

# **“TRANS”FORMATIVE ASSESSMENT**

## **10 Key Points**

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NSTA President 2008-09

# First Word/Phrase

What is the first word or phrase that comes to mind when you hear the word:

**assessment?**

# Assessment **For** Learning

- Linking instruction and assessment
- Assessing before and throughout instruction
- Collecting evidence used to adjust current and future instruction
- Encouraging students to become more aware of their own learning (metacognition) and adjust their own learning tactics
- Changing the culture of the classroom from an emphasis on “right answers” to one of “ideas”

# Transformative Assessment

Assessment that  
fundamentally **transforms**  
teaching and learning.

Formative assessment works!

# The Basketball Task

How many times do the white-shirted students pass the basketball?

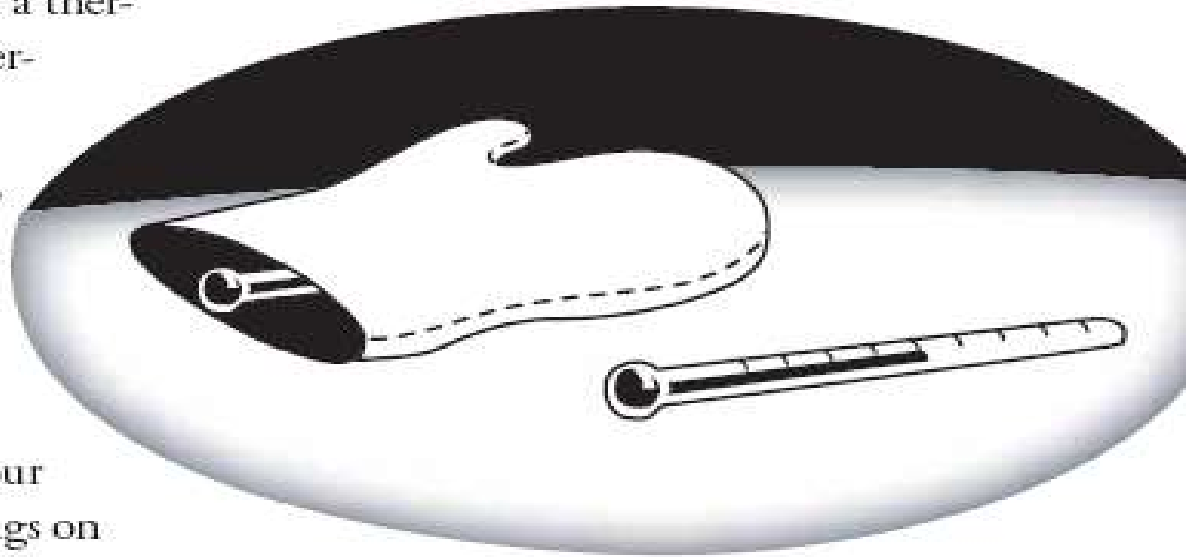


# Misconceptions Are Like the Big Gorilla in the Room



Sarah's science class is investigating heat energy. They wonder what would happen to the temperature reading on a thermometer if they put the thermometer inside a mitten.

Sarah's group obtained two thermometers and a mitten. They put one thermometer inside the mitten and the other thermometer on the table next to the mitten. An hour later they compared the readings on the two thermometers. The temperature inside the room remained the same during their experiment.



What do you think Sarah's group will discover from their investigation? Circle the response that best matches your thinking.

- A** The thermometer inside the mitten will have a lower temperature reading than the thermometer on the table.
- B** The thermometer inside the mitten will have a higher temperature reading than the thermometer on the table.
- C** Both thermometers will have the same temperature reading.

**Key Point #1- How students view an object, phenomenon or event depends on their prior knowledge and experiences**



# What is the full picture?





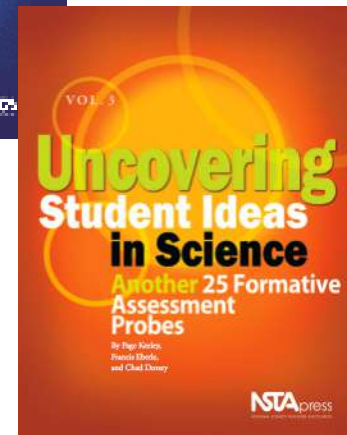
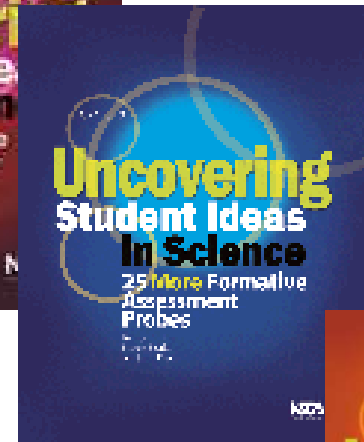
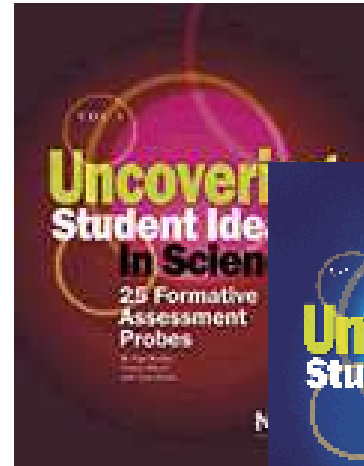
# Key Finding from *How People Learn*

“Students come to the classroom with preconceptions about how the world works. If their initial understanding is not engaged, they may fail to grasp the new concepts and information that are taught, **or they may learn them for purposes of a test but revert to their preconceptions outside the classroom”**

How People Learn, Bransford, Brown & Cockling. pp 14-15

# Uncovering Student Ideas...

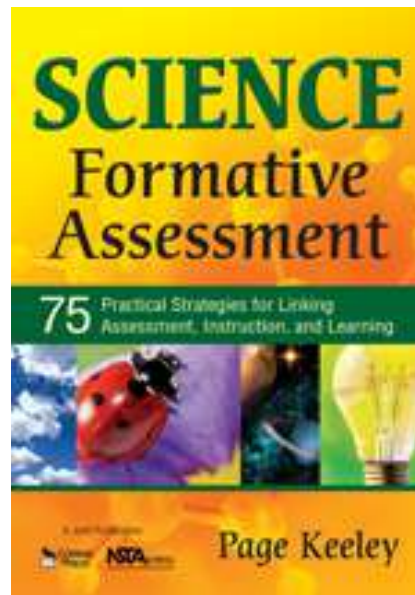
- Astronomy
- Earth Science
- Life Science
- Physical Science
- Nature of Science (Vol 3)
- Unifying Themes (Vol 4- coming soon!)



Available through NSTA Press [nsta.org](http://nsta.org)

# Formative Assessment Classroom Techniques (FACTs)

75 Practical Strategies for Linking  
Assessment, Instruction, and Learning



**Key Point #2: Just because you taught it  
doesn't mean they learned it!**

# Emmy's Moon and Stars

Emmy looked out her window and saw the Moon and stars. She wondered how far away they were. Circle the answer that best describes where you think the Moon and stars are that Emmy sees.

- A** There are no stars between the Earth and the Moon.
- B** One star is between the Earth and the Moon.
- C** A few stars are between the Earth and the Moon.
- D** There are many stars between the Earth and the Moon.
- E** Several stars are between the Moon and the edge of our solar system.



Explain your thinking.

# Grade 4-5 Responses (N= 124)

- 32%- A. No stars between the Earth and Moon
- 16%- B. One star between Earth and Moon
- 12%- C. A few stars between Earth and Moon
- 9%- D. Many stars between the Earth and Moon
- 31%- E. Several stars between the moon and the edge of our solar system



# Darkness at Night

Six friends were wondering why the sky is dark at night. This is what they said:

Jeb: "The clouds come in at night and cover the Sun."

Talia: "The Earth spins completely around once a day."

Nick: "The Sun moves around the Earth once a day."

Becca: "The Earth moves around the Sun once a day."

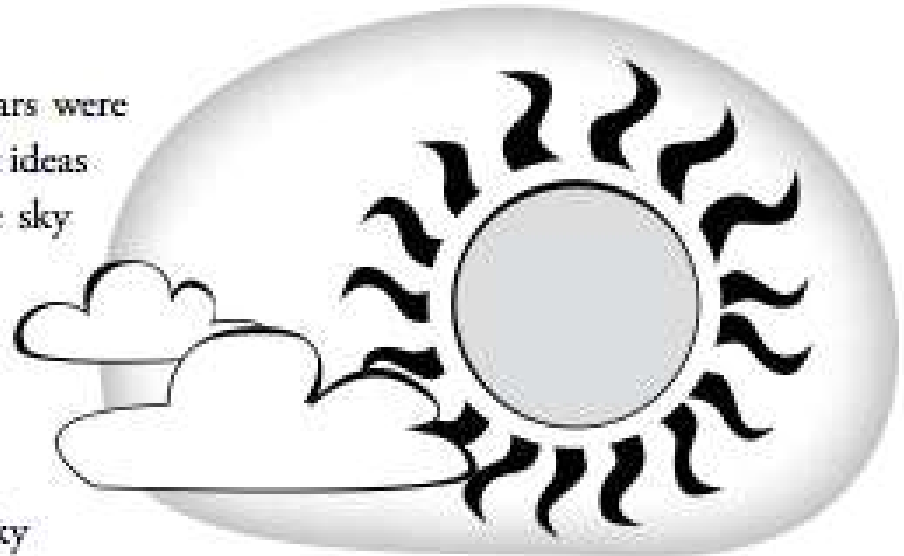
Latisha: "The Sun moves underneath the Earth at night."

Yolanda: "The Sun stops shining."



# Where Do Stars Go?

Five friends were wondering where stars were in the daytime. They each had different ideas about why we do not see stars in the sky during the day. This is what they said:



Jack: "The stars stop shining when the Sun comes out."

Shelley: "The stars are still in the sky above us, but we can't see them."

Nancy: "The stars go underneath Earth during the daytime."

Emma: "The stars cool down during the day and the Sun gets hotter."

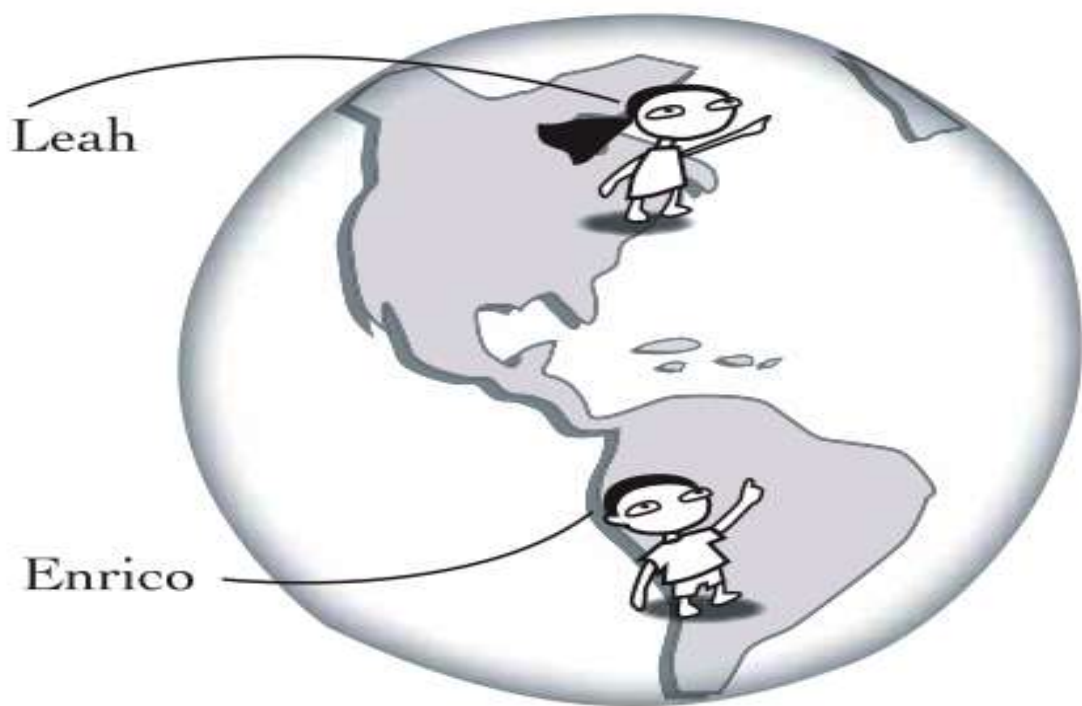
Flavio: "The stars are on the other side of Earth where it's nighttime."

Which friend do you most agree with? \_\_\_\_\_

Describe your thinking about why you do not see stars during the daytime. Provide an explanation for your answer.

# Gazing at the Moon

Enrico and Leah live in opposite hemispheres. Enrico lives in Santiago, Chile, which is in the Southern Hemisphere. Leah lives in Boston, Massachusetts, which is in the Northern Hemisphere. They both gazed at the Moon on the same evening. Enrico noticed there was a full Moon when he looked up at the sky from his location (the Southern Hemisphere). What do you predict Leah saw when she looked up in the sky from her location (the Northern Hemisphere)?



- A** New Moon (no part of the Moon is visible)
- B** Crescent Moon (a quarter of the face of the Moon is visible)
- C** Half Moon (half of the face of the Moon is visible)
- D** Gibbous Moon (three-quarters of the face of the Moon is visible)
- E** Full Moon (the entire face of the Moon is visible)

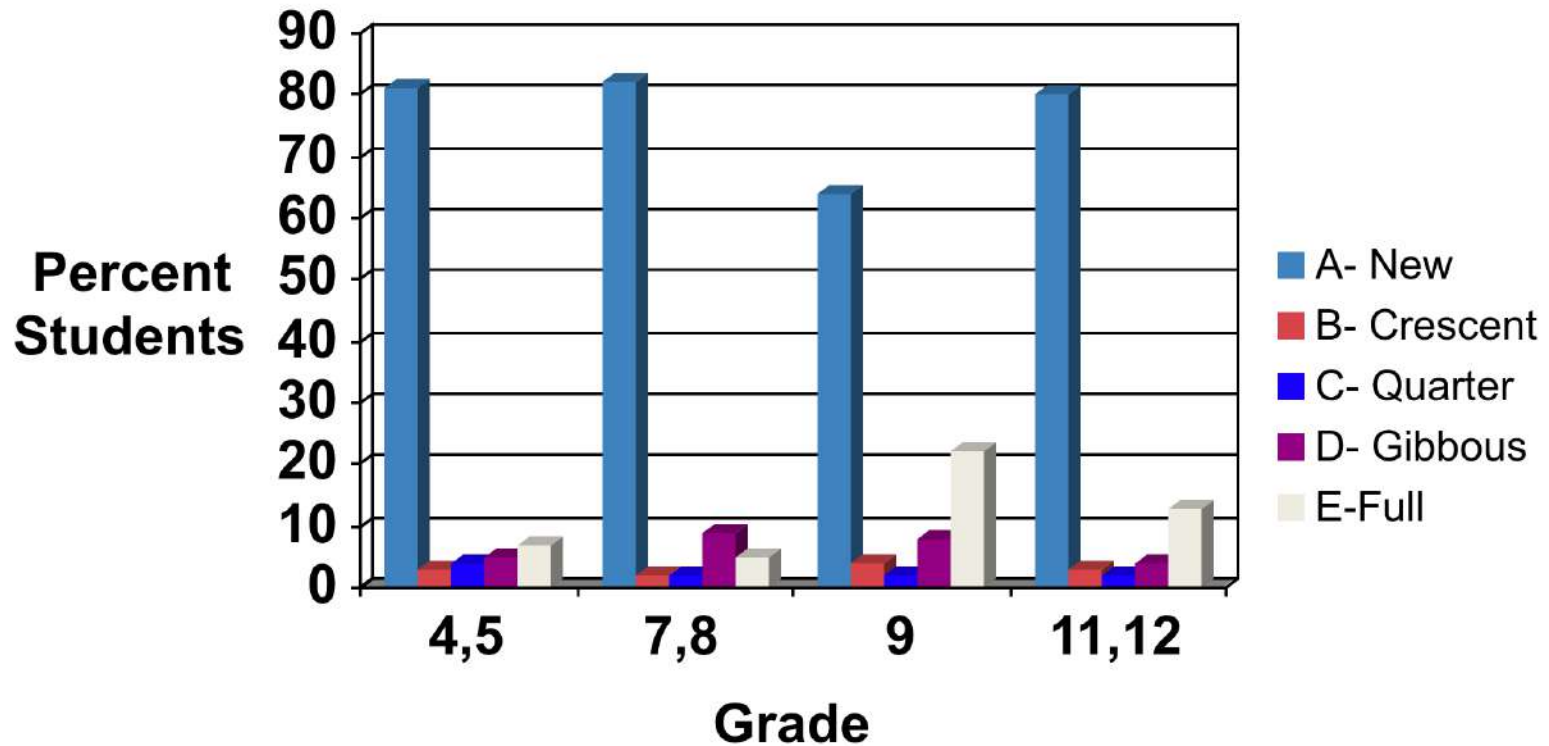
Provide an explanation for your answer. How did you decide what the Moon would look like in the opposite hemisphere?

# FACT: Commit and Toss



# Student Data (50-100 students per set)

## Gazing at the Moon



# Common Explanations

- Opposite hemisphere- opposite moon (**most common explanation**).
- Depends on where you are on Earth- same longitude, same moon. Would be different on the other side of the Earth (**often the right selected response, wrong explanation**)
- What part of the moon you see depends on the angle (tilt of the earth). If you are tilted away, you see less (**B, C, D responses**).
- Doesn't matter where you are- you see the same moon. (**Correct response but seldom explain why**)

# Key Point #3: Formative assessment promotes thinking as well as provides information about thinking



# Assessment for Thinking: Chicken Eggs





# Chicken Eggs

The students in Mrs. Bartoli's class were studying how chickens develop from an egg. The students put a dozen freshly laid, fertilized chicken eggs in an incubator. They wondered what would happen to the weight of an egg as the chick inside develops. This is what the students thought:

Group A: We think an egg will get heavier. An egg weighs more just before hatching than when it was laid.

Group B: We think an egg will get lighter. An egg weighs less just before hatching than when it was laid.

Group C: We think the weight of an egg stays the same as the chick develops inside.

# Thinking about:

- Food- what it is and what it is used for
- Transformation of matter
- Growth and development
- Conservation of matter
- Open versus closed systems
- Permeability of materials
- Gas exchange

**Key Point #4: An emphasis on facts, formulas, and definitions obscures the “big ideas” for science literacy**

**EVAPORATION**

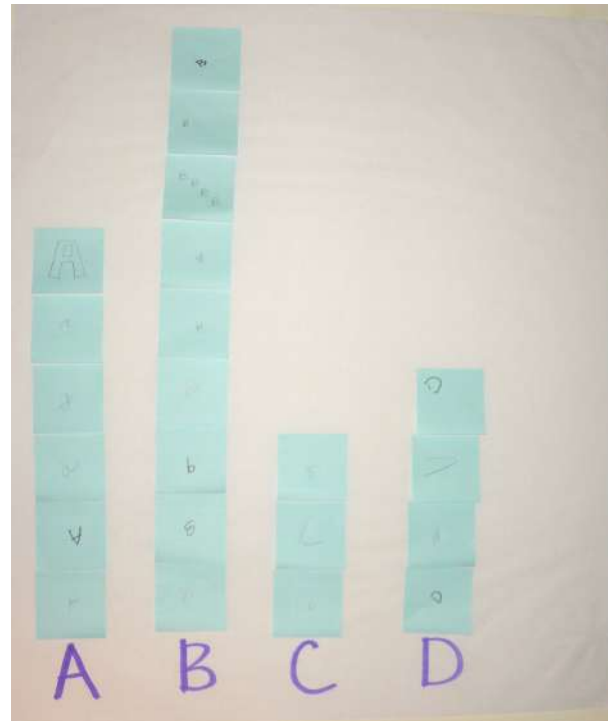
# Where Did the Water Come From?

Latisha took a sealed, plastic container of ice cubes out of the freezer. The outside of the container was dry when she took it out of the freezer. She set the container on the counter. She did not open the container. Half an hour later she noticed the ice had melted inside the container. The container was full of water. A small puddle of water had formed on the kitchen countertop, around the outside of the container. Which best describes where the puddle of water came from?



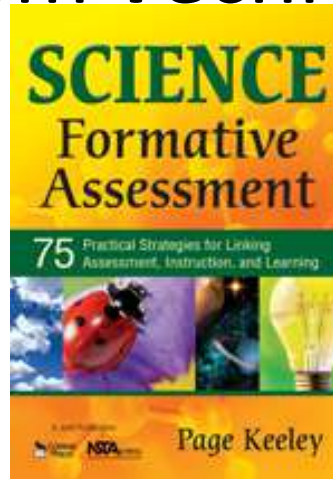
- A** A gas in the air.
- B** Melted ice inside the container.
- C** Cold on the outside of the container.
- D** Condensation from water inside the container.
- E** Water that evaporated from inside the container.
- F** Cold changed hydrogen and oxygen atoms to water.

# FACT: Sticky Bars



**Key Point #5: Selection and use of formative assessment strategies must be purposeful.**

**75 FACTs- Formative Assessment  
Classroom Techniques**



# Probes and FACTs- Multiple Purposes

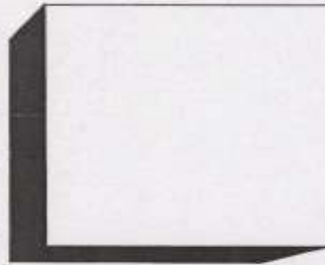
- Elicit and Identify Preconceptions
- Engage and Motivate Students
- Activate Thinking and Promote Metacognition
- Provide Stimuli for Scientific Discussion
- Initiate Scientific Inquiry and Idea Exploration
- Formal Concept Development and Transfer
- Improve Questioning and Quality of Student Responses
- Provide Teacher to Student Feedback
- Peer and Self-Assessment
- Reflection



# Key Point #6- Probes can be used to initiate inquiry and engage students in scientific argumentation

## Solids and Holes

Lance had a thin, solid piece of material. He placed the material in water and it floated. He took the material out and punched holes all the way through it. What do you think Lance will observe when he puts the material with holes back in the water? Circle your prediction.



- A** It will sink.
- B** It will barely float.
- C** It will float the same as it did before the holes were punched in it.
- D** It will neither sink nor float. It will bob up and down in the water.

Explain your thinking. Describe the “rule” or reasoning you used to make your prediction.

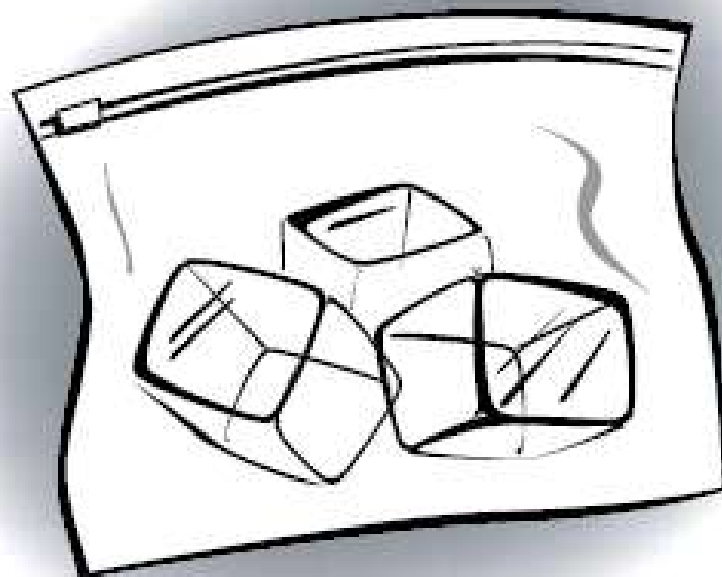
# FACT: PEO-E Probes

- Predict
- Explain
- Observe
  
- Explain (revise explanation)

# Ice Cubes in a Bag

You are having an argument with your friend about what happens to the mass when matter changes from one form to another. To prove your idea, you put three ice cubes in a sealed bag and record the mass of the ice in the bag. You let the ice cubes melt completely. Ten minutes later you record the mass of the water in the bag. Which of the following best describes the result? Circle your prediction.

- A** The mass of the water in the bag will be less than the mass of the ice in the bag.
- B** The mass of the water in the bag will be more than the mass of the ice in the bag.
- C** The mass of the water in the bag will be the same as the mass of the ice cubes in the bag.



Describe your thinking. Provide an explanation for your answer.

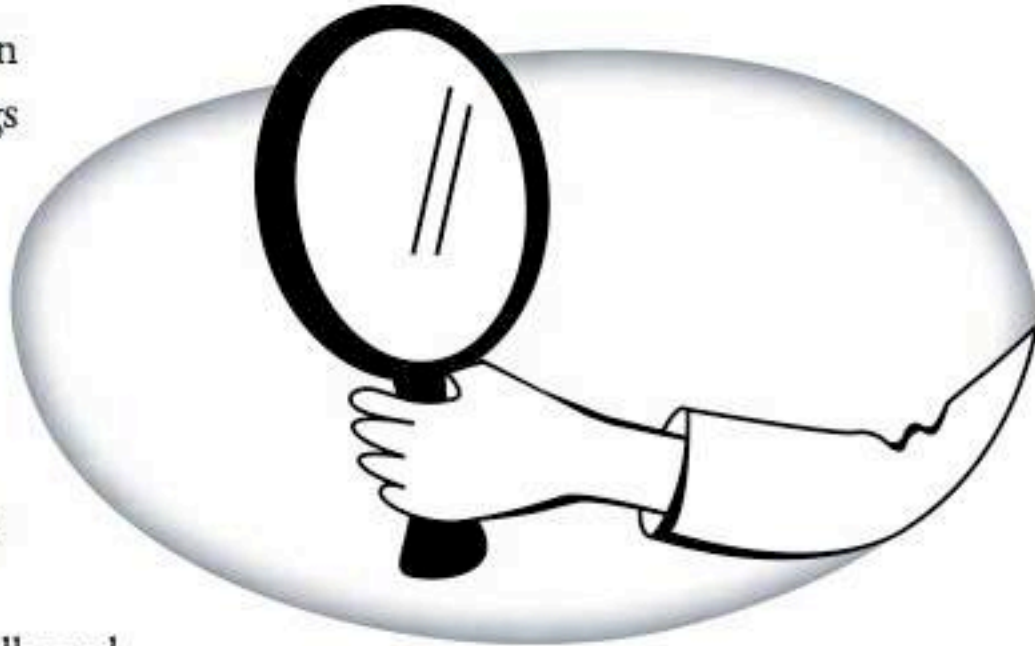
# Can It Reflect Light?

types of objects or materials can reflect light? Put an X next to the things you think can reflect light.

water  
gray rock  
leaf  
mirror  
glass  
cardboard  
potato skin  
black paper  
tomato soup  
crumpled paper  
any metal

- dull metal
- red apple
- rough cardboard
- the Moon
- rusty nail
- clouds
- soil
- wood

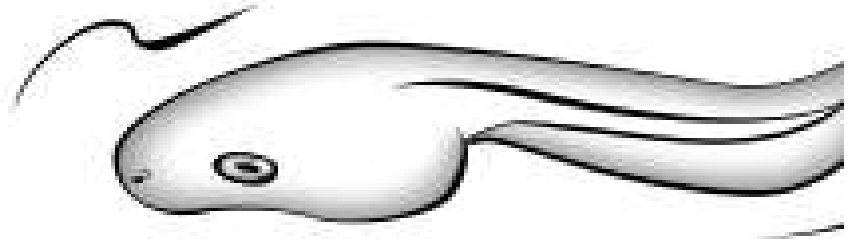
- milk
- bedsheet
- brand new penny
- old tarnished penny
- smooth sheet of aluminum foil



Describe your thinking. Describe the “rule” or the reasoning you used to decide if

# Does It Have a Life Cycle?

How do you decide if an organism goes through a life cycle? Put an X next to the organisms that have a life cycle.



frog

cow

daisy

butterfly

mushroom

chicken

grasshopper

grass

maple tree

fern

earthworm

human

shark

snail

beetle

bean plant

mold

crab

snake

spider

moth

Explain your thinking. Describe the rule or reason you used to decide if an organism

has a life cycle.

# FACT: Card Sort Strategy



**Key Point #8- Hands on activities and use of children's books can have unintended consequences**

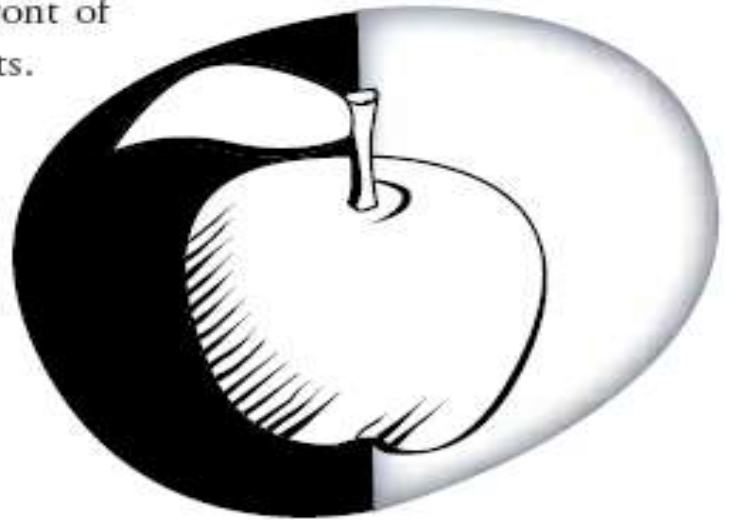


# Apple in the Dark

Imagine you are sitting at a table with a red apple in front of you. Your friend closes the door and turns off all the lights. It is totally dark in the room. There are no windows in the room or cracks around the door. No light can enter the room.

Circle the statement you believe best describes how you would see the apple in the dark:

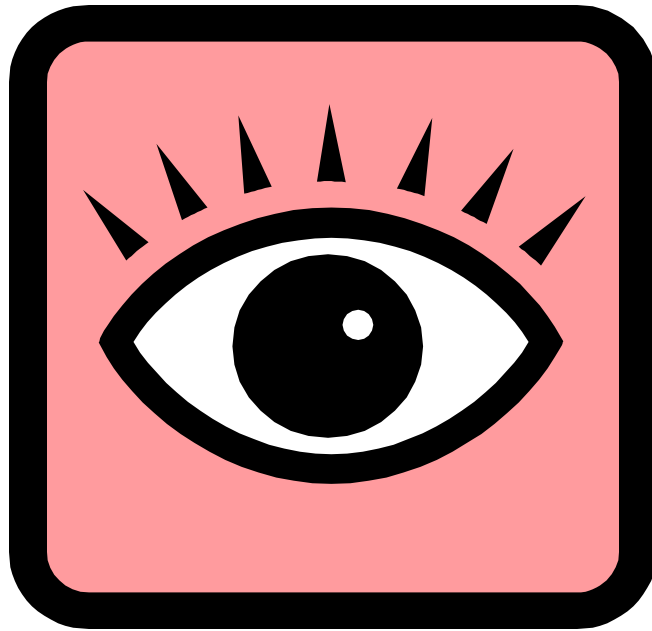
- A** You will not see the red apple, regardless of how long you are in the room.
- B** You will see the red apple after your eyes have had time to adjust to the darkness.
- C** You will see the apple after your eyes have had time to adjust to the darkness, but you will not see the red color.
- D** You will see only the shadow of the apple after your eyes have had time to adjust to the darkness.
- E** You will see only a faint outline of the apple after your eyes have had time to adjust to the darkness.



Describe your thinking. Provide an explanation for your answer.



Observing pupils in the dark



# Common Conception

The eye as the activator of vision- something comes out of our eyes so we can see.

# Sources of Confusion or Misconceptions- Children's Books

"But it's nighttime," Stellanuna squeaked. "We can't fly in the dark or we will crash into trees."

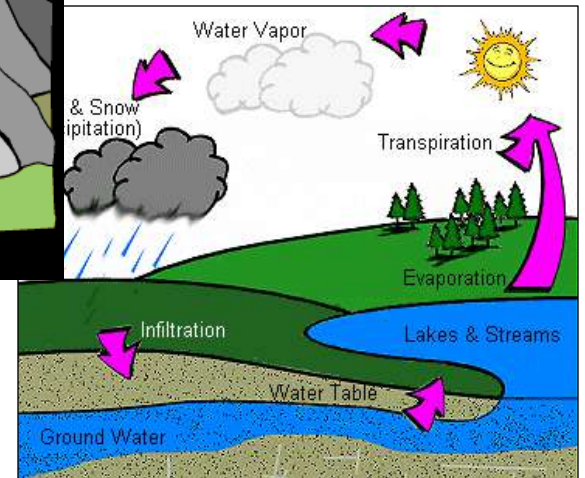
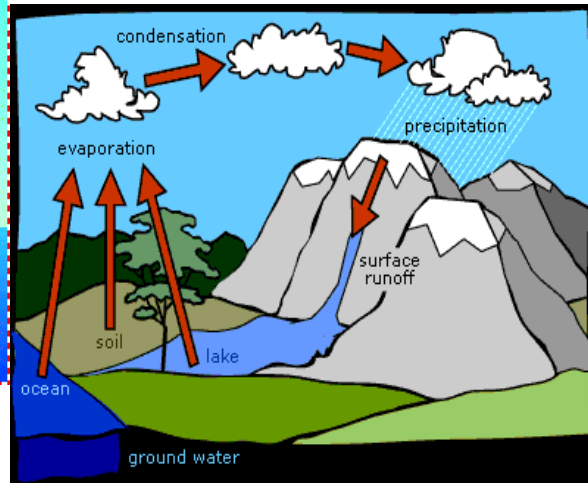
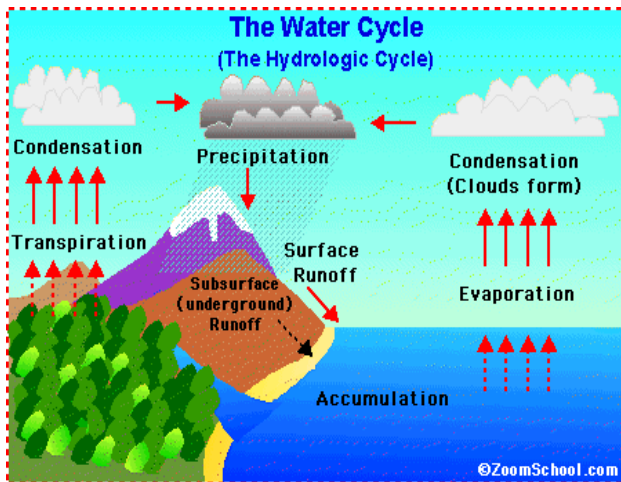
"We're bats," said Mother Bat. "We can see in darkness. Come with us."

Stellanuna was afraid, but she let go of the tree and dropped into the deep blue sky.

Stellanuna *could* see. She felt as though rays of light shone from her eyes. She was able to see everything in her path.



# Key Point #9: Representations can reinforce or develop misconceptions

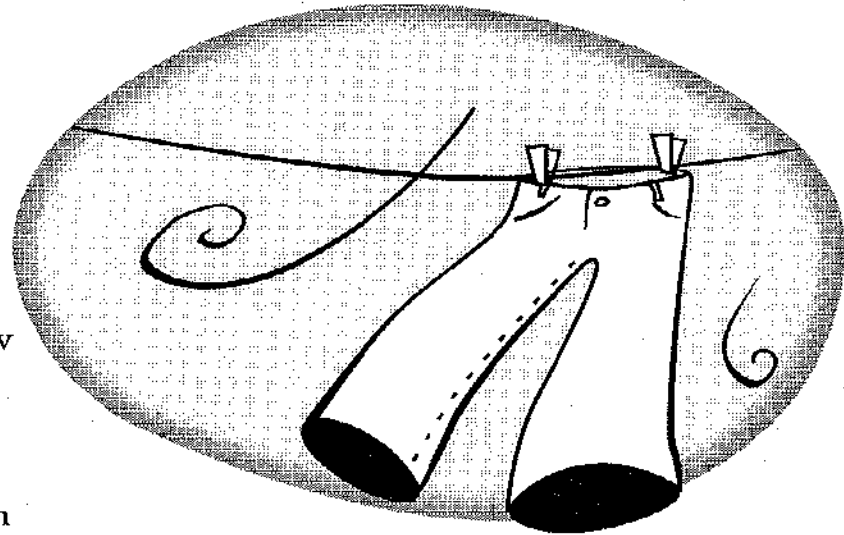


# Wet Jeans

Sam washed his favorite pair of jeans. He hung the wet jeans on a clothesline outside. An hour later the jeans were dry.

Circle the answer that best describes what happened to the water that was in the wet jeans *an hour later*.

- A** It soaked into the ground.
- B** It disappeared and no longer exists.
- C** It is in the air in an invisible form.
- D** It moved up to the clouds.
- E** It chemically changed into a new substance.
- F** It went up to the Sun.
- G** It broke down into atoms of hydrogen and oxygen.



Describe your thinking. Provide an explanation for your answer.

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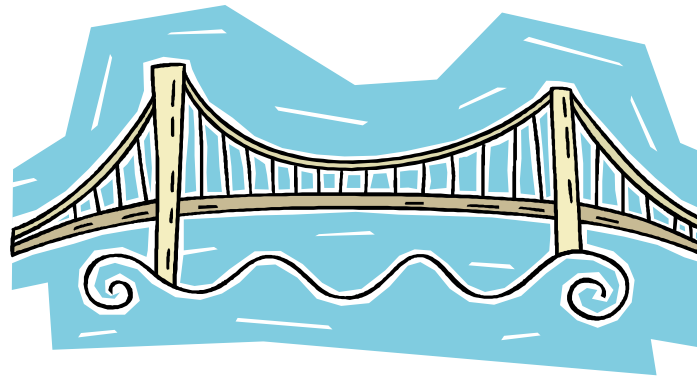
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**Key Point #10: Misconceptions are not bad!**  
**They can be a good thing when teachers**  
**PURPOSEFULLY use them to bridge**  
**students' ideas with conceptual**  
**understanding of science.**

Students'  
Ideas



Conceptual  
Understanding

Use what students know and think to help them get to the other side

# Reflection FACT

I used to think \_\_\_\_\_, but  
now I know \_\_\_\_\_!