

Writing to Represent Scientific Knowledge

www.ohiorc.org/for/science/ogt



Topics to be discussed in this webcast include:

- State student performance data on short answer and extended response questions
- Difficulties associated with writing in science
- Strategies science teachers can use to help students develop writing skills
- Scientific discourse
- Using released OGT items to help develop students' writing skills

Panelists:

Sarah Beth Woodruff, Director, Ohio's Evaluation and Assessment Center for Mathematics and Science Education

Sylvia Clark, Science Teacher, Bath High School and ORC Science Review Board member

Moderator:

Terry Shiverdecker: Science Content Specialist for ORC

2005	No Response	0.0 Points	Full Points
Short Answer	6 %	37%	3%
	4%	13%	61%
	5%	10%	64%
	7%	39%	34%
Extended Response	6%	20%	24%
	7%	12%	7%

2008	No Response	0.0 Points	Full Points
Short Answer	3%	29%	26%
	2%	9%	9%
	3%	35%	12%
	3%	21%	26%
Extended Response	1%	3%	20%
	4%	19%	7%

Short Answer and Extended Response Data, 2005 & 2008

“Historically, Ohio students have performed below expectations on state achievement test items that require them to construct a response. Ohio Graduation Test data indicate that between 2005 and 2008, 21% of Ohio students received full credit (2 points) for their responses to short-answer test questions and only 11% responded correctly (4 points) to items requiring an extended response [Ohio Department of Education (ODE), 2008]. Though anecdotal evidence and practical experience point to a variety of reasons why this may be the case, no empirical study has been conducted to determine the root cause for consistently poor performance.”
 From *Writing to Represent Scientific Knowledge—Thinking Beyond the OGT*,
<http://www.ohiorc.org/for/science/ogt/article.aspx?articleId=47>.

Between 2005 and 2008 the number of students not responding to short answer and extended response questions dropped. More students are now attempting to answer these questions.

The number of students receiving 0 points on the short answer and extended response questions remains high.

More students are attempting to answer the questions, but there is no apparent improvement in students’ ability to answer short answer and extended response questions.

Full item analysis data can be found at
<http://www.ode.state.oh.us/GD/Templates/Pages/ODE/OEDDetail.aspx?page=3&TopicRelationID=285&ContentID=9479&Content=53511>.

Cognitive Demand

- Recalling/Identifying Accurate Science
- Communicating Understanding/Analyzing Science Information
- Demonstrating Investigation Processes of Science
- Applying Concepts/Making Relevant Connections with Science

Students are writing across the curriculum but this does not seem to be impacting science achievement. Students may not understand that improved writing skills can lead to increased science achievement.

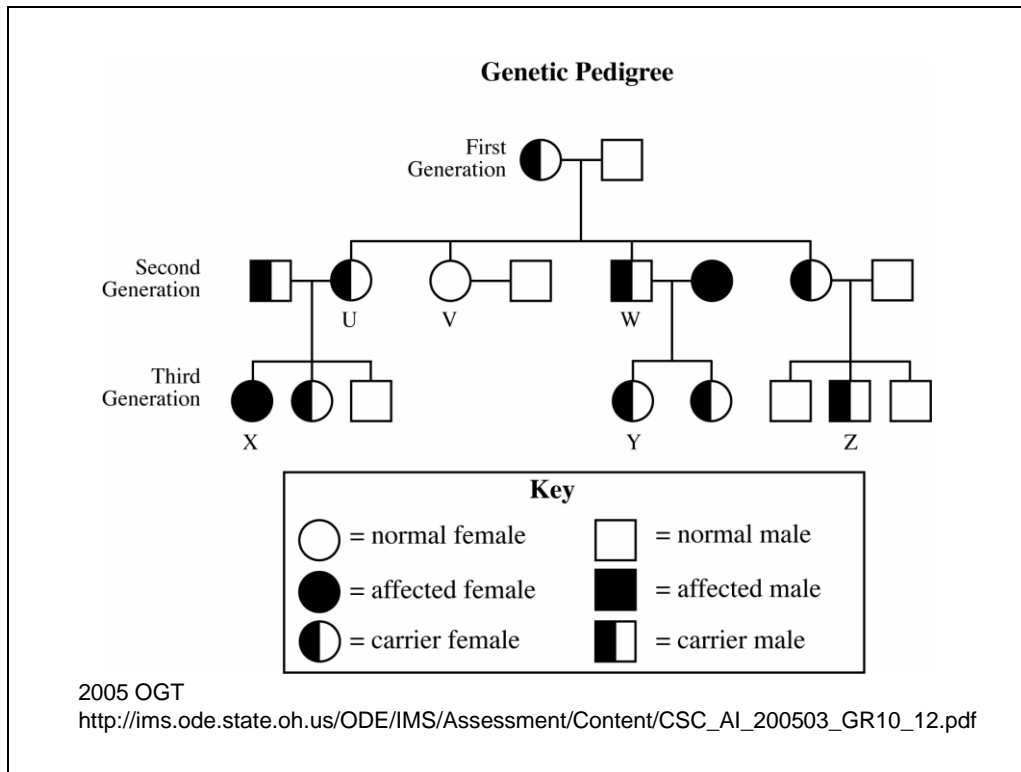
Attention should be shifted from memorization to depth of understanding in an effort to improve students' capacity to articulate understanding and draw relationships between individual facts.

Students may not be truly learning science or understanding the concepts in a meaningful way.

Short answer and extended response questions are not knowledge level questions. They require application of knowledge.

Providing a variety of writing opportunities across the various types of cognitive demand will improve students' ability to communicate what they know in science.

For more information on cognitive demand see "Ohio Graduation Test (OGT) Blueprint for Science" at <http://www.ode.state.oh.us/GD/DocumentManagement/DocumentDownload.aspx?DocumentID=11252>.



This released test item illustrates a Demonstrating Investigation Processes of Science question.

This item appeared on the March 2005 OGT. Go to ORC #6383
 (<http://www.ohiorc.org/record/6383.aspx>) to access this released item.

Demonstrating Investigation Processes of Science

Draw a Punnett square or comparable diagram for the couple in the first generation of the pedigree. Use B to represent the allele for normal red blood cells and b to represent the allele for sickle cell disease. How do the couple's actual children compare to the expected results shown in your Punnett square?

2005 OGT

http://ims.ode.state.oh.us/ODE/IMS/Assessment/Content/CSC_AI_200503_GR10_12.pdf

To successfully respond to this question students must represent scientific knowledge with both text and a diagram.

Learning Cycle Phase	Sample Writing Tasks
Engage	Free-writing Generation of a preliminary graphic organizer Drawing Journal entry
Explore	K-W-H-L T-H-C Performance assessment (ability to do science) Science laboratory notebooks Follow-up journal entry
Explain	Refined drawings/graphic organizers Performance task presentation Complete KWHL or THC Reflective journal entry Standards-based test questions based on data-rich, investigative, or technological design scenario

<http://www.ohiorc.org/for/science/ogt/article.aspx?articleId=47>

Recording observations (e.g. diagrams, drawings, etc.) while in the lab provide students with opportunities to write to represent scientific knowledge. Follow the lab experience with opportunities to represent knowledge in text. This provides students with opportunities to relate what they see/experience in the lab with the concept at hand.

Life Science Example

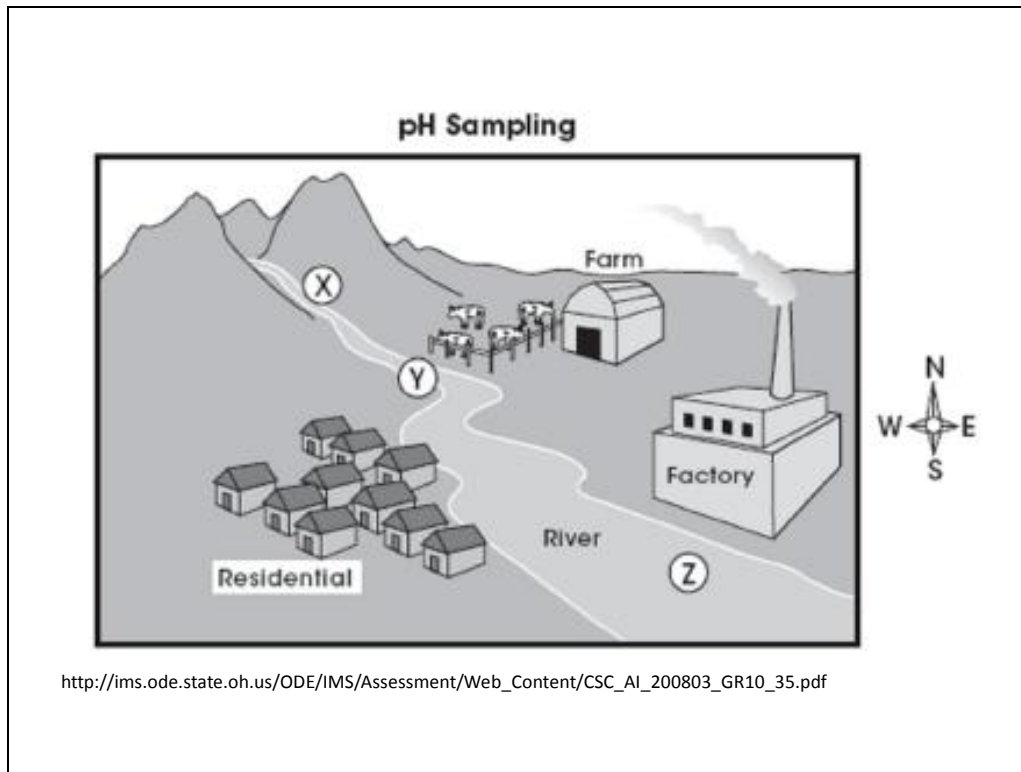
- In the lab observe and draw various types of cells (eukaryotic, prokaryotic, cork/plant, and squamous epithelial)
- Observe a living Elodea plant leaf.
- Review photographs taken by electron microscope of cell structures and perform measurements.
- After the experience write about:
 - what the cells have in common
 - how the cells different
 - the functions of the cellular structures

Be very intentional about putting appropriate types of writing tasks into the different phases of the learning cycle.

Learning Cycle Phase	Sample Writing Tasks
Expand	Reflective question, hands-on assessment Invention/innovation writing activities or presentations Refinement of graphic organizer Performance assessment Projects and presentations Portfolios Final reflective journal entry Scientific inquiry research report
Assess	Formative, include reflection guides/rubrics to guide learning Summative pretests and post-tests Performance assessments and skills demonstrations Individual and group products

<http://www.ohiorc.org/for/science/ogt/article.aspx?articleId=47>

“Writing in the science classroom typically might consist of completing study questions, taking notes, composing a laboratory report, or answering an essay question. While these forms of writing have their place, integrating the writing process more fully and authentically broadens and deepens students' learning of science content. Regardless of the form that writing takes in the classroom, it always should foster conceptual growth and change. Writing strategies that encourage conceptual change should be embedded in each phase of a learning cycle and should facilitate students' expression and exploration of naïve concepts, explanation of emergent conceptual understandings, and reflection upon incongruence between the two.” From *Writing to Represent Scientific Knowledge—Thinking Beyond the OGT*, <http://www.ohiorc.org/for/science/ogt/article.aspx?articleId=47>.



Writing is a necessary but insufficient condition.

Don't write for the sake of writing-write to become better scientists.

Scientific discourse is critical for students to fully understand scientific concepts. Scientific discourse helps students build the skills necessary to communicate what they know and are able to do in science.

Applying Concepts / Making Relevant Connections with Science

Based on the diagram and the researcher's investigation, provide two reasons why this may not be a valid conclusion. Describe how each reason could invalidate the conclusion.

http://ims.ode.state.oh.us/ODE/IMS/Assessment/Web_Content/CSC_AI_200803_GR10_35.pdf

Applying Concepts / Making Relevant Connections with Science

Identify two savings that result from recycling aluminum cans and explain one ecological benefit of each. (4 points)

2006 OGT
http://ims.ode.state.oh.us/ODE/IMS/Assessment/Content/CSC_AI_200603_GR10_31.pdf

Released OGT items will not reappear on future OGTs.

Look at the content of the question and then find an appropriate way to use the item in instruction.

Do not use items in isolation-use them in the context of the learning cycle, use them in a way that is relevant to what the student is currently learning. Use them in a way that will build skills.

Know what your students don't know-spend your time seeking out resources/released test items in these areas.

www.ohiorc.org/for/science/ogt

www.ohiorc.org

ORC would be happy to work collaboratively with you to plan building or district wide professional development programs.

Mailing Address:

The Ohio Resource Center
1929 Kenny Road, Suite 400
Columbus, OH 43210

Phone Numbers:

Voice: (614) 247-6342
Fax: (614) 292-2066