

Using immersive virtual environments to assess science understanding: the impact of contextualization

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What is science?





Science is...

Collaborative



Socially Constructed



Inquiry Based



<http://betsyb.blogspot.com/2011/10/fun-exploding-science-experiments.html>

Situated and investigative



<http://en.wikipedia.org/wiki/Volcanology>

Thrives on diverse




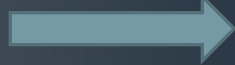
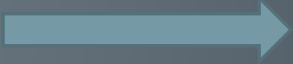
perspectives

<http://www.dian-fossey.com/>

And, so should be science classrooms,
curriculum and assessments!

“High stakes exams are among the most
effective means of alienating students
from science.”

(King et al, 2005)

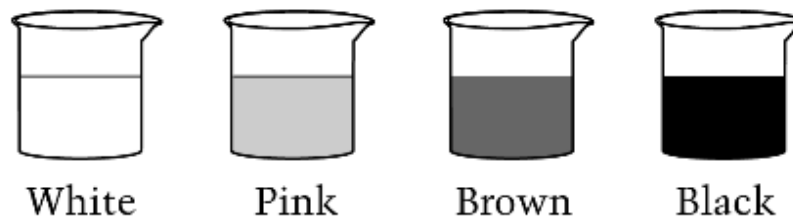
- **I**ntegrate scientific inquiry with content
- **C**ontextualize the question 
- be **E**fficient in scoring in cost and time
- be **S**tatistically reliable and valid 
- **E**ngage 

ICESE

A framework for good high stakes
science tests

Are high stakes tests valid?


11. Janet has four identical containers. In each container there are 200 grams of a different colored sand, as shown below. All the sand is at the same temperature and has the same grain size.



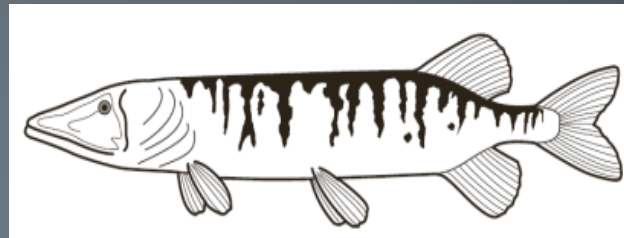
Janet leaves the containers out in the full sun for three hours. Then she measures the temperature of the sand in each container. Her results are shown below.

White	Pink	Brown	Black
22°C	28°C	41°C	45°C

Explain why the temperature of the sand in each container is different.



The picture below shows a type of fish that is adapted to live in the weedy areas of freshwater lakes. How is this fish adapted to live in the weedy areas in freshwater lakes?



- The upper fin looks like another fish.
- The lower fins look like the legs of a turtle.
- The stripes of the fish look like plants in the water.
- The mouth of the fish looks like the bottom of a lake.

State Assessment



SAVE Science

A test of content, inquiry and 'being scientific'

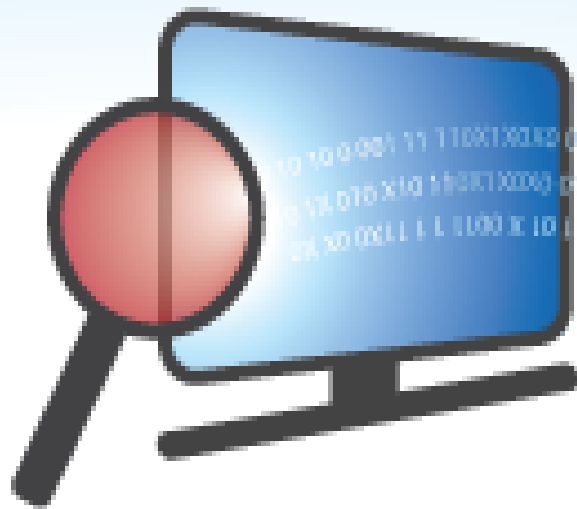
SAVE Science Assessments

- Based in immersive VEs
 - 4 assessment modules
 - Based on classroom curriculum
- Problem-based scenarios
- Student as scientist
- Need to use scientific inquiry skills as well as content understanding to solve problem

SAVE Science and ICESE

- Integrate scientific inquiry with content
- Contextualize the question
- Efficient in scoring in cost and time
- Statistically reliable and valid
- Engage

SAVE Science



Sub-study research question

- What is the impact of context on answering multiple choice questions?

Sample:

- 379 students from urban and near-urban school districts
 - Pilot Study:
 - 302 10-14 year olds
 - Urban and near-urban
 - Explored sheep trouble module
 - Study 2:
 - 77 12-14 year olds
 - Urban
 - Weather trouble module

Pilot Study Design—Sheep trouble

- Speciation Question

- How would different structures most likely benefit two subpopulations going through speciation?
- *If these two sets of sheep are undergoing speciation, what is the most likely benefit to each sub-population of the different leg lengths?*

- Adaptation Question

- “Based on its physical appearance, what is the most likely function of this bird’s beak?”
- *It looks like the sheep's legs are different lengths. What is the most likely function of the old sheep's shorter legs?*

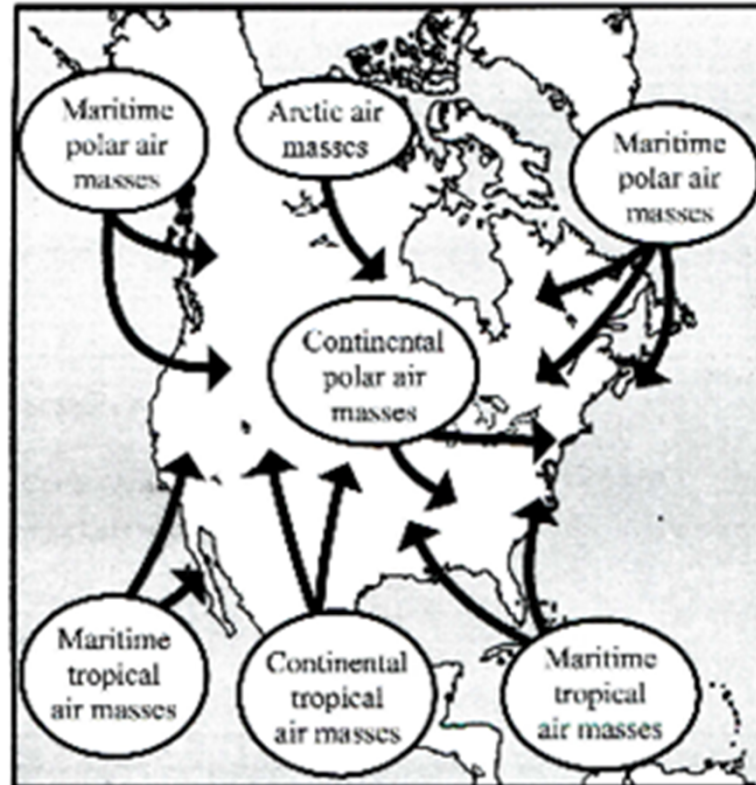
Pilot Study results

Question was situated or original	Number of students	Adaptation Multiple choice Question	Speciation multiple choice question
Situated	275	75%	58%
Original	9000	66%	39%

Study 2 Design—Weather Trouble

- Weather front question, unchanged between contexts

6 Look at this picture showing the major air masses influencing North America.



Cool, wet weather covers eastern Pennsylvania from the east in October. What type of air mass is most likely the cause?

- ☐ maritime polar
- ☐ maritime tropical
- ☐ continental polar
- ☐ continental tropical

Study 2 Results

Type of question answered correctly	Percent of students answering questions correctly
Text-based only	22%
IVE-based only	22%
Neither	27%
Both	29%
Total	77%

Conclusion

- Providing context matters for some students
- Format mattered for nearly half
- Providing multiple assessment paths could permit a larger set of students to convey their science understanding
- Engaging!



Thanks

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 - Project Manager: Uma Natarajan at Temple U
 - Graduate students: Younsu Kim, Cecile Foshee, Kent Slack, Chris Teufel, Melissa Karakus, Mary Johns, Minjung Ryu
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