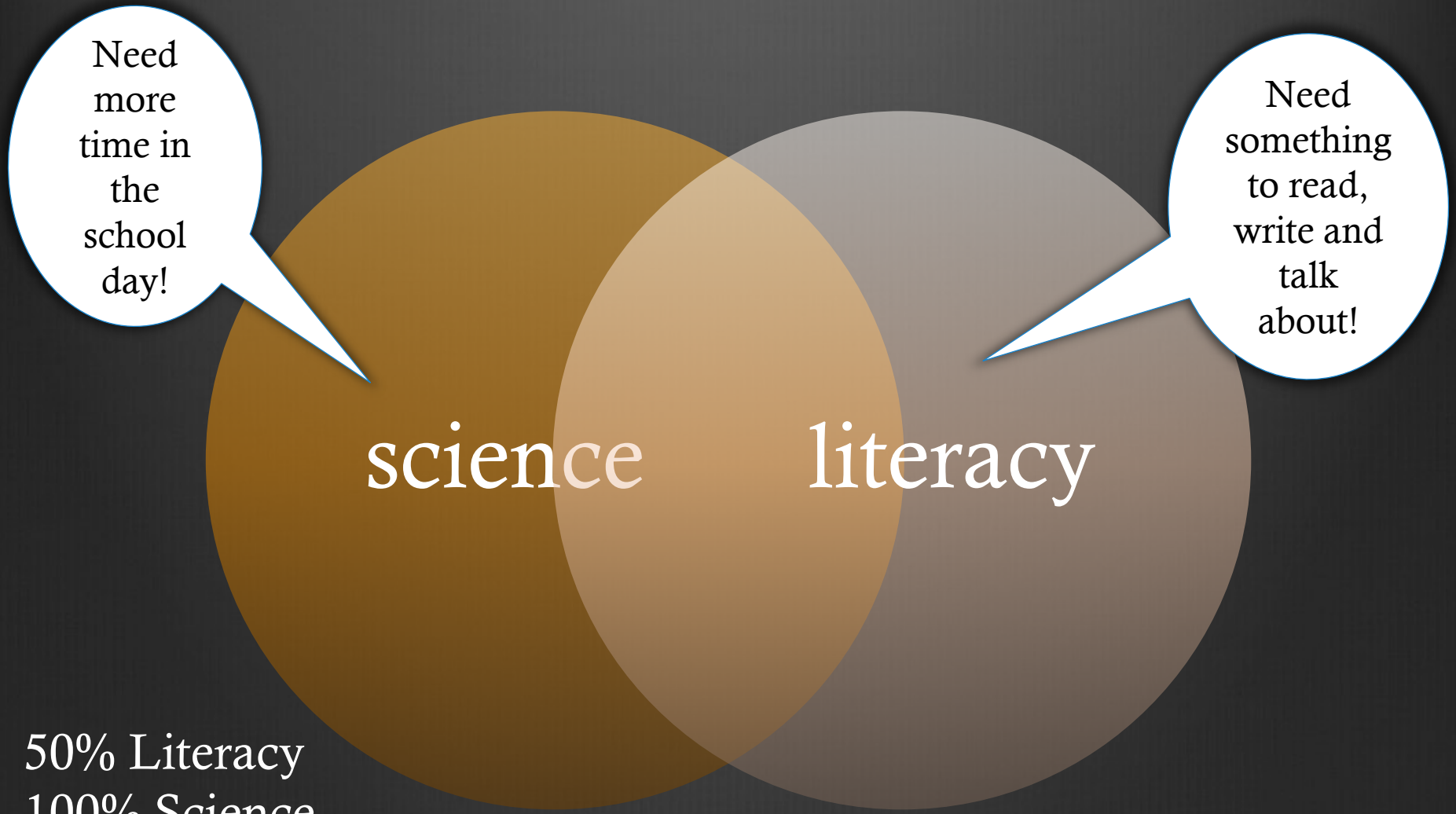
Sherrie Roland, Grafton Village Elementary School
Stafford County Public Schools, Virginia

P. David Pearson

literacy	researcher
science	designer

Jacquey

A matter of curricular economy

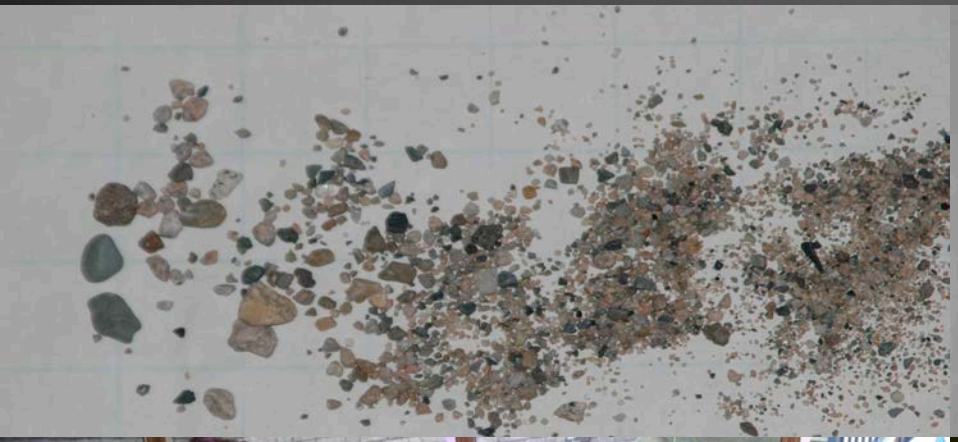


50% Literacy
100% Science

Basic approach

Provide instruction for how to read science text, write science text and engage in science talk

Firsthand Investigation



Second Hand Investigation

Cornstarch

HOW IT LOOKS
Cornstarch is a white **powder**.

PURE SUBSTANCE OR MIXTURE?
Cornstarch is a **pure substance**.

WHERE IT COMES FROM
Cornstarch is made from corn. Corn is ground up and then separated into different parts. Cornstarch is one of the parts.

IMPORTANT PROPERTIES
- Cornstarch has no smell and almost no **flavor** by itself.
- Cornstarch is partly **soluble** in water.
- When you mix it with cold water, cornstarch makes a smooth, white paste. This **mixture** acts like a **liquid** if you stir it slowly. It acts like a **solid** if you stir it fast.
- When cornstarch is mixed with hot water, the mixture gets thick and almost clear. The mixture becomes sticky when it starts to dry out.

WHAT IT'S USED FOR
Because cornstarch makes mixtures thick, it is often used in cooking. Cornstarch is used to make thick sauces like gravy.

Because cornstarch can become sticky, it is used to glue the paper around the outside of crayons.

CAUSE AND EFFECT
- Cornstarch makes a mixture thick.
- Cornstarch can become sticky if it's mixed with hot water.

Cooks often use cornstarch to make gravy thick.

Cornstarch is keeping the paper glued onto these crayons.

photo Ok

we could move gravy photo to p12 if you prefer

13

Galileo wrote about his **observations** of the Moon's surface. Many people disagreed with Galileo. They observed the Moon and made different claims about it. Some people said that the Moon was covered with a shiny material that no one could see. They said that the material made the Moon reflect light. They thought that a more powerful telescope would let them see this shiny material.

12

Here's how scientists disagree.

Scientists get together to talk about their investigations. They share their claims and their evidence. They listen to one another and ask questions. Sometimes two different scientists doing the same investigation have different evidence and different **explanations**. They disagree. These disagreements are very exciting for scientists.

Measurements

Material		Brightness of light source	Transmitted light	Reflected light	Absorbed light
loose-leaf paper (white)		1,000 lux	170 lux	167 lux	663 lux
lunch bag (brown)		1,000 lux	45 lux	89 lux	866 lux
poster board (white)		1,000 lux	0 lux	200 lux	800 lux
waxed paper (white)		1,000 lux	744 lux	87 lux	169 lux

17

Jess's Substance Table

Substance	Properties		
	Looks shiny	Makes spikes	Notes
Shampoo	yes	no	foamy
Shaving cream	no	yes	very foamy
Egg whites	yes	no	too thick
Corn syrup	no	no	too thin
Lime gelatin	yes	yes	green
			smells like lime
Glue stick	no	yes	hard when dry

Jess **compared** the substances. Only lime gelatin made his hair shiny and spiky. But there were problems with the lime gelatin. Who wants green hair? Who wants to smell like lime?

9

Tightly-paired First and Secondhand Experiences

Shared Goal

Firsthand + Secondhand

Observe Sand Samples Close Up

Learn from a Sand Scientist

The Color of Sand

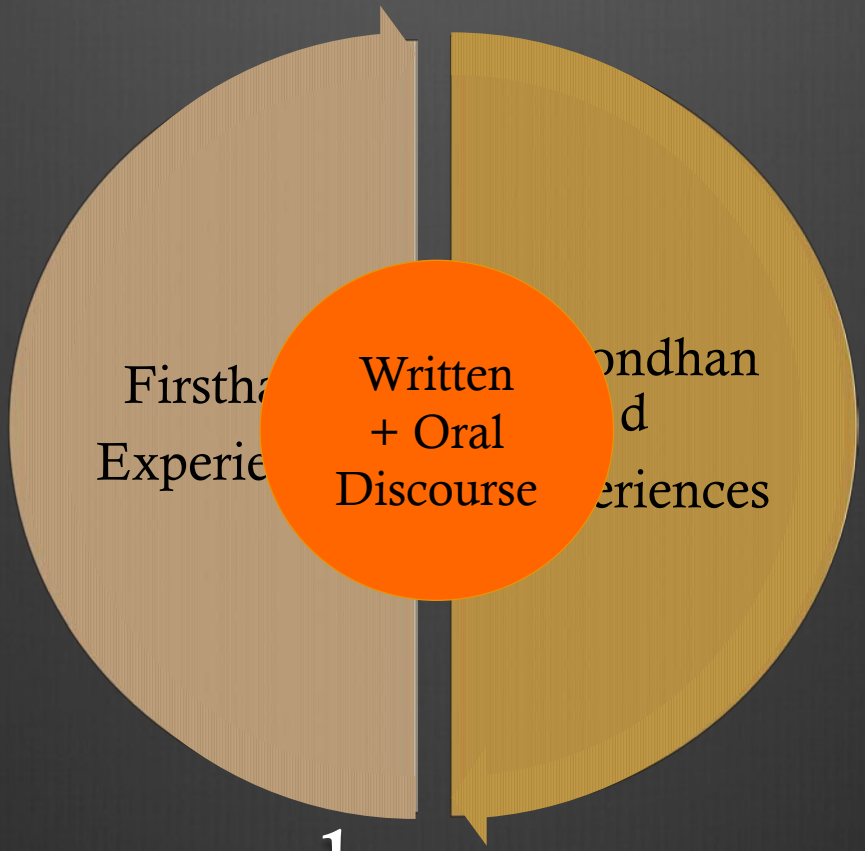
Sand comes in all different colors. Color is important evidence. It helps me figure out what the sand is composed of.

Black sand is often composed of **lava** rock. Hot lava sometimes **flows** from **volcanoes** to the **ocean**. The ocean cools the lava. It turns into hard, black rock. Waves crash on the lava rock. The rock breaks into smaller pieces and becomes sand. Then the waves carry the sand grains to the beach.

10

= construct explanations and arguments

Purpose?



More and more accurate explanations of the natural world

Written and Oral Discourse

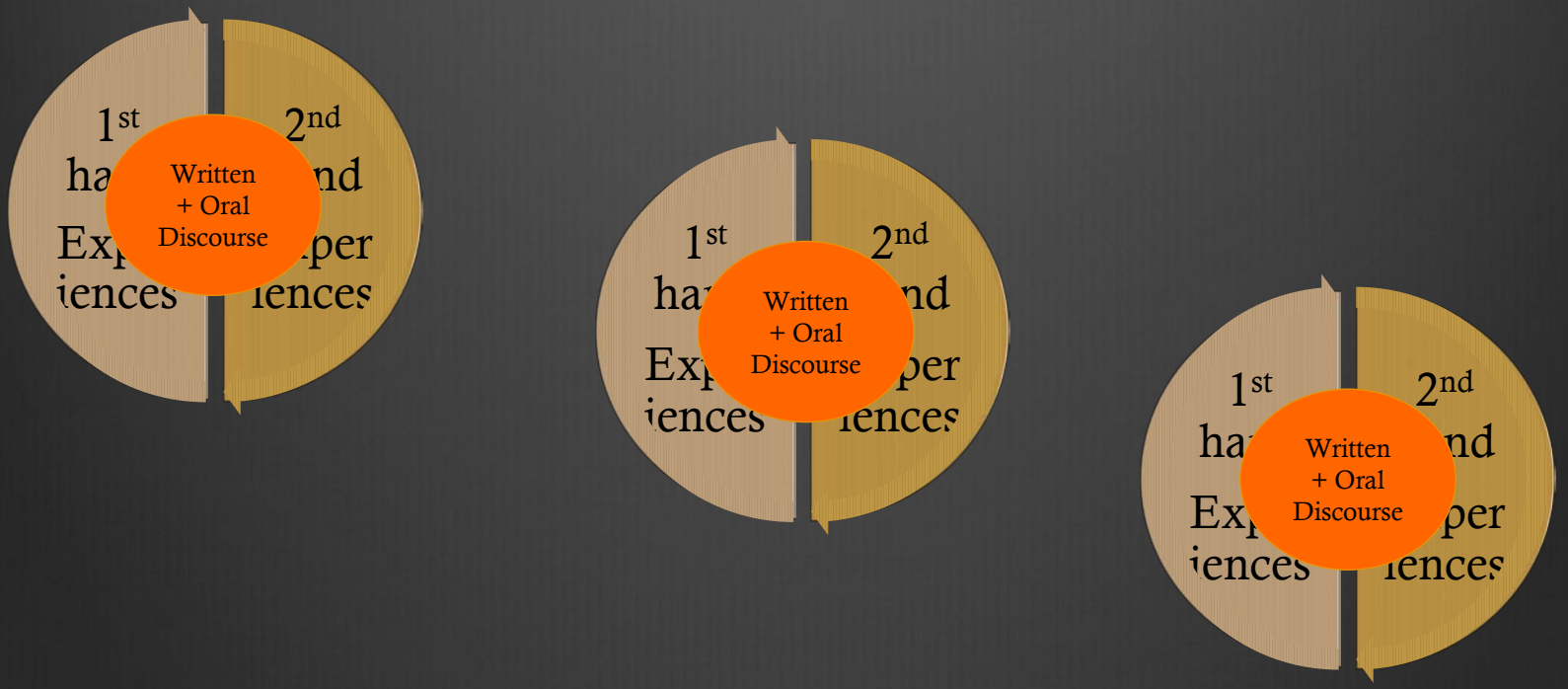
If you were on Jupiter, would Jupiter's moons have phases?

Jupiter's moon does have phases. The moon light is reflected from the sun like Earth's moon. Also Jupi moons revolves Jupiter. As the moons of Jupiter rev light shines on them the same it does to our moon causing it to make different phases, and also Jupiter rotates). I think that Jupiter's moons are similar to Earth's.

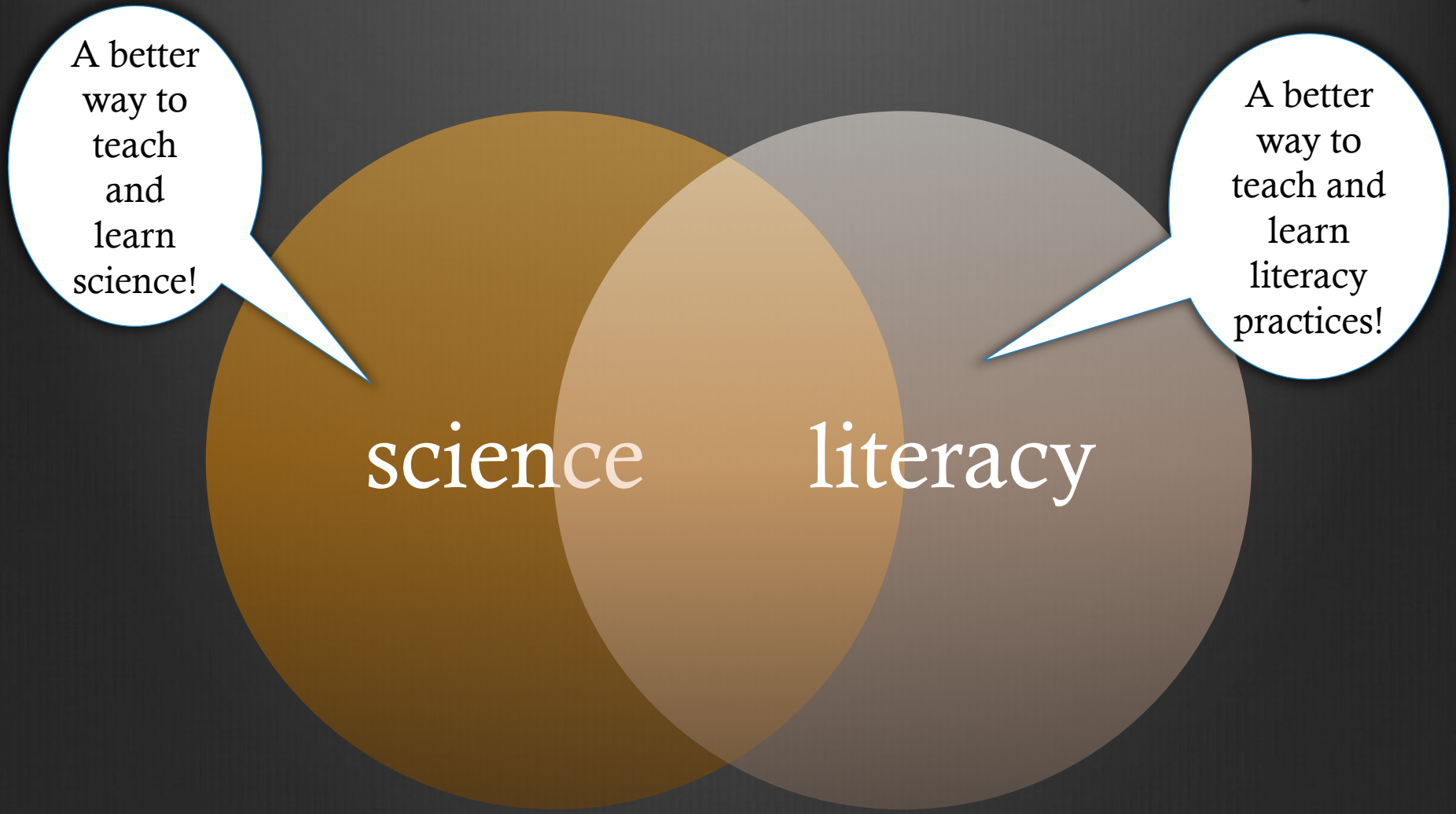
Bike tires are made of rubber. They are not made of metal. Explain why rubber is better than metal for making a bike tire.

They are better because if they were metal they would rust. The metal tires would get schaded up a lot if you rode fast. If you go over a bump with metal tires you would fall down. If you went over a bump with rubber tires,

Essential Multi-Modal Experiences



A matter of effectiveness



What evidence do we have?

Three "Gold Standard" Studies

- Grades 2/3 Soil Habitats & Shoreline Science
- Grades 3/4 Light Energy
- Grades 4/5 Planets and Moons

Several Pilot Studies focused on English language learners

Positive Results Across the Board:

STUDENTS

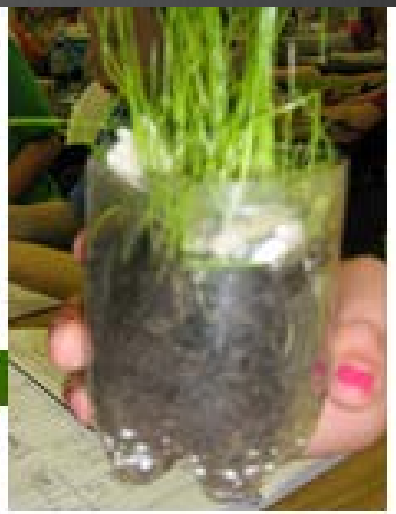
- Outperform control students on measures of:
  - science conceptual knowledge
  - science vocabulary
- Perform equivalently or higher than control students on measures of:
  - science reading comprehension
  - science writing

TEACHERS

- Spend more time teaching science than control teachers
- Have more student-to-student talk in their classrooms

Comparison of Size of the Effect

Type of Intervention	Average Effect Size
Participation of elementary students in one 8-10 week SEEDS unit	.61
Computer-based instruction	.45
Cooperative learning with elementary students	.3
Use of inquiry methods in science	.3
Class size reduction	.2



DO -IT

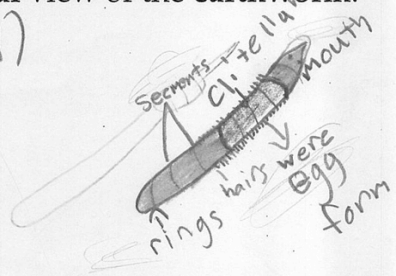
READ -IT

TALK-IT

WRITE -IT

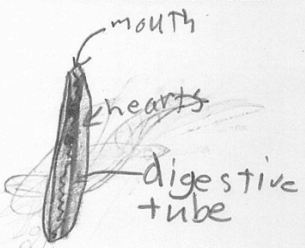
External view of the **earthworm**:

(outside)



Internal view of the **earthworm**:

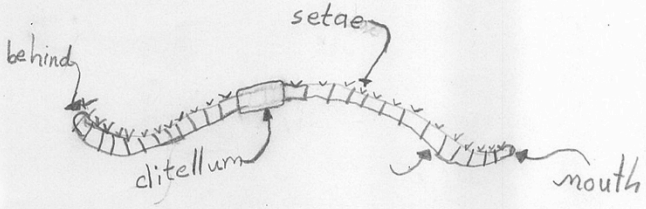
(Inside)



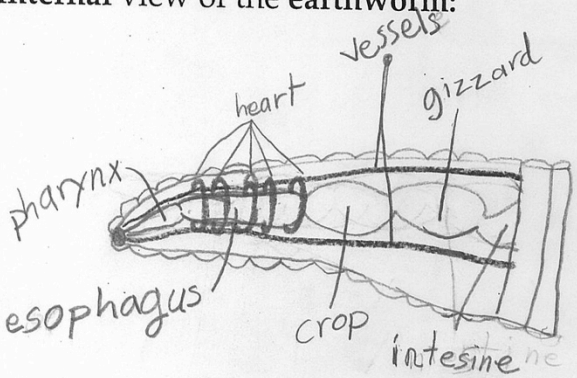
Sciencewords	Everydaywords
segments	partswords
respond	react
moisture	wetness
dorsal	topside
Ventra	underside

1. Label the parts of your **earthworm diagrams**.
2. **Observe** your **earthworm** with a **hand lens**.

External view of the **earthworm**:

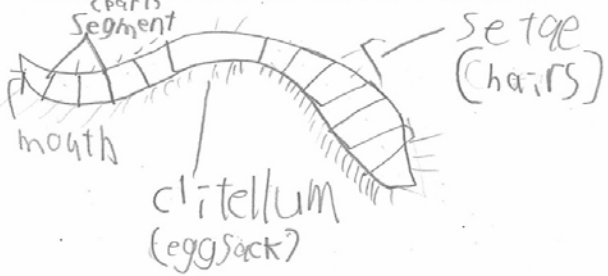


Internal view of the **earthworm**:



1. Label the parts of your **earthworm diagrams**

External view of the **earthworm**:



Internal view of the **earthworm**: