

Developing assessments in-house: The case of Michigan

Ed Smith

Michigan State University

The new MEAP Science Assessments are designed to

- To provide information about student understanding of science,
- To promote assessment practices which support learning with understanding for all students, and
- To promote teaching for understanding over content coverage

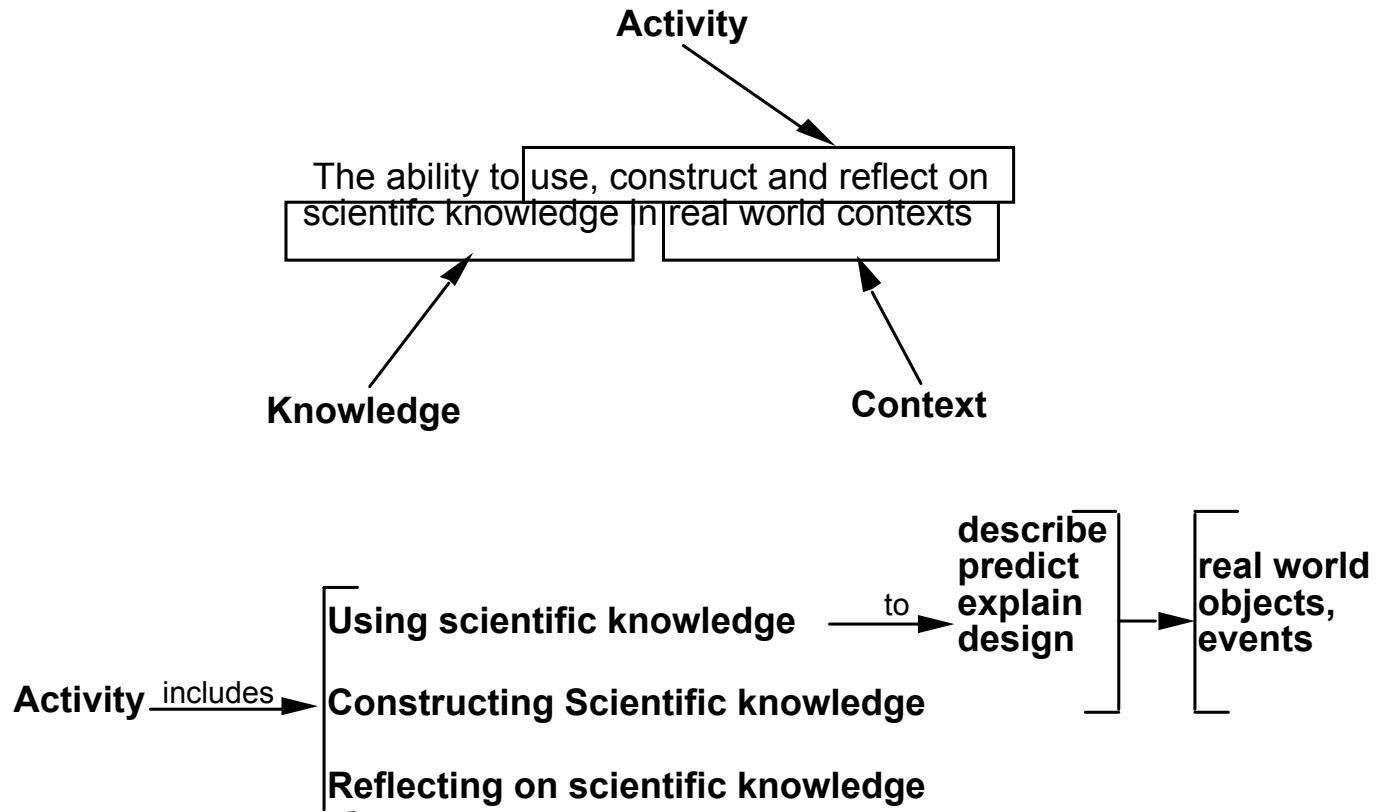
Michigan Essential Goals and Objectives for Science Education (MEGOSE)

- The conceptual framework for the MEAP Science Assessment
- The primary source of guidance for science curriculum reform in Michigan 1990-2000
- Widely available books used by item writing teams, teachers, teacher educators, etc.
- New Michigan Curriculum Framework not as comprehensive or in as accessible a format

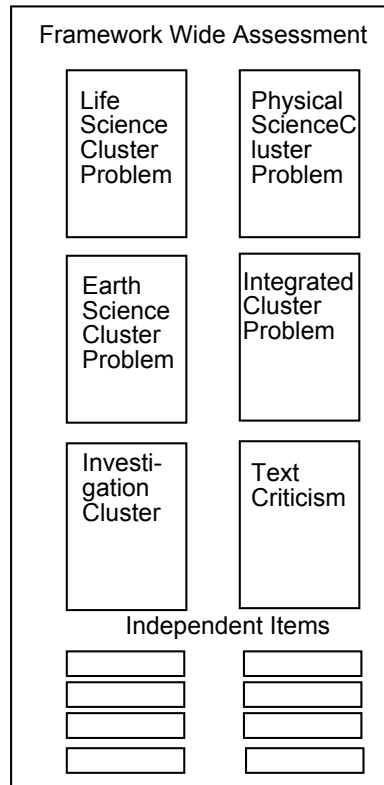
Figure 2--Toward Common Goals and Discourse

ELS 3-30-96

Dimensions of Science Literacy



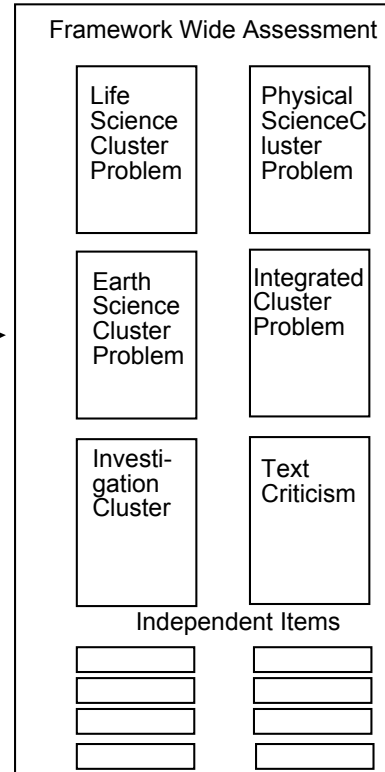
**1996 MEAP
Science
Assessment**



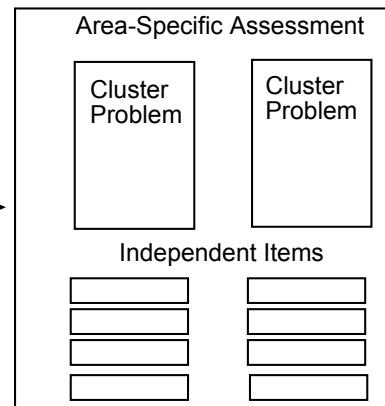
Remains the same



**1997 MEAP
Science
Assessment**



New in 1997



Example Objective

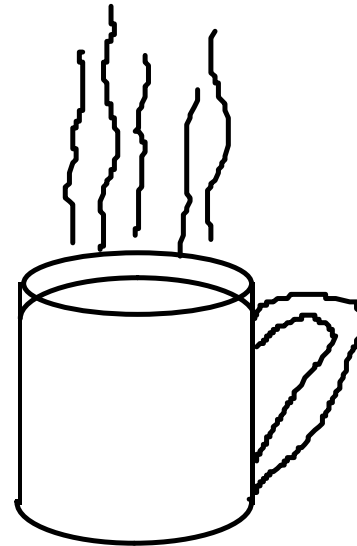
Objectives--Elementary School	Related concepts, terms, and tools	Real-world contexts
4) Describe common physical changes in materials: evaporation, condensation, thermal expansion and contraction.	States of matter: <i>solid, liquid, gas</i> Changes in states of matter: <i>evaporation, condensation</i> Thermal expansion and contraction	Changes in state, such as <i>water evaporating as clothes dry, condensation on cold window panes</i> Expansion of bridges in hot weather

Innovative Features

- The Assessments will include three types of problems in addition to a set of independent items: **cluster problems, a text criticism and an investigation cluster**. The investigation cluster will pose questions about an investigation to be carried out prior to the MEAP Science Assessment.
- The Assessments will consist of **two parts**: a **Framework-Wide Assessment** which will assess a representative sample of objectives from the MEGOSE framework. An **Area-Specific Assessment which** will provide a more concentrated assessment of a small set of closely related objectives.
- The Assessments will include **constructed response items** as well as multiple choice response items. Constructed response items may require writing a sentence or short paragraph, constructing or completing a table or graph, or drawing and/or labeling a diagram.



Sample cluster problem

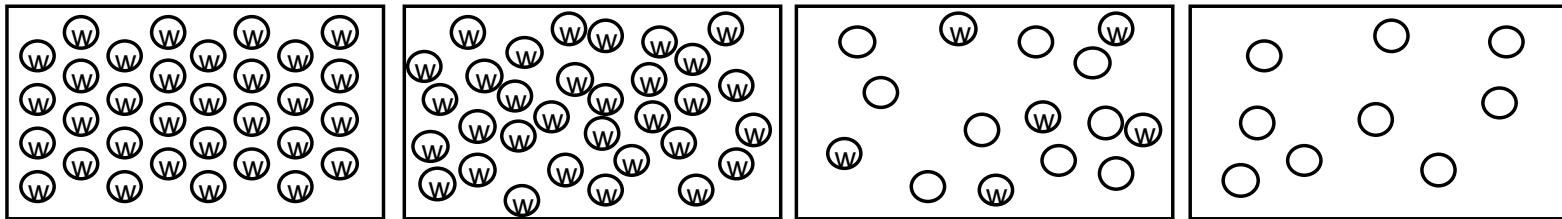
Juanita made a cup of hot chocolate by pouring boiling water into a cup with some chocolate powder. As she looked at the cup, she saw a little cloud rising up from the cup. As the cloud rose it disappeared.



1. Which is the best description of the change(s) in state of the water from the time the hot water was poured into the cup until after the cloud disappeared? (PCM4)
 - a. evaporation then dissolving
 - b. evaporation
 - c.* evaporation then condensation then evaporation
 - d. condensation then evaporation then dissolving

2. We cannot really see molecules. But if we could see them, which of the following diagrams would be the best description of the water molecules after the cloud has disappeared? (PME12)

Key:  Water molecule
 Other kinds of molecules



3. Use the idea that molecules attract each other to explain how the cloud formed above the cup. Include where the molecules came from, what happened to the speed of the molecules and why. (PCM8)

Sample Response

Water vapor rises from the cup. As it rises it hits cooler room air, the molecules slow down. As they slow down, the attraction pulls them together to form tiny drops of water. These tiny drops are the cloud.

4. As the hot chocolate cooled, it lost heat energy. What happened to the heat energy lost by the hot chocolate?

(PME14)

- a.* It was transferred to the air around the cup.
- b. It was changed into coldness.
- c. It cooled off by the coldness of the air around the cup.
- d. It did not exist any more.

5. Juanita wondered if there were any chocolate in the cloud rising from the cup. Which would be the best procedure to get evidence about this idea? (C2)

- a. Compare the weight of the chocolate and hot water before they are mixed with the weight of the hot chocolate after it is mixed.
- b.* Hold a piece of glass over the cup to collect drops and observe their color.
- c. Carefully draw diagrams of the cup and the cloud to show exactly what they look like.
- d. Take a vote of all the students in your class to find out whether more people think there is or is not chocolate in the cloud.

6. Juanita's class voted on whether or not they thought there was chocolate in the cloud.

Twenty two (22) voted 'no' and three (3) voted 'yes.' Is this good evidence that there is not chocolate in the cloud? Why or why not? (R6)

- a. Yes, because 22 is many more than the 3 who voted the other way.
- b. Yes, because I think that is the right answer.
- c. No, because three voted 'no' so we can't be sure.
- d.* No, because people's opinions are not good scientific evidence.

Criteria for item match to benchmark

- Does the item involve the students doing the activity specified in the benchmark?
- Does the item use or require use of terms not listed in the benchmark, or terms, concepts and tools (or essay?).
- Does the item match the intended level as reflected in the essay and related higher and lower level benchmarks?

Example item that does not meet the criteria

Which of the following occurs during evaporation?

- A. The molecules move faster and farther apart.
- B. The molecules move faster at about the same distance apart.
- C. The molecules turn into air.
- D. The molecules turn from solid to liquid.

(Not about a real world context)

Example item that does not meet the criteria

Which of the following is the BEST description of what happened as the cloud disappeared?

- A. Condensation
- B. Evaporation
- C. Sublimation
- D. Precipitation.

(Used a term not included in MEGOSE for that level)

Intended “Messages”

- Intensive work on a particular topic has payoff
- Asking students a range of questions about real-world situations is good assessment
- Students need to be writing in science
- Students need to be doing investigations
- Students need to be critically reading science source material

Sources of Slippage

- Lack of institutional memory
 - Turnover in staff
 - Insufficient documentation
 - Shift away from policy role of committee
- Pressure from contractors
- Insufficient staff
- Staff positions not at level required to carry out functions
- Budget reductions/lack of advocacy
- Political leadership agendas

Alternative messages

- Cover as much as possible as fast as possible--No time for in-depth
- Investigations aren't really important.
- The test is just a bunch of picky items
- Writing isn't as important any more.
- Things are not REALLY changing after all
- The MEAP is incompatible with teaching for understanding

Draft Scoring Rubric

<p>Elements</p> <ul style="list-style-type: none"> * 1. Water molecules/vapor/gas was rising from the cup. * 2. The water (vapor) hit cooler air. 3. The water (vapor) cooled off as it rose. * 4. The molecules slowed down. * 5. Molecules attracted each other * 6. The molecules got closer together. 7. The molecules held each other/stuck together. 	<ul style="list-style-type: none"> * 8. The water/molecules formed tiny drops. * 9. The cloud is made of tiny drops * 10. Causal link (e.g., because, resulted in, and so, etc.) between 4 and either 2 or 3 * 11. Causal link between 5 and either 6, 7 or 8
<p style="text-align: center;">Scoring</p> <ul style="list-style-type: none"> * Full credit (3) 5-11 elements Partial credit (2) 3-4 elements Partial credit (1) 1-2 elements No credit (0) Incorrect or no response 	

* Indicates the scoring of the sample response

Cluster Problem Specifications

Description. A cluster problem will present the student with a real world scenario and a cluster of five (grade 5) or six (grade 8) items about that scenario. The scenario will consist of a written description of a real world event, situation or object, often accompanied by a diagram and/or other graphic.

Objectives addressed. Each cluster problem will include items for "Using" objectives as well as items for "Constructing" and/or "Reflecting" objectives as indicated in Table 4.

Response modes. Each cluster problem as presented on an assessment will include one item requiring a constructed response. Other items will require a multiple choice response.