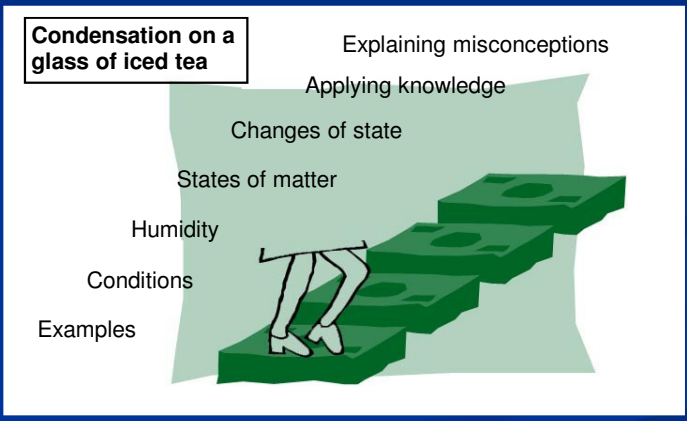
Assessment in the service of instruction

…knowing where each student is in their learning, so we can help them move to the next step

Steps to learning



Finland, scoring at the top on all international assessments

"Teachers create their own assessments to get feedback on student learning and improve the quality of their teaching; students regularly use feedback from teachers to develop a better understanding of their own knowledge level and to improve."

Ed Leadership, Oct 2008.

Two parts to this discussion

- Connecting assessment to instruction through Assessment for Learning
- Recognizing that assessment and instruction are both guided by a deep understanding of what we want students to learn (curriculum).

The main point

- We have to be very careful about what we assess, because what we assess is what we want students to learn. (Understanding by Design)

What we want students to learn: Science literacy

- Using scientific knowledge to
  - Describe
  - Explain
  - Predict
  - Design
- Constructing new knowledge (inquiry)
- Reflecting on scientific knowledge (evidence, reason, connections beyond science)

Assessment for learning

- What kinds of assessments are good for guiding instruction?
- How often should teachers "check for understanding"?
- How can the assessment tasks be analyzed to provide appropriate feedback to both teachers and students?
- What does the feedback tell teachers about the next steps to take in teaching, about remediation and differentiated instruction?
- How much knowledge do we currently have about learning progressions in K-12 science?

Two lenses for looking at the process

Assessment is formative if you use it to:

1. Decide what your "next steps" will be in teaching. (Teachers)
2. Decide what your "next steps" will be in learning. (Students)

Kinds of assessments

- What kinds of assessments are good for this? – Ones that give you insight into what students are thinking.

Condensation is

a) the change of state from solid to liquid

b) the change of state from liquid to gas

c) the change of state from gas to liquid

d) the change of state from liquid to solid

You've noticed that droplets form on the outside of some of the pipes in your basement in the summer. What do you think these droplets are and where did they come from?

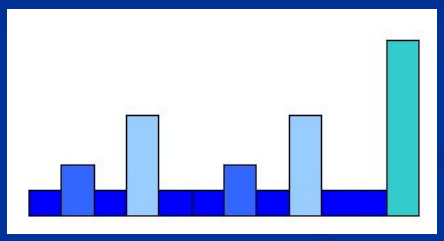
a) They must have leaked out through the pipes, so they are whatever is inside the pipes.

b) They are "sweat" from the pipes, just like our perspiration.

c) They came from the air. They are water. This only happens in the summer because the air is humid in the summer.

You've noticed that droplets form on the outside of some of the pipes in your basement in the summer. How would you find out what these droplets are and where they came from?

How often?



Analyzing data

How can assessment tasks be analyzed to provide appropriate feedback to both teachers and students?

- This is the work of professional learning communities (PLCs) using protocols about how to look at student work.
- Dana's charts for planning formative assessment and analyzing student work are very useful.

- Did students "get it"? If not, what exactly don't they understand?
- For the condensation example, do students know
  - instances and examples?
  - concept of humidity?
  - concepts about changes of state?
  - how to apply concepts to the situation?

9 During thermal expansion, individual molecules

A rotate.

B move faster.

C move slower.

D do not change speed or direction.

E get larger.

23 Which characteristic of Earth is *most* responsible for our seasons?

A Earth's gravitational pull on the moon

B Earth's rotation

C Earth's mass

D Earth's tilt on its axis

E Earth's distance from the sun.

Benefits to *students*

This is the part that teachers love:

If students know the learning targets, and if they know where they are relative to the learning targets, then they can plot how to get themselves there.

Formative assessment helps students take responsibility for their own learning!

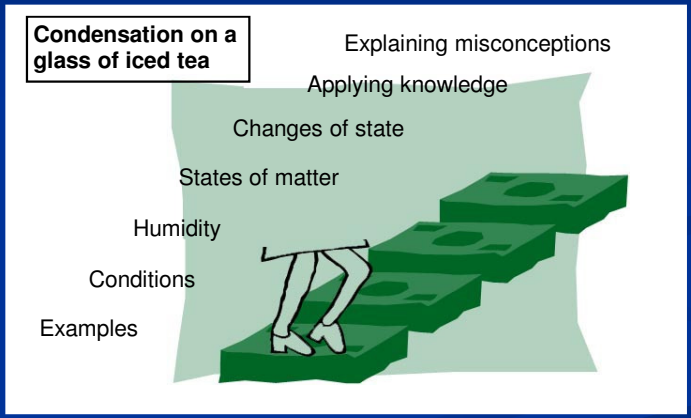
Student's log

Item	GLCE	Score	What don't I know?	What can I do to improve?
3	P.CM.06.11	2/4	How the droplets form	Read pp. 17-18, then talk to Mr. B.
4	P.CM.06.11	3/4	(stupid mistake)	

Next steps for whom?

- What does the feedback tell teachers about the next steps to take in teaching
  - the whole class?
  - remediating small groups?
  - differentiating instruction?

Learning progressions



Michigan Assessment Consortium

Margaret Heritage, April 23, 2009

Video Conference "Learning Progressions"
9:00-11:00 a.m.

We assess to find out if students have learned what we want them to learn.

- We have to be clear about what we want students to learn.
- We have to use assessment tasks that let us find this out.

We want students to learn many things!

- How the world works – experiences, patterns, explanations
- How science is done – inquiry and evidence

We want students to learn how to

- reason with evidence
- solve problems
- conduct inquiry
- use deep conceptual understanding to explain phenomena (apply what they know)

What does science mean to you?

- What one thing do you find fascinating in the world of astronomy, physics, chemistry, biology, geology, meteorology, or engineering?
- Why is science important?
- What do you want to know more about in science?

What's this item about?

Eye color is a trait that two parents could pass on to their children even though the trait might not be expressed in the parents. Such a trait is considered to be

a) acquired.

b) inherited.

c) neutral

d) positive

A student tested the conductivity of four different materials. Which of the materials would have the highest conductivity?

a) glass

b) rubber

c) copper

d) wood chips

A mechanical wave with high energy is characterized by a

a) short period

b) low amplitude

c) high amplitude

d) high temperature

Is this your conception of what science is?

Where convergent boundaries occur between plates of Earth's crust, they _____

A. drift away from each other.

B. erode and eventually disappear.

C. move toward each other.

D. stay still.

17 Steven filled an ice tray nearly full with water. When he took the tray out of the freezer, the ice extended above the top of the tray. He wondered if there had been a change in the amount of substance in the tray. Which is the **BEST** measure to find any change in the amount of substance in the ice tray?

A mass

B volume

C area

Reasoning with a concept. Experiences, pattern, explanation.

22 Kari's class was investigating how a powdered drink mix dissolves in water of different temperatures. They needed to determine how much mix would dissolve in a given sample of water. Which would be the **BEST** procedure?

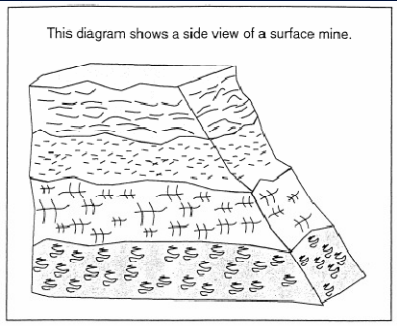
A Add heaping teaspoons of mix until no more dissolves. Count the number of heaping teaspoons used.

B Measure the mass of mix before and after shaking small amounts into the water until no more will dissolve. Calculate the difference.

C Shake a little bit in at a time until no more will dissolve. Count the number of shakes.

D Add three packages of mix to the water. See how much of it dissolves.

Applying a concept (mass) to a scientific procedure. Also reasoning about the procedure.



Reasoning about a situation, drawing on knowledge (about rock layers)

57 How might the rocks in the above diagram be useful in studying the evolution of life in the surrounding area?

A They may contain fossils which can be compared to the age of the rocks.

B There may be bones of modern-day animals mixed in with the rock piles.

C Building the mine may have caused local animals to move to a new environment.

D When the mine is abandoned, new animals may move in to the area and can be studied.

11 When a light bulb is lit, electrical energy is transformed into

A light and heat energy.

B heat and nuclear energy.

C light and mechanical energy.

D mechanical and magnetic energy.

What makes a light bulb light? Why is a battery necessary? Why do batteries "run down" after awhile? What happens to electricity in a battery to make it "run down"? Why does a bulb get hot when it's lit?

12 Jamie puts a glass bottle of water into the freezer. When he returns for the water he discovers that the bottle has broken. The bottle broke because

A the water expanded in the bottle as it froze.

B the water contracted in the bottle as it froze.

C the air in the bottle began to rise as it cooled.

D the glass could not withstand the temperature in the kitchen freezer.

Here's an experience, maybe a pattern.
What constitutes a good explanation in science?

- Knowledge of phenomena – patterns in experiences
- Explanations of patterns using concepts
  - detail about the concept including representations
  - examples of concepts
- Reasoning with evidence, critical thinking
- Doing science – using procedures to test ideas

Knowledge of phenomena – patterns in experiences

- Condensation occurs on cold objects
- Condensation occurs in humid conditions

Detail about the concept including representations

- Molecules are constantly in motion.
- In gases, molecules are far apart. In liquids, they are close together.
- The temperature of a substance is an indication of the speed of its molecules. (animation)
- There are forces between molecules that bind them together.

Reasoning with evidence, critical thinking

- Combine the conditions with the concepts to explain the pattern.

Doing science – using procedures to test ideas

You are walking to school one morning and it starts to rain. By the time you get to school, your shirt is wet. After an hour you notice that your shirt is not wet anymore.

1. What happened to the water? If you can, try to use the idea of molecules in your explanation.
2. Describe an experiment you could conduct to provide evidence about your explanation.
3. How could get your shirt to dry faster? Why would this work?

Two main points

1. What we assess reflects what we think is important about the subject. What we assess becomes what we think is important about the subject.
2. Neither teachers nor students can make sound instructional decisions without feedback from assessments.

Leona's epiphany

Identify the law of conservation of mass:

a) All things must be conserved because we are running out of natural resources.

b) When one mass collides with another, the forces applied to each mass are equal.

c) In any interaction, the product of mass times velocity is conserved.

d) In any chemical or physical change, mass cannot be created or destroyed.

You just carried a log into your house to put into the fireplace. Before you burned it, you decided to weigh it. It weighed exactly 10 pounds. After it had burned up and cooled, you weighed the ashes from the log. They weighed only one-half pound.

What happened to the other 9.5 pounds of log?
Choose as many as apply.

1) It just burned up and disappeared.

2) It turned into heat energy which weighed 9.5 pounds.

3) It turned into heat energy which went into the atmosphere but heat doesn't have any weight.

4) It turned into 9.5 pounds of gases which went into the atmosphere.

5) Provide a choice of your own:

You live near an airport and often smell fumes from planes as they take off. Airport officials said not to worry, the exhaust thins out and disappears. Which statement best describes your understanding about this situation?

1) They are the experts and ought to know what they are talking about so I'm not concerned.

2) I don't think that stuff disappears and I'm going to investigate it further.

3) I don't like the smell but it goes away as soon as the stuff disappears so I guess I'll just put up with it.

4) Even if I can't smell it anymore, it is still in the air and it can be dangerous.

Explain your choice.

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