

ANNE TWEED

As a principal consultant, Dr Anne Tweed supports schools, districts and state departments with professional development activities that develop highly qualified teachers. Anne is a former president of the US National Science Teachers Association (NSTA) and spent 30 years teaching secondary school science, including environmental science, biology, chemistry, Earth science and marine science. She is now a Principal Consultant at McREL International. In addition to writing several books and articles, Anne also worked on the program planning team to revise the 2009 NAEP Framework for Science.

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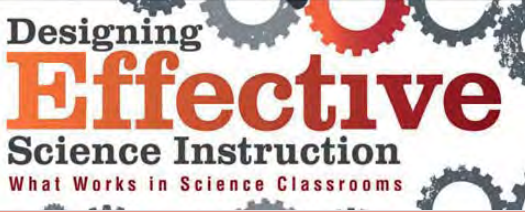
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Formative Assessment


Overview

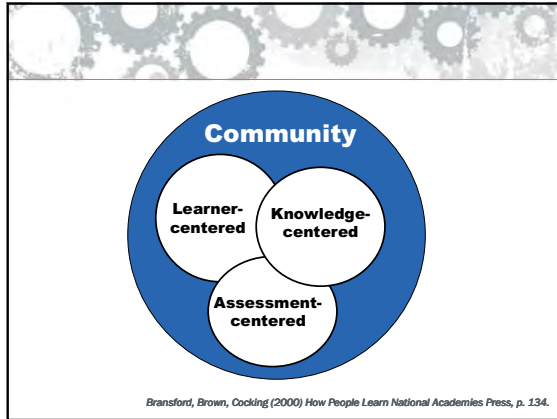
- What is Formative Assessment?
- Elements of Formative Assessment
- Examples of Formative Assessment
- Teaching for Formative Assessment
- Feedback that Supports Learning

What is Formative Assessment?

An Ongoing Process To:

- Collect evidence about student learning
- Provide feedback about learning to teachers and to students
- Close the gap between the learner's current state and desired goals





Learning Environments

- The *knowledge-centered lens* focuses on what is to be taught, why it is taught, and what mastery looks like. (Content)
- The *learner-centered lens* encourage attention to preconceptions and begins instruction with what student think and know. (Understanding)
- The *assessment-centered lens* emphasizes the need to provide frequent opportunities to make students' thinking and learning visible as a guide for both the teacher and the student. (Understanding)
- The *community-centered lens* encourages a culture of questioning, respect and risk taking. (Environment)

McREL's C-U-E Framework

- **Key conclusions are:**
 - Begin with what the student brings—knowledge, culture and beliefs
 - Make science ideas accessible and relevant
 - Include assessments that support learning (formative assessments)
 - Promote a sense a community that values learning and high standards.
- **All four elements are interrelated.**

From: *How People Learn* (1999)



2 Categories of Assessment

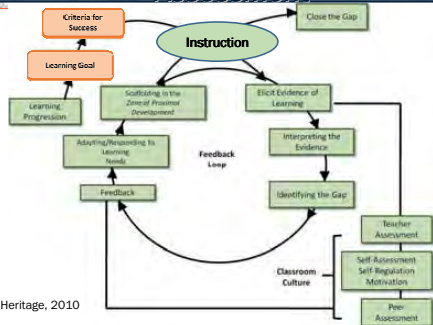
Summative	Formative
<ul style="list-style-type: none">• After instruction ends• Every 3-4 weeks• Samples content• Tests general concepts• Can help revise course or program• Measures unit, course effectiveness	<ul style="list-style-type: none">• During instruction after some learning• At critical points• Ideally, assesses every major concept• Non-graded• Can determine future learning activities• Results in feedback to students to move learning forward

McREL

Elements of Formative Assessment



The Process of Formative Assessment

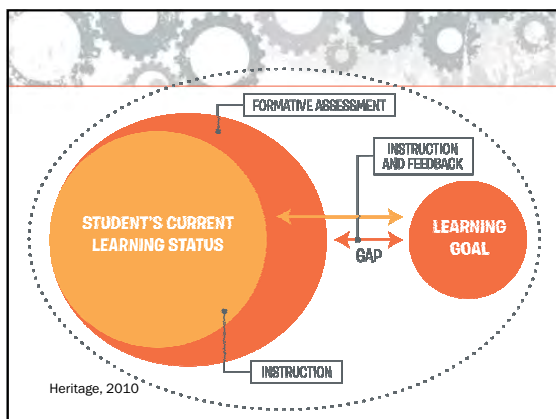


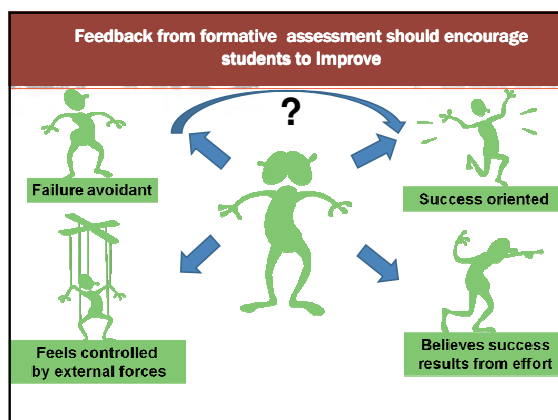
Heritage, 2010

Closing the Gap

“Formative assessment gathers and uses information about students’ knowledge and performance to close the gap between students’ current learning state and the desired state by pedagogical actions”

(Shavelson 2006, p.3)





Impact of Formative Assessment

On students

- ☐ Increased focus (particularly underachieving students).
- ☐ More likely to express learning needs.
- ☐ Supports development of a learning culture.
- ☐ Can improve quality of work.
- ☐ Greater ownership of learning as responsibility shifts from teacher to student.
- ☐ Opportunities for self-assessment.



Slide 6

Module

Impact of Formative Assessment

On teachers

- ☐ More focus on learning (not activity).
- ☐ Increases teacher understanding of learning goals and success criteria.
- ☐ Focus on quality rather than "covering" the curriculum.
- ☐ Provides framework in which to review lessons and refine work.
- ☐ Assists in reflection of lesson and learning that occurred.

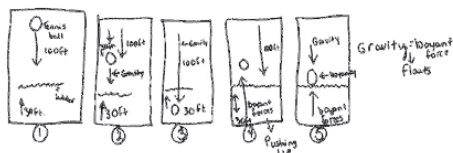


Slide 7

Module

Science: Formative Task

What would happen to a tennis ball dropped from a height of 100 feet into 30 feet of water?



New Standards
Portfolio Assessments,
1989

Mathematics: Formative Task

Group 1: Division of fifteen-fifths means a fraction or a division. Fifteen divided by five is three.

Group 2: Division means dividing some numbers and make it to a smaller number. Fifteen-fifths is fifteen divided by five. That makes three.

Group 3: Division is opposite of multiplication. Fifteen-fifths is like five goes into fifteen and that makes three because three times five is fifteen.

Group 4: Division is when you flip the number when you divide and when you multiply. Fifteen-fifths is like five times something is fifteen, so the answer is three.

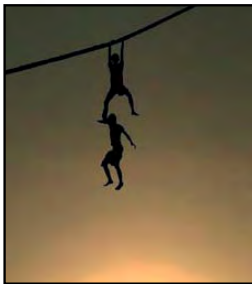
Group 5: Division is dividing one number by another to solve the problem. Like fifteen-fifths is X so, then five times X equals three.

Heritage, Silva & Pierce, 2006

Action Sequence



Inaction



**Evidence becomes
"DANGLING
DATA"**

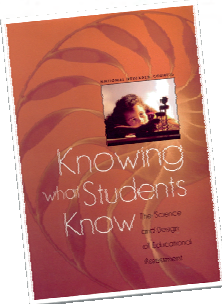
Sadler, 1989

Just Right Instruction



- Match the learning experiences to student's current level of learning
- Gradual release of scaffolding

Feedback



"One of the most important roles in assessment is the provision of timely and informative feedback to students during instruction and learning ..."

(NRC, 2001, p.87)

Effective Feedback



"Feedback to students should be about the particular qualities of their work, with advice on what they can do to improve, and should avoid comparisons with other students."

(Black & William, 1998, p.143)

Key Guidelines About Feedback



GUIDELINES

Effective feedback is:

- specific and clear
- related to learning goals and success criteria (learning targets)
- provides the learner with suggestions, hints or cues for how to improve rather than correct answers
- timely and relevant
- focuses on the task and not on the student
- identifies what is done well and next steps for student work

Ways of Providing Feedback



ORAL



WRITTEN

Timing of Feedback



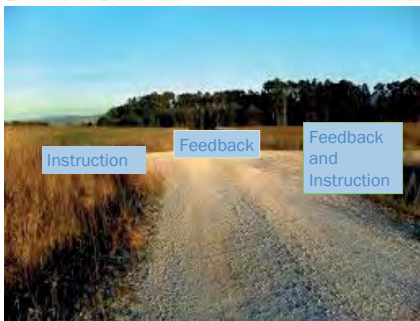
- In the moment
- A hinge point during the lesson sequence
- After the lesson

Responsive Action



- Feedback is only formative if it is **used** by students
- Teachers must allow **time** for students to use feedback

Decisions, Decisions



It's Your Turn

In small groups, discuss:

1. When is instruction more appropriate than feedback?
2. When is feedback more appropriate than instruction?
3. When is feedback combined with instruction most appropriate?



Responsive Action Outcomes



- Helps students develop conceptual understanding
- Allows students to build a repertoire of learning strategies and tactics
- Promotes student responsibility for their learning

WRONG WAY

T: Your work showed me that you don't understand what we have been discussing in class.

S: OK, so what do I do about it?

T: Ask.

S: About what?

T: You must try harder

S: !!!!!!!

Grades ≠ Feedback



- Grades do not meet any of the criteria of effective feedback
- Grading is not part of the process of formative assessment

Feedback to Groups

It's Your Turn

Read each of the scenarios on *Handout Effective Feedback: Is It?* After you have read each one, in your small team, decide if you think it shows an example of effective feedback. Why or why not?


Key Guidelines About Feedback

GUIDELINES

Effective feedback is:

- specific and clear
- related to learning goals and success criteria (learning targets)
- provides the learner with suggestions, hints or cues for how to improve rather than correct answers
- timely and relevant
- focuses on the task and not on the student
- identifies what is done well and next steps for student work

Reflections and Peer Discussion



What about this process makes sense to you? What works easily? What is difficult? If there are challenges, how can they be overcome? Use the try it out template to plan for formative assessment in your classroom.

Thank You!

Designing Effective Instruction:
atweed@mcrel.org



Learning Environments – *How People Learn*

In *How People Learn*, the researchers' synthesis included advice on designing effective learning environments with four specific perspectives in mind. As "lenses," these design characteristics can be used to evaluate the effectiveness of learning environments.

The **learner-centered lens** encourages attention to preconceptions and begins instruction with what students think and know.

The **knowledge-centered lens** focuses on what is to be taught, why it is taught, and what mastery looks like.

The **assessment-centered lens** emphasizes the need to provide frequent opportunities to make students' thinking and learning visible as a guide for both the teacher and the student in learning and instruction.

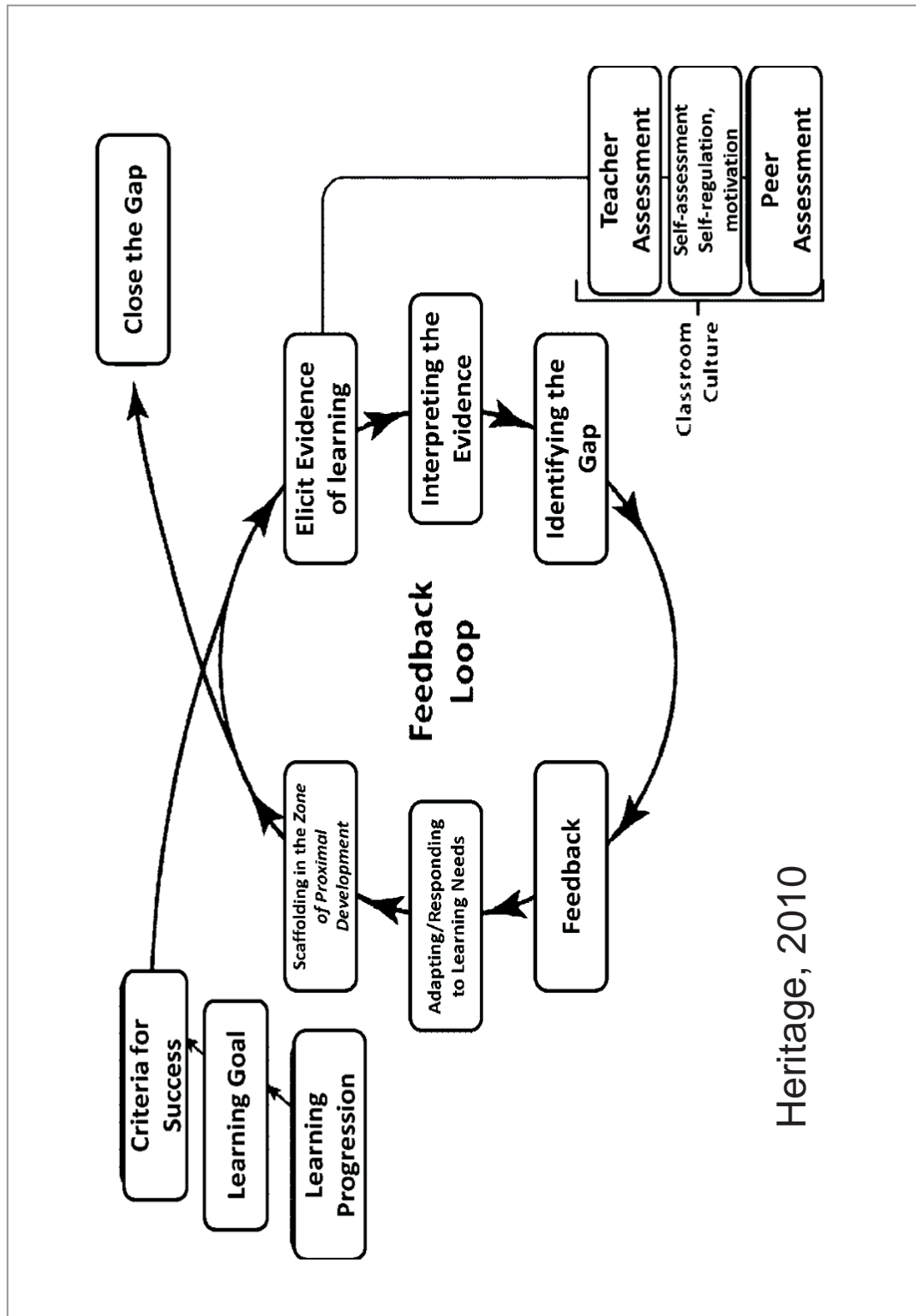
The **community-centered lens** encourages a culture of questioning, respect, and risk taking.

The Venn diagram below illustrates the relationship among the four perspectives. The learner-centered, knowledge-centered, and assessment-centered perspectives overlap, and all three are held within the circle of community. The four interrelated perspectives influence one another and need to be aligned in order to improve the classroom learning environment—and, ultimately, student achievement.



Note: From *How People Learn* (p. 122) by Bransford, Brown and Cocking, 2000, Washington, DC: National Academy Press. Copyright 2000 by National Academy Press. Reprinted with permission.

The Process of Formative Assessment





Planning Tool for Formative Assessment Tasks

	Criteria:	Plan
Learning Goal(s)	<p>The main learning goal IS a complete science or maths idea (key concept) or process aligned with the national standards.</p> <p>The main learning goal is NOT a topic, phrase, activity or question.</p> <p>Learning goals must be clear and fully elaborated, with a plan for communicating them to the students.</p>	
Success Criteria/Learning Targets	<p>Students provide evidence of where they are in relationship to the learning goal (able to say, do, think, present, solve, calculate, explain or reason, etc). Success criteria related to performance expectations are:</p> <ul style="list-style-type: none"> • clear, fair and unbiased, • aligned to student practices and crosscutting concepts • at the right level of cognitive demand, and • detailed enough that students know what evidence they need to provide. 	
Task	<ul style="list-style-type: none"> • Aligned both to the learning goal and the success criteria. The evidence generated provides sufficient detail to enable the teacher to make instructional adjustments and provide feedback to 	

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Quality of Evidence Indicators (rubric)	move student learning forward. <ul style="list-style-type: none">• The tasks provide teachers with information about a broad range of student understandings or skills that is likely to be present in the class.• Multiple opportunities are provided for students to show where they are in learning.	
	The students can clearly and accurately provide evidence of meeting the learning goal (DCI) and performance expectation. They can apply their learning to new situations. Conceptual understanding is clearly evident and students can make claims, generate explanations and cite evidence.	Mastery
	Students can accurately solve the parts of the task that involve lower levels of cognitive demand. The student problem solving processes include some errors and the explanations may include some inaccuracies.	Partial
	Misconceptions are evident. Students cannot complete all parts of the task without help. Conceptual understanding is not evident and students' explanations may not be supported by the evidence included in student work.	In Progress

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Research on Effective Feedback: Is It or Isn't It

READING

Read the following excerpted article on feedback, to learn more about the characteristics of effective feedback. After reading, you'll apply what you've learned about feedback to identify effective and ineffective feedback examples.

Following excerpt from Heritage, 2010:

What Experts Say About Feedback

"One of the most important roles in assessment is the provision of timely and informative feedback to students during instruction and learning ..." (NRC, 2001, p.87).

"Feedback to students should be about the particular qualities of their work, with advice on what they can do to improve, and should avoid comparisons with other students" (Black & Wiliam, 1998b, p.143).

"Good feedback to students relates to explicit criteria about expectations for learning, making the learning more transparent." (OECD, 2005, p.50).

"In order for learners to gain insight into their learning and their understanding, frequent feedback is critical: students need to monitor their learning and actively evaluate their strategies and their current levels of understanding" (NRC, 1999, p. 78).

Research on Effective Feedback: Is It or Isn't It

INEFFECTIVE FEEDBACK

For feedback to be effective, it must be used and lead to new learning. Although it is generally accepted that feedback can assist learning, not all types of feedback have positive results. The kinds of feedback that can have *negative* effects on learning are:

1. feedback that is critical (Baron, 1993);
2. feedback that is comparative and indicates a student's standing relative to peers (Black & Wiliam, 1998; Wiliam, 2007);
3. feedback that is vague and lacks specificity (Kluger & De Nisi, 1996);
4. feedback that is too complex (Kulhavy, White, Topp, Chan & Adams, 1985);
5. feedback that draws attention to the student rather than the task (e.g., praise for individuals vs. their performance) (Kluger & DeNisi, 1996);
6. feedback provided in relation to a poorly defined goal (Hattie & Timperley, 2007).



Research on Effective Feedback: Is It or Isn't It

EFFECTIVE FEEDBACK

There is a significant body of research on the *positive* effects of feedback on learning. Key guidelines about the kind of feedback that helps learners improve are listed below.

1. Feedback should provide information to the student relating to the task or process of learning that fills a gap between what is understood and what is aimed to be understood (Hattie & Timperley, 2007).
2. Feedback to students should be about the particular qualities of their work, with advice on what they can do to improve (Bangert-Drowns, Kulik, Kulik & Morgan, 1991; Black & Wiliam, 1998).
3. Feedback should be specific and clear and be related to learning goals (Hoska, 1993; Song & Keller, 2001).
4. Feedback should provide the learner with suggestions, hints or cues for how to improve rather than correct answers (Bangert-Drowns et al., 1991; Butler, 1987; Kluger & DeNisi, 1996; Narciss & Huth, 2004).
5. Feedback should match the student's cognitive needs – not too complex and not too vague (Bangert-Drowns et al., 1991).
6. Feedback should include both verification and elaboration. Verification is “the simple judgment of whether the answer is correct and elaboration is the informational aspect of the message, providing relevant clues to guide the learner toward a correct answer” (Shute, 2008, p. 158).
7. Feedback should be given after a student has responded to initial instruction. In the case when no learning has occurred it is better to continue with instruction rather than provide feedback (Hattie & Timperley, 2007).

Research on Effective Feedback: Is It or Isn't It

FEEDBACK TIMING

Research has also shown that the timing of the feedback can have both positive and negative consequences. Below are some general guidelines about the timing of feedback.

1. It is better to avoid providing feedback to students while they are actively engaged in the task (Corno & Snow, 1986).
2. Immediate feedback (i.e. immediately after the student's response) is better for supporting procedural or conceptual knowledge (Dihoff, Brosvic, & Epstein, 2003; Corbett & Anderson, 1989, 2001).
3. When a student is learning a new task, immediate feedback is better (Clariana, 1990).
4. In the case of more difficult tasks, involving greater amounts of processing, delayed feedback (i.e., feedback after several minutes, hours or weeks) provides more opportunity for students to process (Clariana, Wagner & Rohrer-Murphy, 2000).
5. Low-achieving students benefit from immediate feedback, particularly when they are learning new concepts or skills they find difficult (Gaynor, 1981; Mason & Bruning, 2001).

While these guidelines can be helpful for teacher decision-making about when to give feedback to their students, ultimately, teachers will need to decide when feedback is appropriate for their students, based on the learning goal(s) and their knowledge of students and how they learn best.



Research on Effective Feedback: Is It or Isn't It

FEEDBACK ACTIVITY CHART

Directions: Read each example of Teacher Feedback in the left column below, and identify specific features of the feedback that are effective or ineffective. Complete the right column by describing the characteristics of effective and/or ineffective feedback evident or implied in each statement.

Examples of Teacher Feedback	Characteristics of Feedback
<p><i>"Your design shows that you are clear about what you want to measure, and you have listed four factors that should remain constant in your test and one that will change."</i></p> <p><i>"For your test to be fair there is one other factor that must remain constant. You are planning to measure the time parachutes of different sizes take fall to the ground. With this in mind, can you review your plan and think about what else needs to be constant? I'll be back in a few moments to hear your ideas."</i></p>	
<p><i>"This work is very poor. You have not tried hard enough."</i></p>	
<p><i>"You did a very good job of using your strategies to read the text accurately. Let's keep on reading and while you are reading think about: is what you are reading making sense, and does what you are seeing match with what you are reading? – just like you did when you noticed that water could not be the right word because it began with the letter 's'."</i></p>	

Research on Effective Feedback: Is It or Isn't It

Examples of Teacher Feedback	Characteristics of Feedback
<p>Student Question: <i>There are a lot of different kinds of vegetables in the market.</i></p> <p>Teacher Feedback: <i>"Do you remember when we talked about the difference between a question and a statement? Look again at what you have written and think about whether it is a statement or a question. (Child responds). Why do you think it is a statement and not a question? (Child responds). I agree, now see if you can turn your statement into a question."</i></p>	
<p><i>"You are not paying sufficient attention to the features of narrative in your writing. Revise your work, paying attention to the fact that the features of narrative structures can include orientation, complication and resolution, as well as descriptions of characters and settings. You are emphasizing character and setting without employing a structure that represents the other, important features of narrative. Use all of the features I have indicated above in your next draft."</i></p>	
<p><i>"Remember, the success criterion for this task was that all your mathematical justification should be backed by evidence. I've used a check mark to indicate the statements that are backed by evidence. Now, you each find the statements that are not supported by evidence and provide it."</i></p>	
<p><i>"Your understanding of this idea is much weaker than the other students in the class. You will need to redo the work to catch up."</i></p>	

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 Work was funded by the U.S. Department of Education
 Collaboration of McREL International and CRESST



LESSON 4 DO GASES HAVE DENSITY?

Name: BobClass: P T S Date: _____

Student Sheet 4.1

Finding the Density of Air

1. Write down the procedure agreed on by the whole class.

1. To find volume: fill bottle with water. Pour out into graduated cylinder
2. To find mass: Use electronic balance - must include: bottle, & rubber bulb
3. Use pump to remove air from bottle
4. Refill the bottle & valve
5. Calculate the mass of air removed from bottle (original mass - removed air mass)
6. Calculate density of air $D = \frac{m}{V}$

2. Record your results. Include all the measurements you make.

Volume	Mass	Density
620 ml.	7g.	.011290322

3. Calculate the density of air by using your group's measurements. Show your calculation.

$$\frac{.011290322}{620/7}$$

The density of the air is: .011290322

4. How does the density of air compare with the density of solids and liquids?

It is way less denser than solids and liquids

5. Why do the class results vary so much?

Different volume measurements, water residue in bottles, different masses from not sucking that much air out

6. Why do some things float in air?

Some things could even be less denser than air

17/20

Name BrianClass P2TS Date _____

Student Sheet 4.1

Finding the Density of Air

1. Write down the procedure agreed upon by the whole class.

1. To find volume fill the bottle with water, pour into graduated cylinder
2. To find mass - use electronic balance - must have bottle's value
3. Use pump to remove the air from the bottle
4. Reweigh the bottle's value
5. Calculate the mass of air removed from bottle (orig. mass - removed air mass)
6. Calculate density of air $D = \frac{m}{V}$
2. Record your results. Include all the measurements you made.

$$\text{Bottle} = 108.7 \text{ g} - 108.2 = .5 \text{ mass}$$

$$\text{Volume} = 630 \text{ ml}$$

3. Calculate the density of air by using your group's measurements. Show your calculation.

Show me the equation. $.0007 = D$

I need you to show me how you arrived at this answer.

The density of the air is: .0007

Work it out & please come show me.

4. How does the density of air compare with the density of solids and liquids?

It is a lot less dense

5. Why do the class results vary so much?

They may take less air out.

What are other things that could have happened?

6. Why do some things float in air?

They way less than air.

-1

weigh

Perhaps better said "they are less dense"



14/20

Name: Alex C.

Class: P T S

Date: 1-28-03

Group 5

Student Sheet 4.1

Finding the Density of Air

1. Write down the procedure agreed on by the whole class.

- 1 To Find the volume: Fill bottle with water, pour into graduated cylinder.
- 2 To Find mass: Use electronic balance - must have bottle's rubber valve
- 3 Use pump to remove air from bottle
- 4 Reweigh the bottle & valve
- 5 Calculate the mass of air removed from bottle (original mass - removed air mass)
- 6 Calculate density of air $D = \frac{m}{V}$

2. Record your results. Include all the measurements you make.

Volume 630 ml
Mass

251
+ 200
130
630

109.1
108.7
0.4

3. Calculate the density of air by using your group's measurements. Show your calculation.

$$d = \frac{m}{V} \quad d = \frac{0.4}{630} \quad d = 0.45$$

The density of the air is: 0.0012 g/cm³

4. How does the density of air compare with the density of solids and liquids?

It is less than almost all of the solids and liquids.

5. Why do the class results vary so much?

The amount in each bottle and there was different amounts of water in each bottle so that changed the mass. Also some people may have spilled water changing their density is less than 0.0012.



“Try It Out” – Planning for Student Learning

Learning Goal(s)— Aligned to National Standards		
Success Criteria— Performance Expectations		
Formative Task— To check learning		
Quality of Evidence Indicators (rubric)	Mastery	
	Partial	
	In Progress	

[illegible]



Lined area for writing, consisting of 20 horizontal lines.

[illegible]

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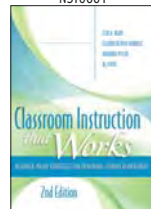
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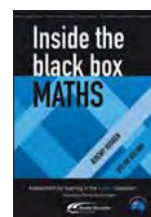
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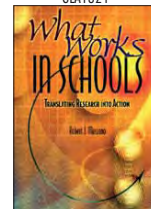
NST0881



111001



GLA1321



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