The Concord Consortium

Revolutionary digital learning
for science, math and engineering

Powerful, Free Models and Simulations for Biology and Life Science Teaching

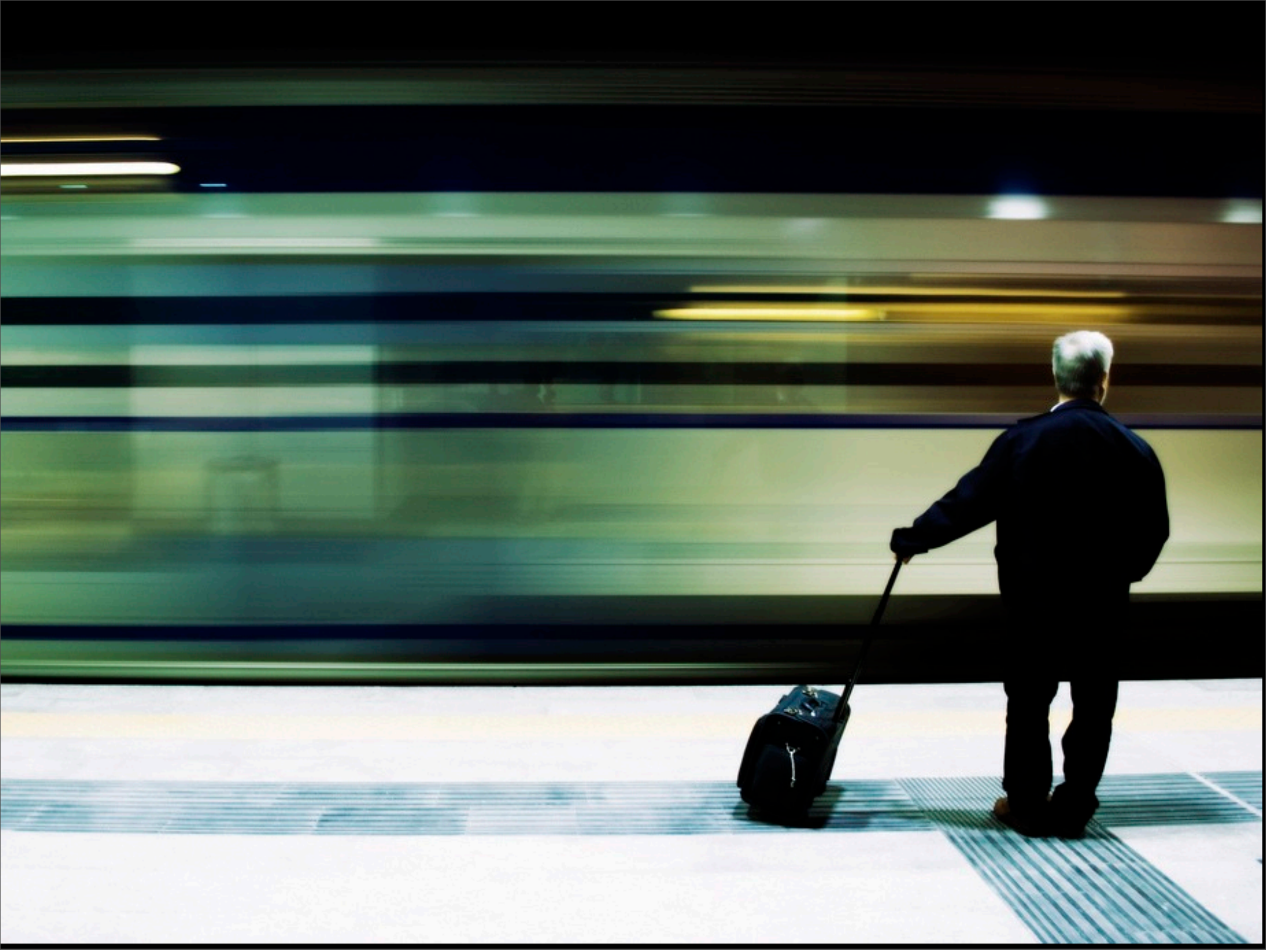
Chad Dorsey, President & CEO
The Concord Consortium, Concord, MA

Project work supported by funding
from the National Science Foundation

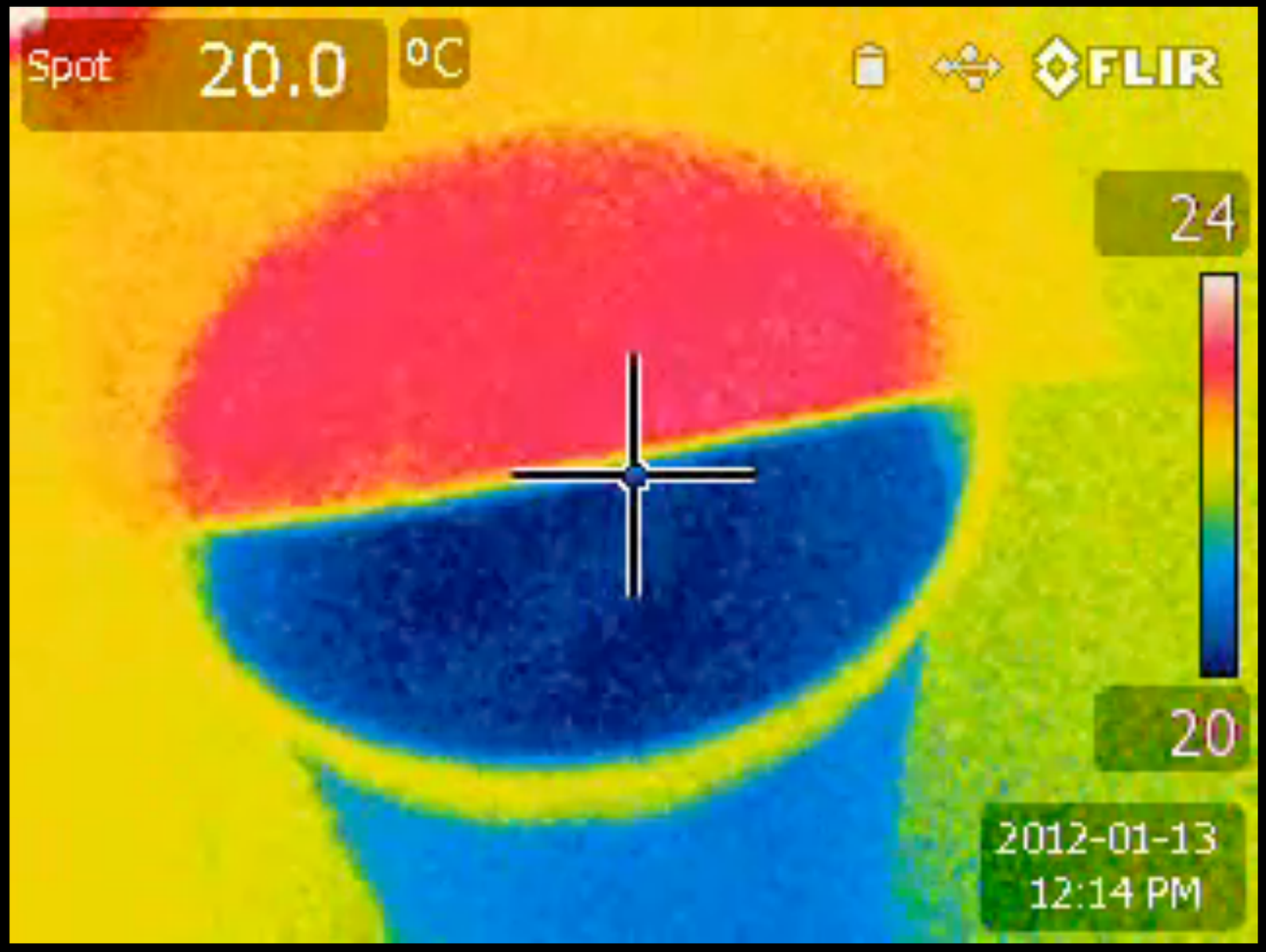

Science education today is
changing at a blinding pace

You want your children to be prepared for the needs of tomorrow

Today's education needs to keep pace with the needs of tomorrow's world



Thermal (IR) camera


Spot 20.0 °C
FLIR
24
20
2012-01-13
12:14 PM

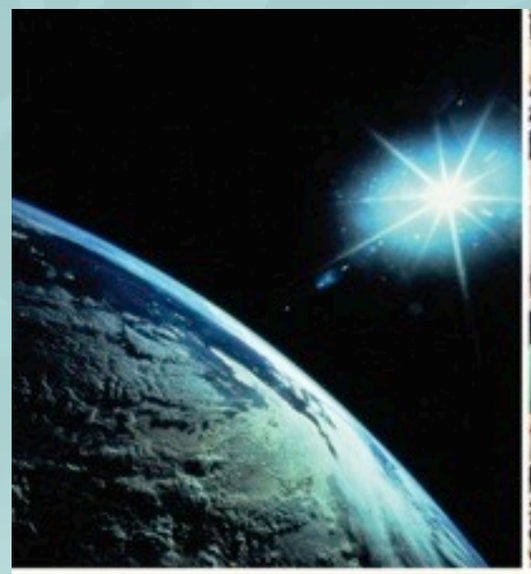
Overview
and Background

Examples of
The Practices

Putting them
into Action

The Concord Consortium

NEXT GENERATION SCIENCE STANDARDS



A FRAMEWORK FOR K-12 SCIENCE EDUCATION

Practices, Crosscutting Concepts, and Core Ideas

NATIONAL RESEARCH COUNCIL
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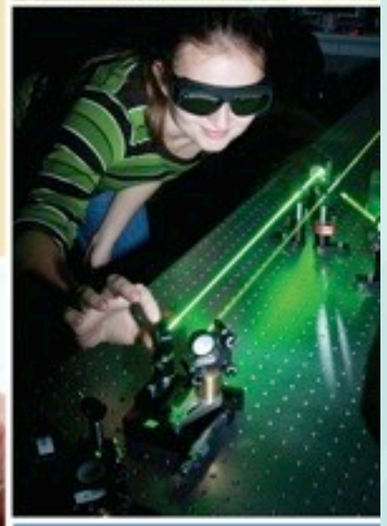
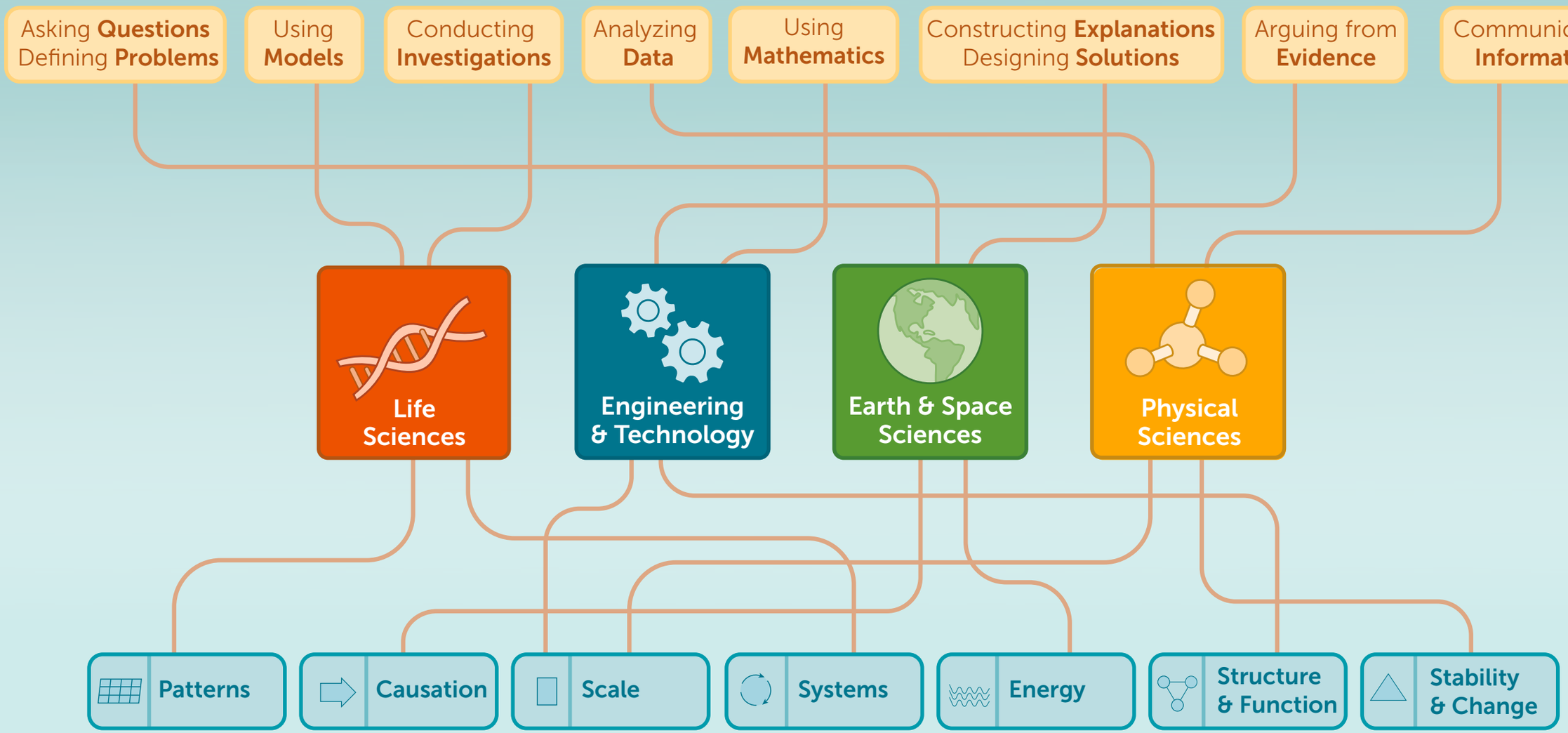


Scientific and Engineering Practices

- Asking questions / defining problems
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations / designing solutions
- Engaging in argument from evidence
- Obtaining, evaluating, communicating information


Asking **Questions** Defining **Problems**
Using **Models**
Conducting **Investigations**
Analyzing **Data**
Using **Mathematics**
Constructing **Explanations** Designing **Solutions**
Arguing from **Evidence**
Communicating **Information**
Life Sciences
Engineering & Technology
Earth & Space Sciences
Physical Sciences
Patterns
Causation
Scale
Systems
Energy
Structure & Function
Stability & Change

Overview
and Background

Examples of
The Practices

Putting them
into Action

Asking Questions

Asking Questions

- Asking questions is essential to developing scientific habits of mind
- Questions are important in both science and engineering
- Students should be able to ask scientific questions that can be investigated
- Students should be able to distinguish scientific from non-scientific questions

Developing and Using Models

Developing and Using Models

- Models are representations of phenomena
- Models are always analogous to the phenomena they represent in some way
- Many kinds of models exist
  - Drawings
  - Physical models
  - Mathematical equations
- Many concepts are often modeled best through simulation

Asking **Questions** Defining **Problems**

Using **Models**

Conducting **Investigations**

Analyzing **Data**

Using **Mathematics**

Constructing **Explanations** Designing **Solutions**

Arguing from **Evidence**

Communicating **Information**

Life Sciences

Engineering & Technology

Earth & Space Sciences

Physical Sciences

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Systems

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Stability & Change

Using
Models

Life Sciences

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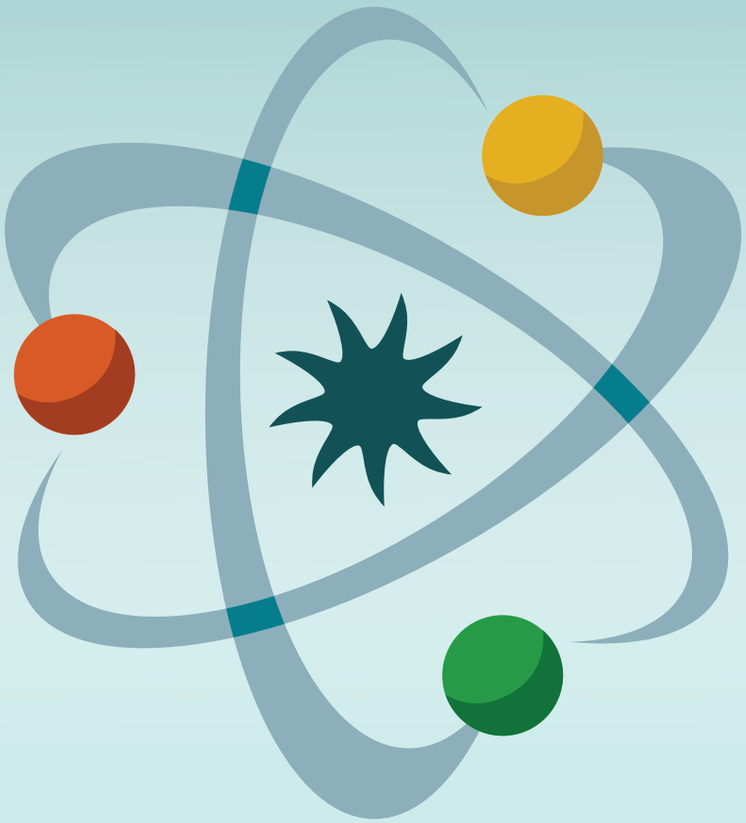
Structure & Function



Molecular Workbench

The Concord Consortium

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Next-Generation Molecular Workbench

Now you can use our award-winning molecular simulations anytime, anywhere.

Try These Activities

States of Matter

Learn what gas, liquid and solids look like at the atomic scale.

Boiling Point

See what happens at the molecular level when a substance starts to boil.

Solubility

Discover why some substances dissolve in water while others do not.

Molecular Workbench is already one of the most versatile ways to experience the science of atoms and molecules. Now thanks to Google's generosity and the power of HTML5, we're bringing it to Web browsers everywhere. Try out the activities listed at right to see for yourself.

Molecular Models

Need a simple model to show intermolecular attractions, gas laws or phase change? Embed these interactives in your own website or blog. Find an interactive now »

Try These Activities

States of Matter

Learn about phase change — a major factor in creating climate on Earth among many other interesting phenomena.

Run Activity »

Boiling Point

The temperature at which substances boil is determined by intermolecular attractions. Explore how these forces affect a substance's boiling point.

Run Activity »

Solubility

Have you ever wondered why oil and water don't mix? Discover why some substances dissolve in water while others do not.

Run Activity »

Intermolecular Attractions and Boiling Point

All molecules attract to each other.

The model shows a drop of a polar liquid and a drop of a non-polar liquid. By heating these liquids, you can vaporize (boil) them, causing molecules to break free of their intermolecular attractions.

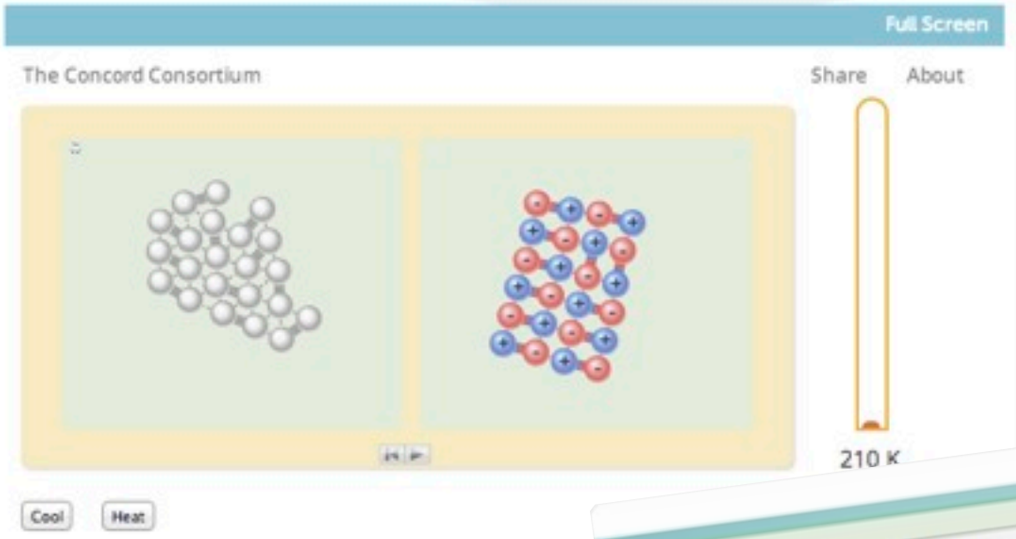
Which liquid boiled first?

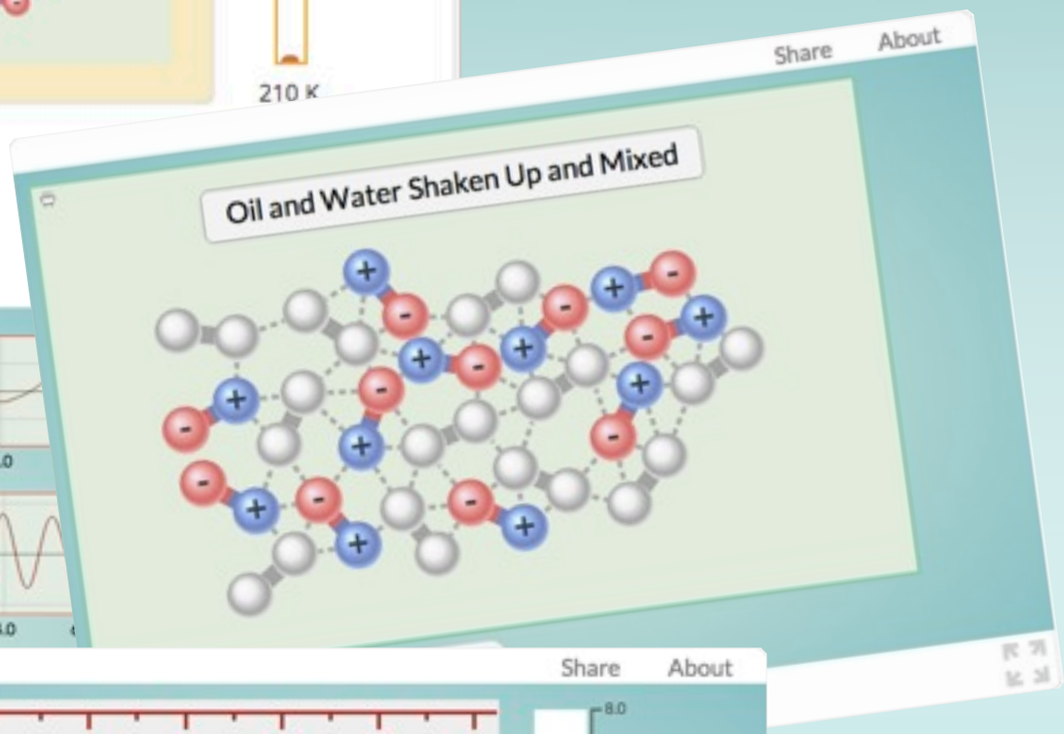
- polar
- non-polar

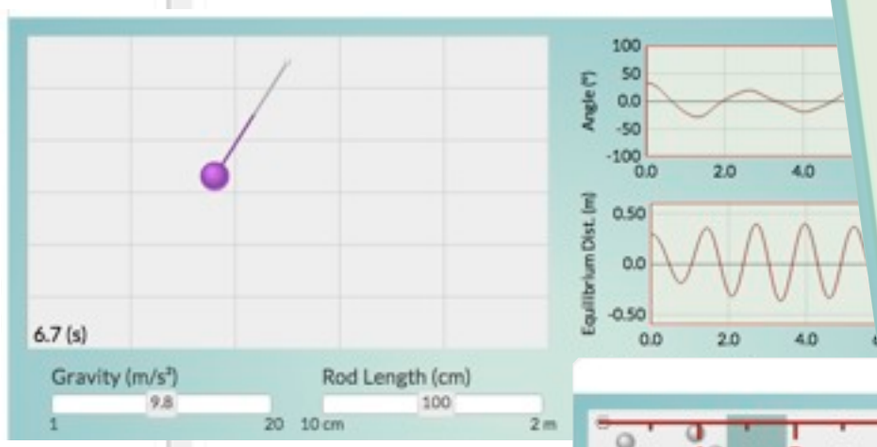
Check Answer

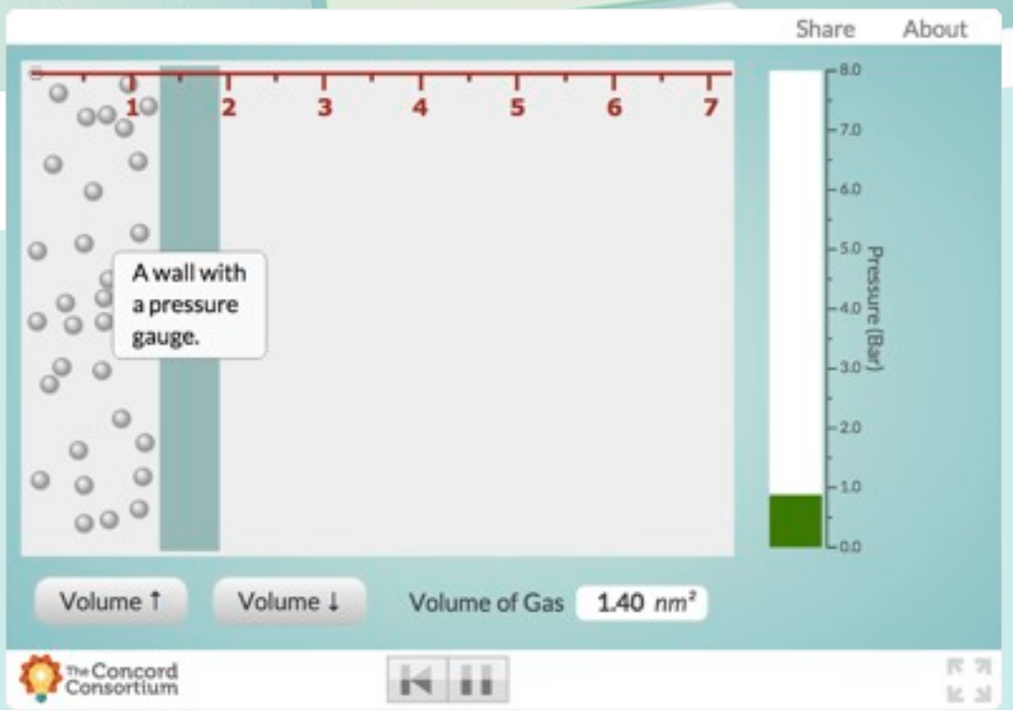
How could you tell when the liquids boiled?

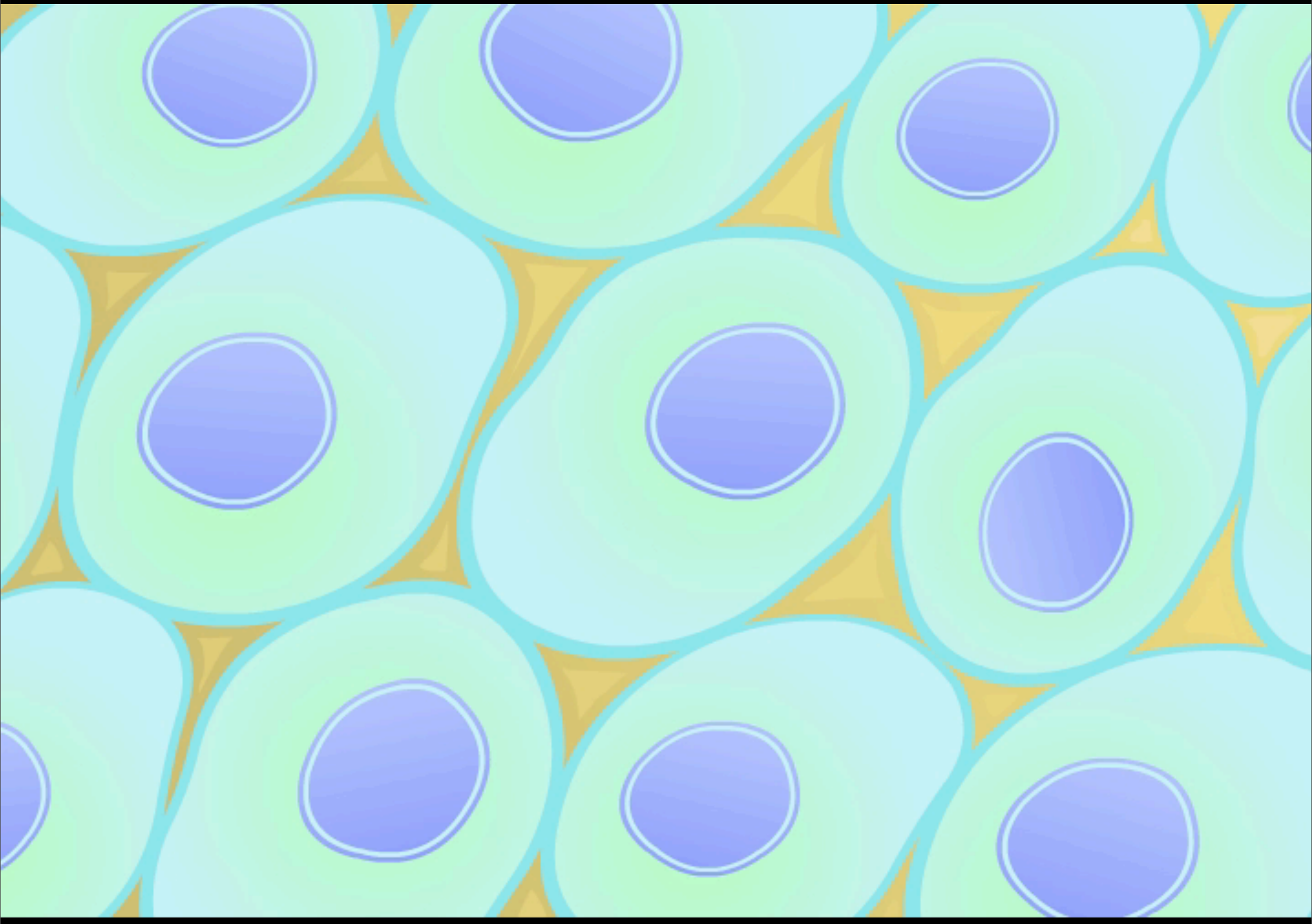
Rubbing alcohol is less polar t
Both are liquids at room temp
Which one boils first? Why?



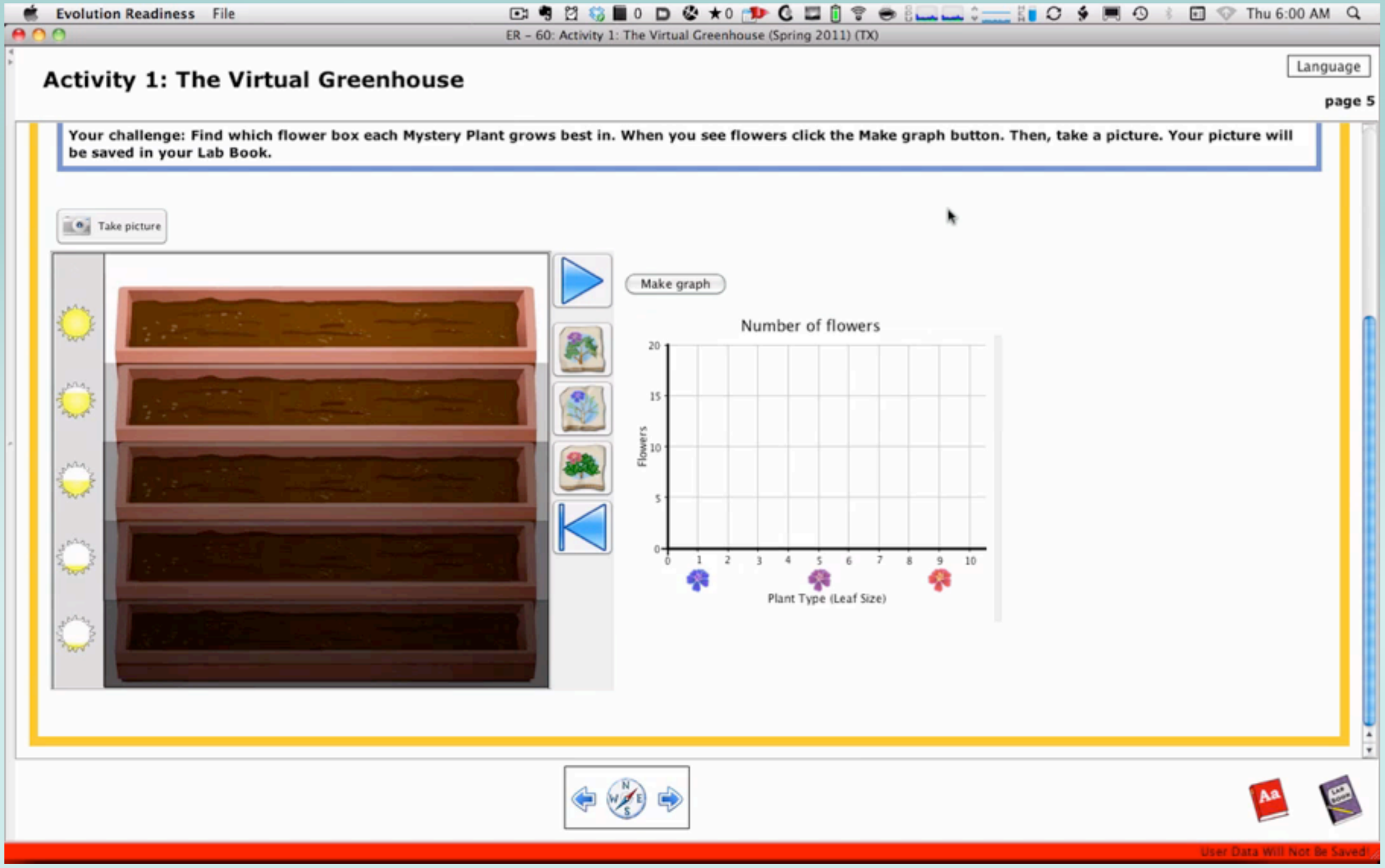






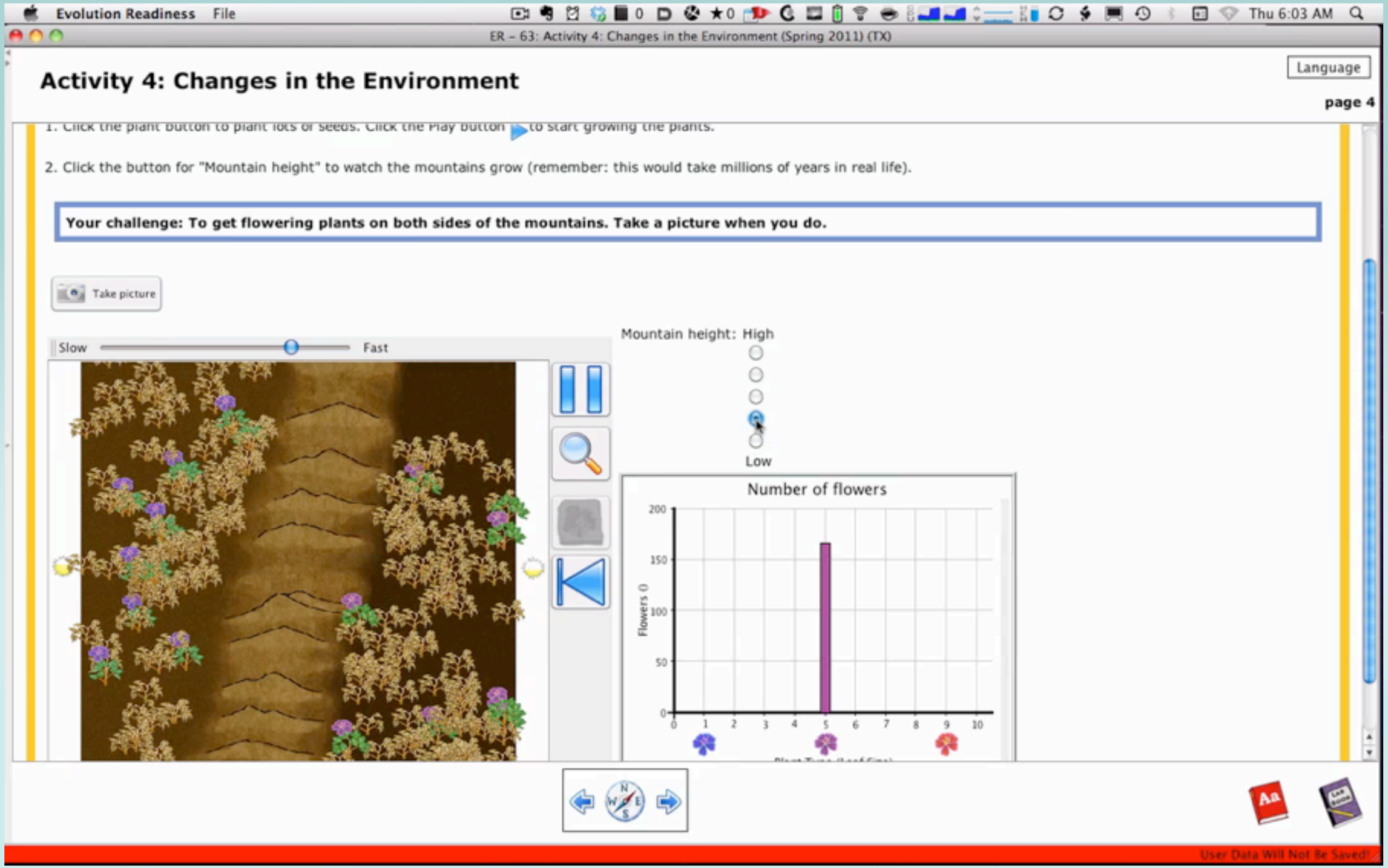


Students should be able to



Use simulations as a tool for understanding and investigating aspects of a system

Students should be able to

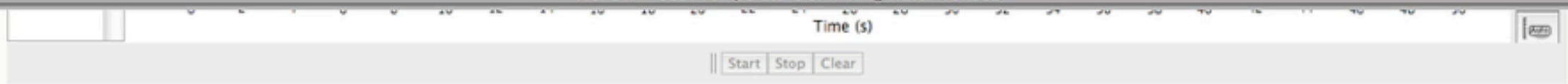


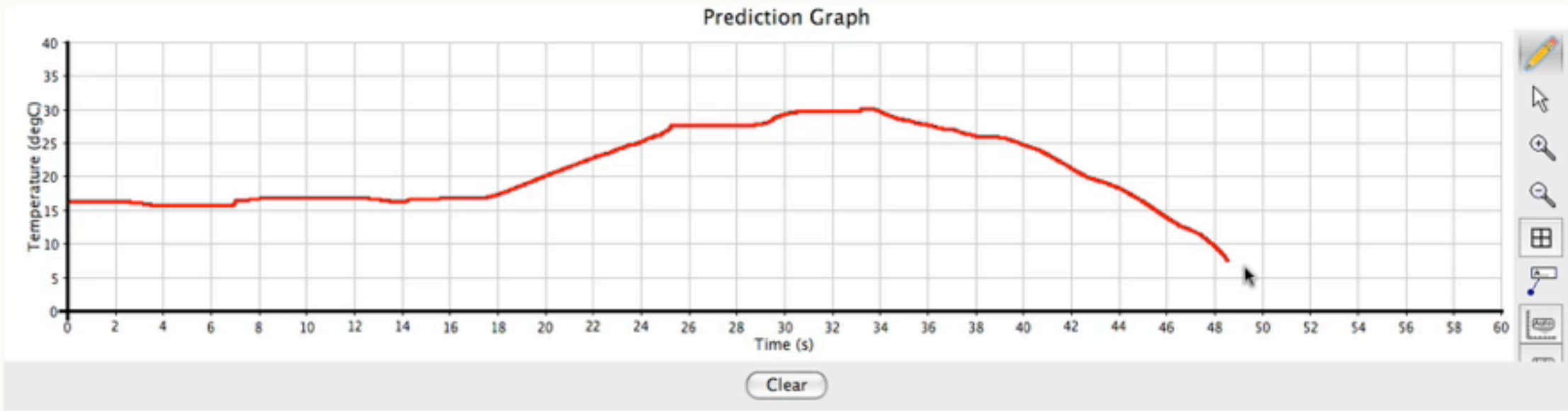
Use simulations as a tool for understanding and investigating aspects of a system

Planning & Carrying Out Investigations

Planning and Carrying Out Investigations

- Scientists and engineers explore the world in part to test theories and explanations
- Testing explanatory models requires planned investigation
- Investigations must identify the relevant variables and consider how they might be observed, measured and controlled
- Planning for controls is an important part of the design of investigations





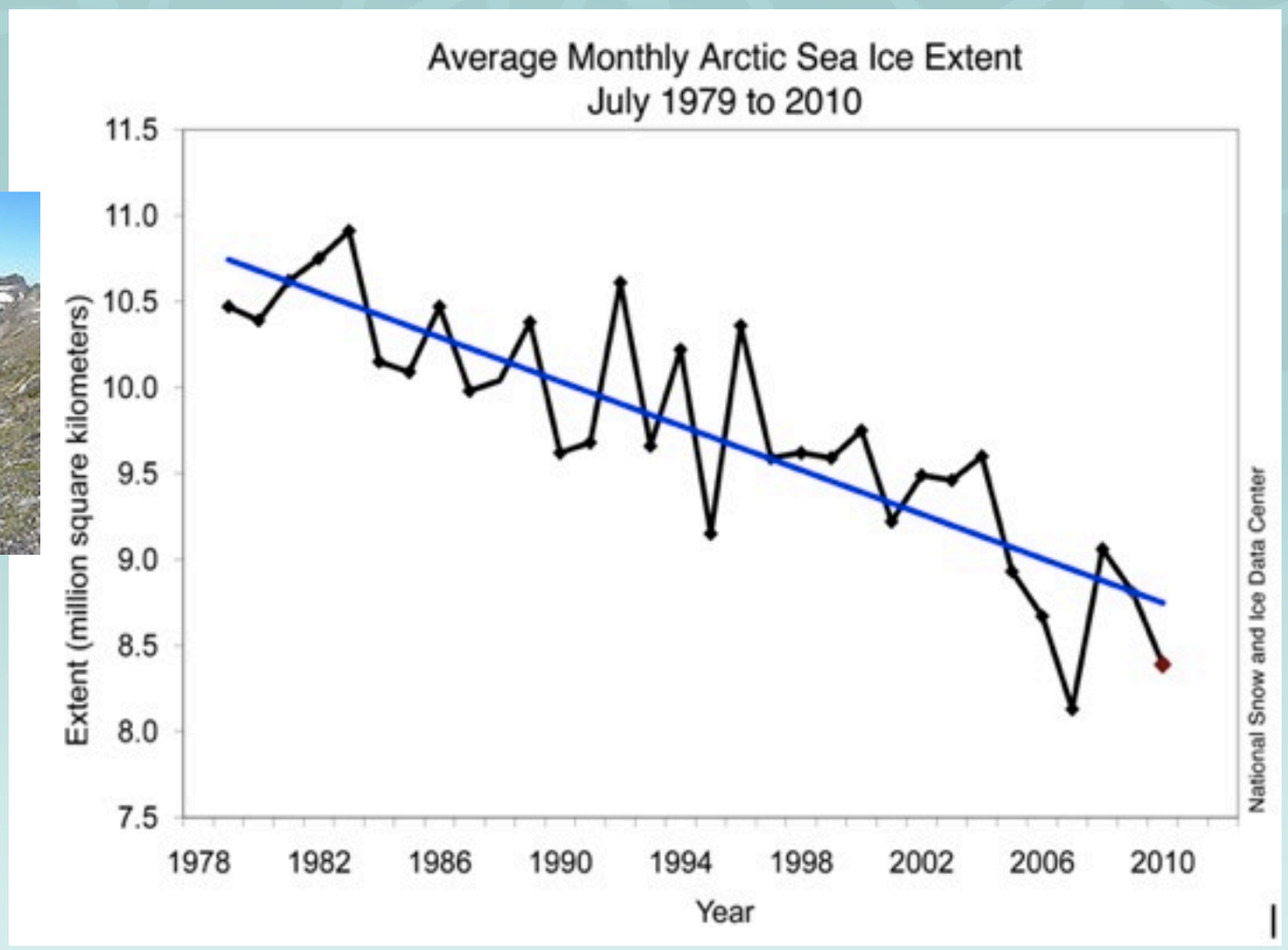
4. Test your prediction:

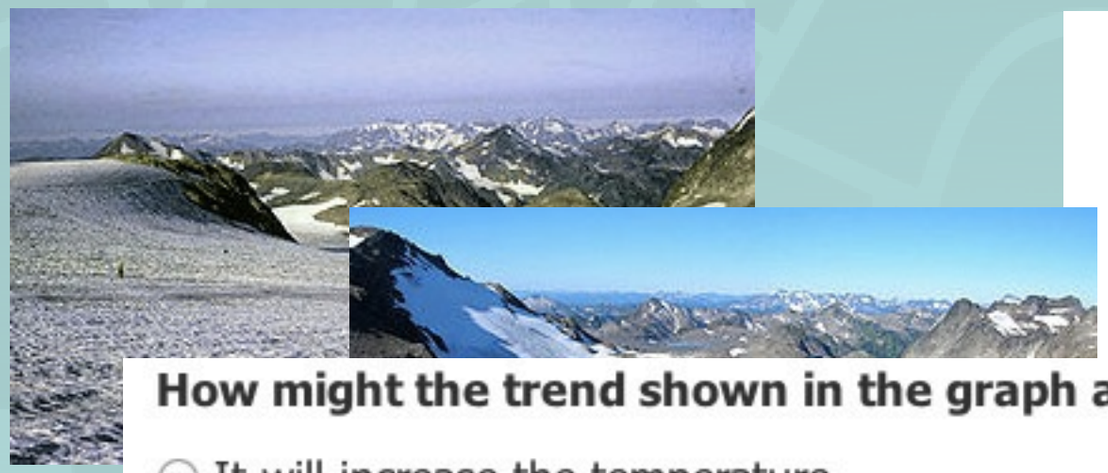
a. Measure the cold water for 10 seconds.
b. Measure the warm water for 10 seconds.
c. Pour the small cup of water into the large cup. Measure and record the temperature of the mixture.

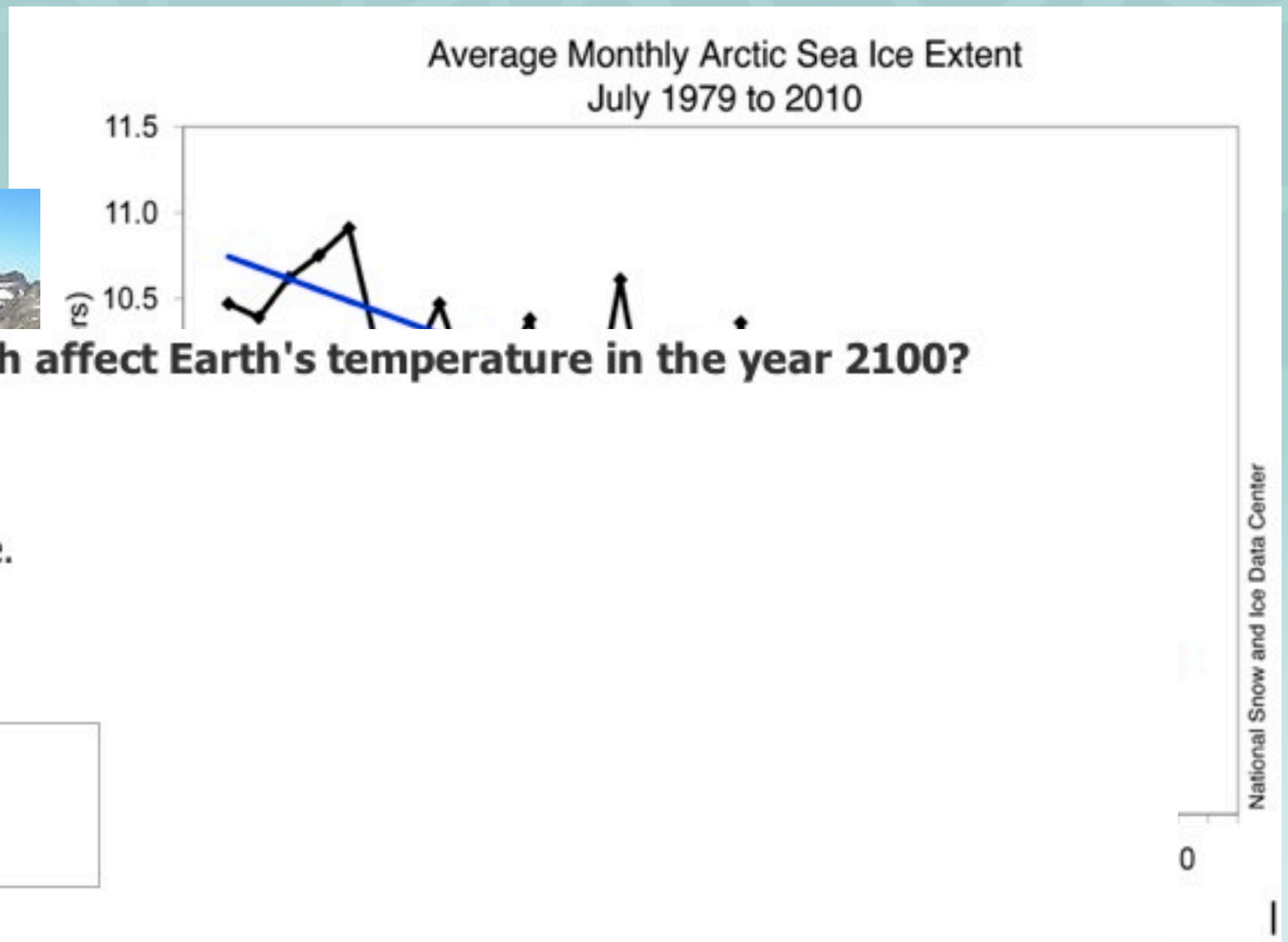
Constructing Explanations

Constructing Explanations

- Scientific explanations are accounts that link scientific theory with specific observations or phenomena
- Scientists achieve their own understanding by building theories and theory-based explanations
- Constructing explanations is thus an essential step in building student understanding


Average Monthly Arctic Sea Ice Extent
July 1979 to 2010
Extent (million square kilometers)
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
1978
1982
1986
1990
1994
1998
2002
2006
2010
Year
National Snow and Ice Data Center





How might the trend shown in the graph affect Earth's temperature in the year 2100?

- It will increase the temperature.
- It will decrease the temperature.
- There will be no effect on the temperature.

Explain your prediction.

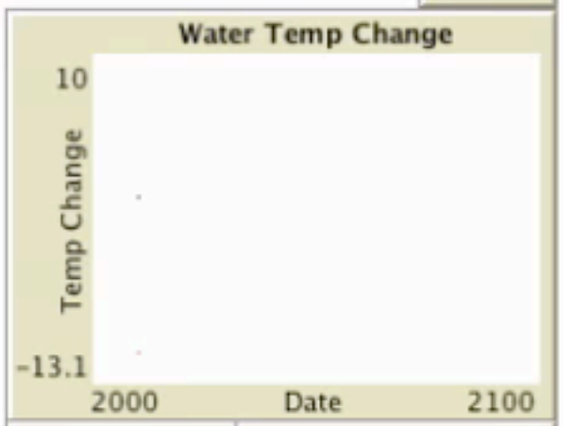
On a scale from 1 to 5, how certain are you about your temperature prediction for the future?

- (1) Not at all certain
- (2)
- (3)
- (4)
- (5) Very certain

Explain what affects your level of certainty about your prediction for temperature change.

Reset | Run/Pause | Date 2010

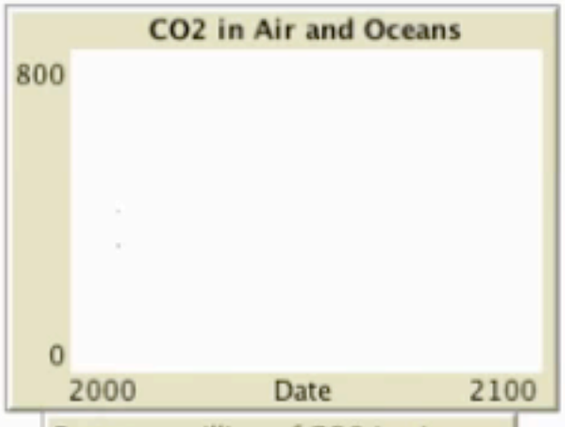
Temperature 12 deg C | On Off Slow-down | On Off Show-only-10% | On Off Hide-heat | Remove 10% of CO2 | Add 10% More CO2



Temp rise: -11

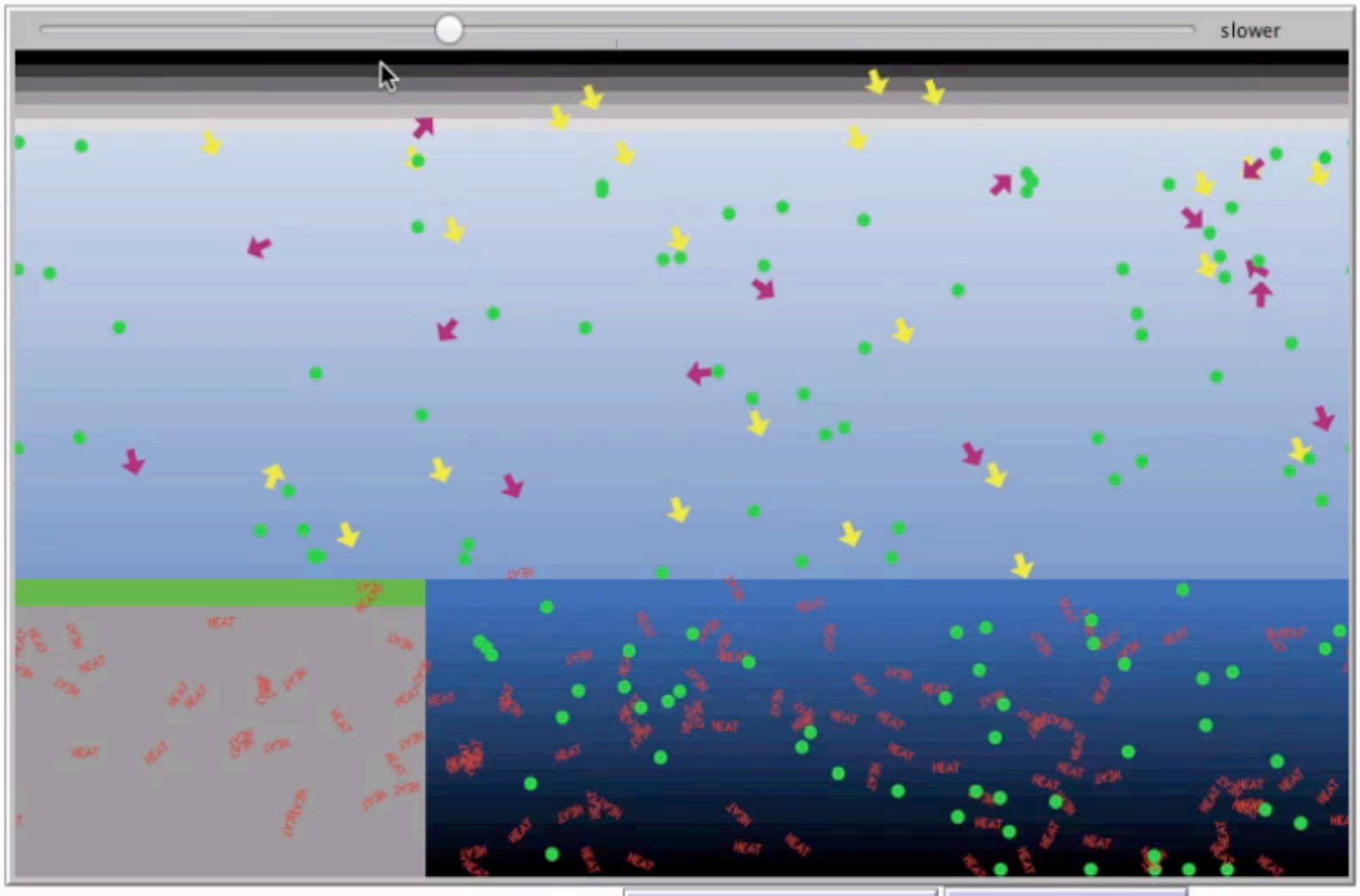
Amount of WV in air: 0

Red is temperature change from the starting temperature.



Parts per million of CO2 in air: 420

Green is CO2 in air (in ppm)
Blue is CO2 in oceans



Follow an energy packet | Hide current gases

Follow a greenhouse gas | Hide current rays

powered by NetLogo

Reset | Run/Pause | Date 2014

%-Ice-cover 30 % | Ice-albedo 0.95 | On Off Show-only-10% | Remove 10% of CO2 | Erupt!

normal speed

Temp Change

10 / Temp Change / -10 / 2000 / Date / 2100

Temp change 1.3 | Amount of WV in air 65

Red is temperature rise from the starting temperature. Blue indicates the amount of water vapor in the air

CO2 in Air and Oceans

1000 / 0 / 2000 / Date / 2100

Parts per million of CO2 in air 210

Green is CO2 in air (in ppm)
Blue is CO2 in oceans

% Ice Cover

100 / 0 / 2000 / Date / 2100

Follow an energy packet | Follow a greenhouse gas | Hide current gases | Hide current rays | On Off Hide-heat

powered by NetLogo

Reset | Run/Pause | Run 10 years

Date: 2010

Human-emission: -50 %

% different from 2010 levels

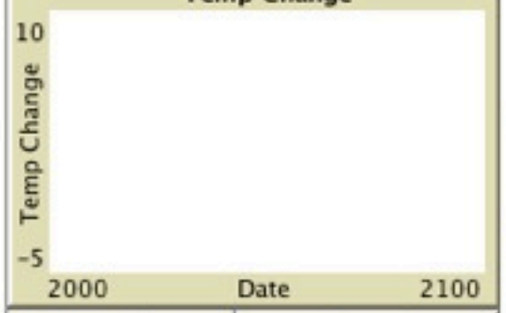
On Off Hide-heat

On Off Show-only-10%

Remove 10% of CO2

Add 10% More CO2

Temp Change

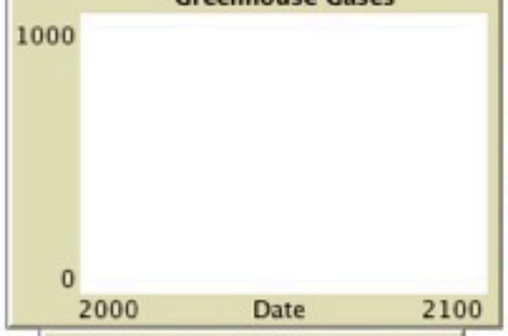


Air Temp Change	Ocean Temp Change
0	0

Red is the air temperature change.
Blue is the ocean temperature change.

Starting-Temperature: 13 °C

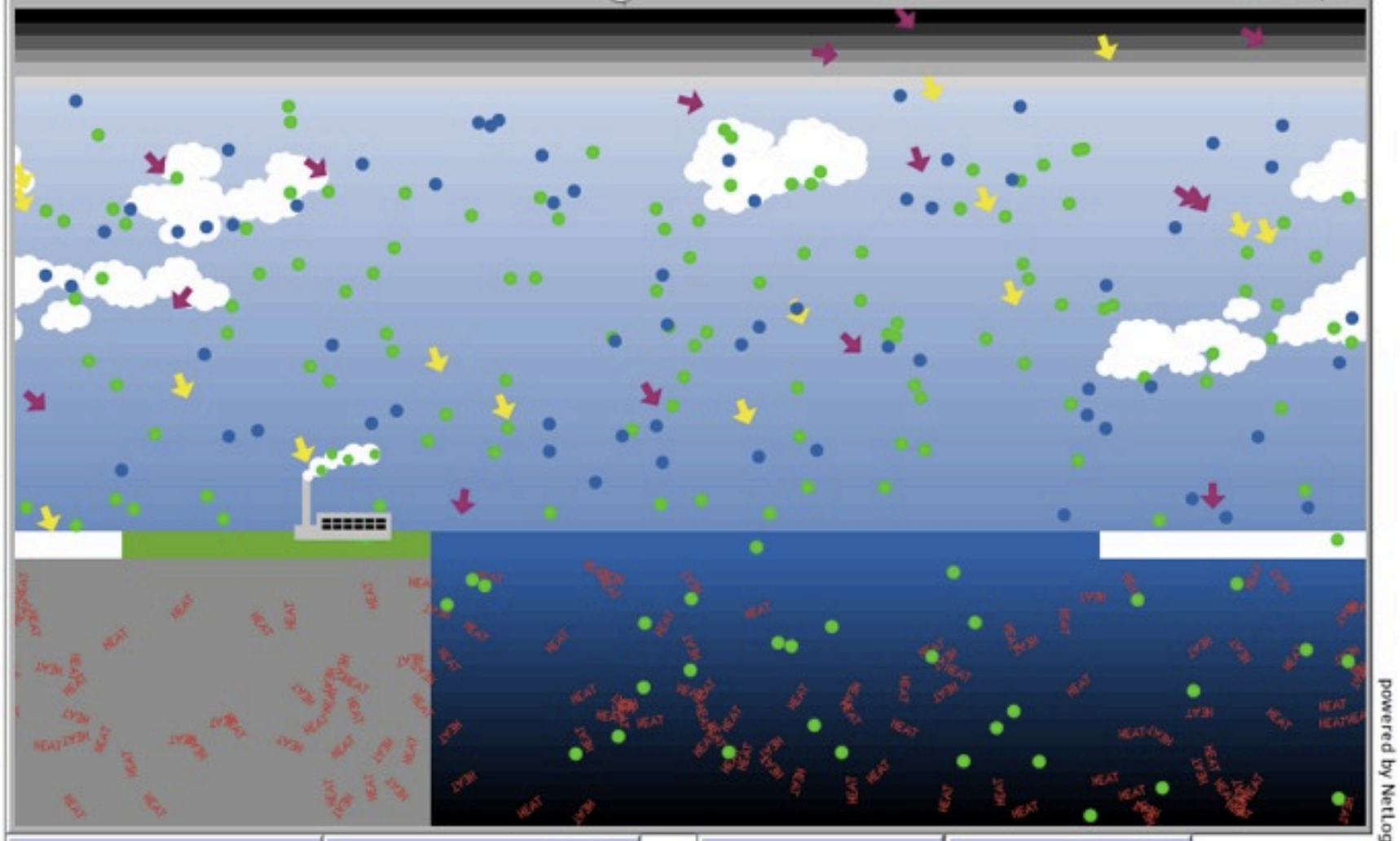
Greenhouse Gases



Parts per million of CO2 in air: 393

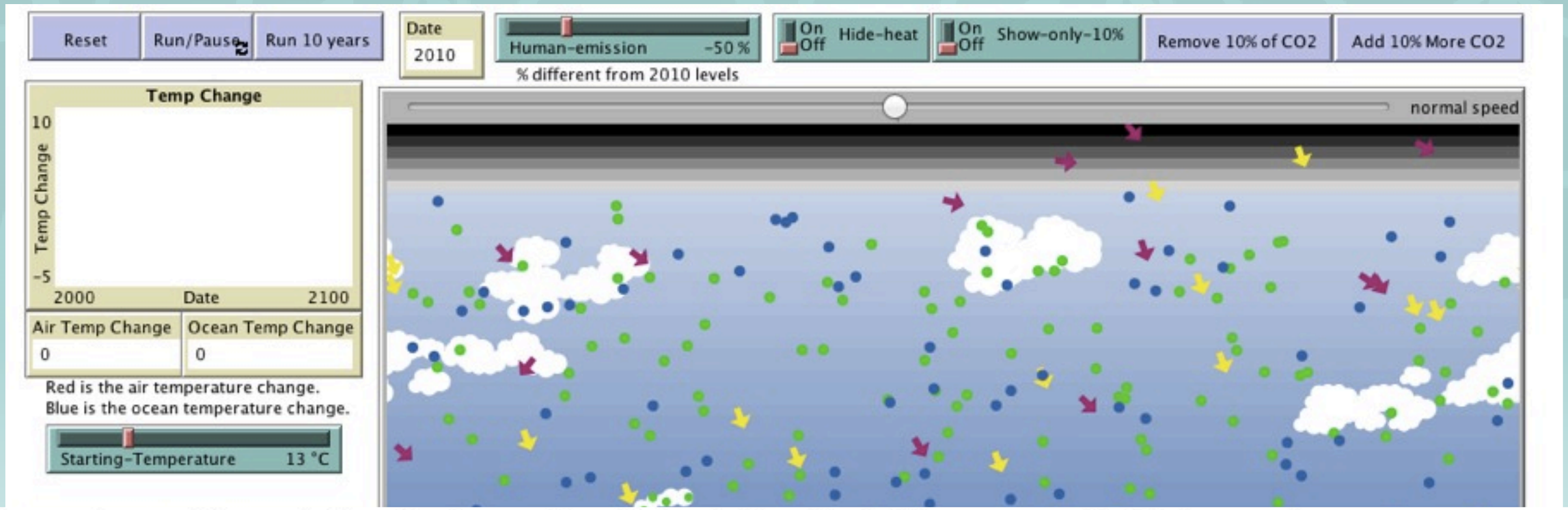
Green is CO2 in air (in ppm)
Blue is water vapor in air

normal speed



Follow an energy packet | Follow a greenhouse gas | Hide current gases | Hide current rays

powered by NetLogo

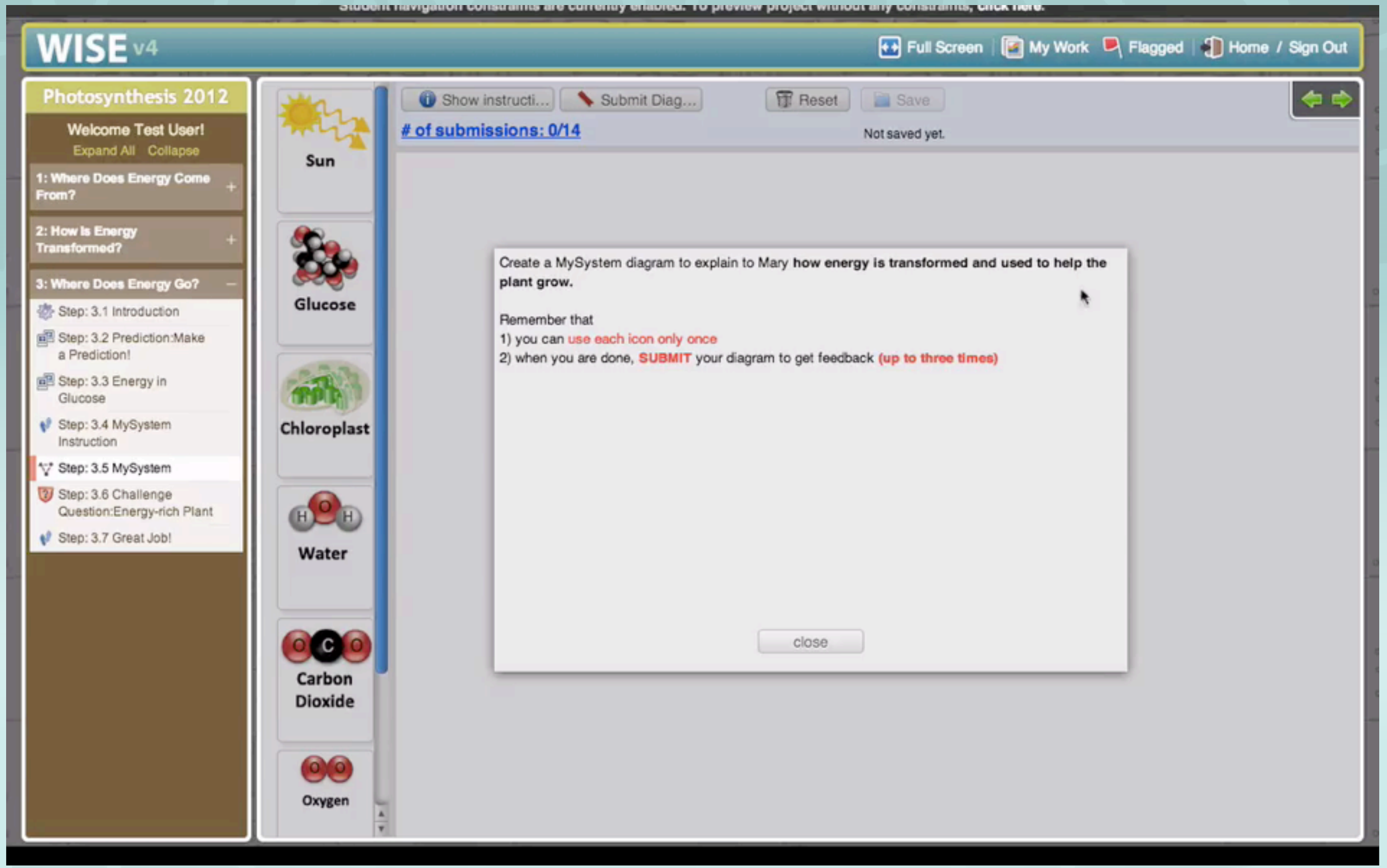


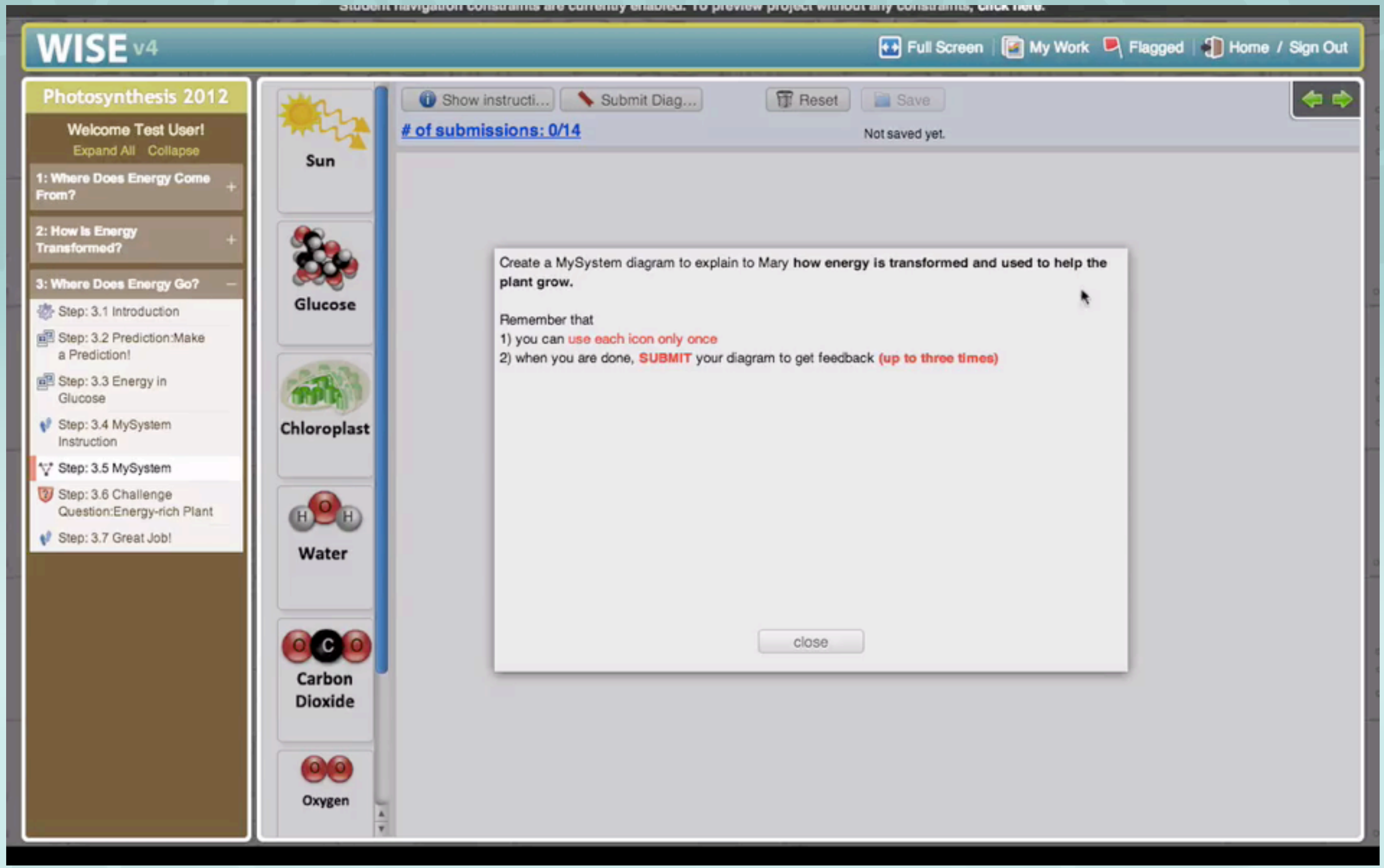
The most urgent issue facing climate modelers today is the effect of humans on Earth's temperature.

Run the model and adjust the "Human-emission" slider to determine how much humans would need to change their CO_2 emissions (as compared to 2010 emissions) to significantly reduce global temperature.

How much did you need to change human emissions to reduce the average global temperature?

Explain your conclusion by describing the experiments that you have run and their outcomes.


WISE v4
Full Screen
My Work
Flagged
Home / Sign Out
Photosynthesis 2012
Welcome Test User!
Expand All
Collapse
1: Where Does Energy Come From?
2: How Is Energy Transformed?
3: Where Does Energy Go?
Step: 3.1 Introduction
Step: 3.2 Prediction:Make a Prediction!
Step: 3.3 Energy in Glucose
Step: 3.4 MySystem Instruction
Step: 3.5 MySystem
Step: 3.6 Challenge Question:Energy-rich Plant
Step: 3.7 Great Job!
Sun
Glucose
Chloroplast
Water
Carbon Dioxide
Oxygen
Show instructi...
Submit Diag...
Reset
Save
# of submissions: 0/14
Not saved yet.
Create a MySystem diagram to explain to Mary how energy is transformed and used to help the plant grow.
Remember that
1) you can use each icon only once
2) when you are done, SUBMIT your diagram to get feedback (up to three times)
close



Knowledge Integration guidance vs. specific guidance given: $t(53) = 2.41$, $p < .05$, $d=0.65$

82% of students in the knowledge integration condition, compared to 55.6% of students in the specific guidance condition successfully improved diagrams.

14.8% of students in the specific condition added incorrect ideas after receiving guidance

Engaging in Argument from Evidence

Arguing from Evidence

- Science is replete with arguments that take place both informally and formally.
- Historical case studies show how new ideas are often difficult to accept and have to be argued for.
- The knowledge and ability to detect "bad science" are requirements both for the scientist and the citizen.
- Students should be able to understand and construct arguments, identify flaws, and improve their arguments

Office

Welcome to Geniverse, John

Member #1, Group #1 edit

Gene to Protein Genie

Case Log

Journal of Drake Genetics

Overview
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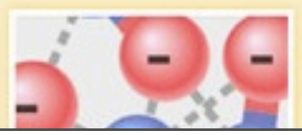
SmartGraphs Contest

Create a math, science or social science activity for our SmartGraphs software and you could win an iPod, $100 Amazon gift card and have your activity featured on our website! Graphs are everywhere in STEM classrooms, but understanding them is another matter. Free SmartGraphs activities provide interactive hints and scaffolding for students as they learn. We're excited to see what kinds of activities you create using our new authoring system. Learn more »

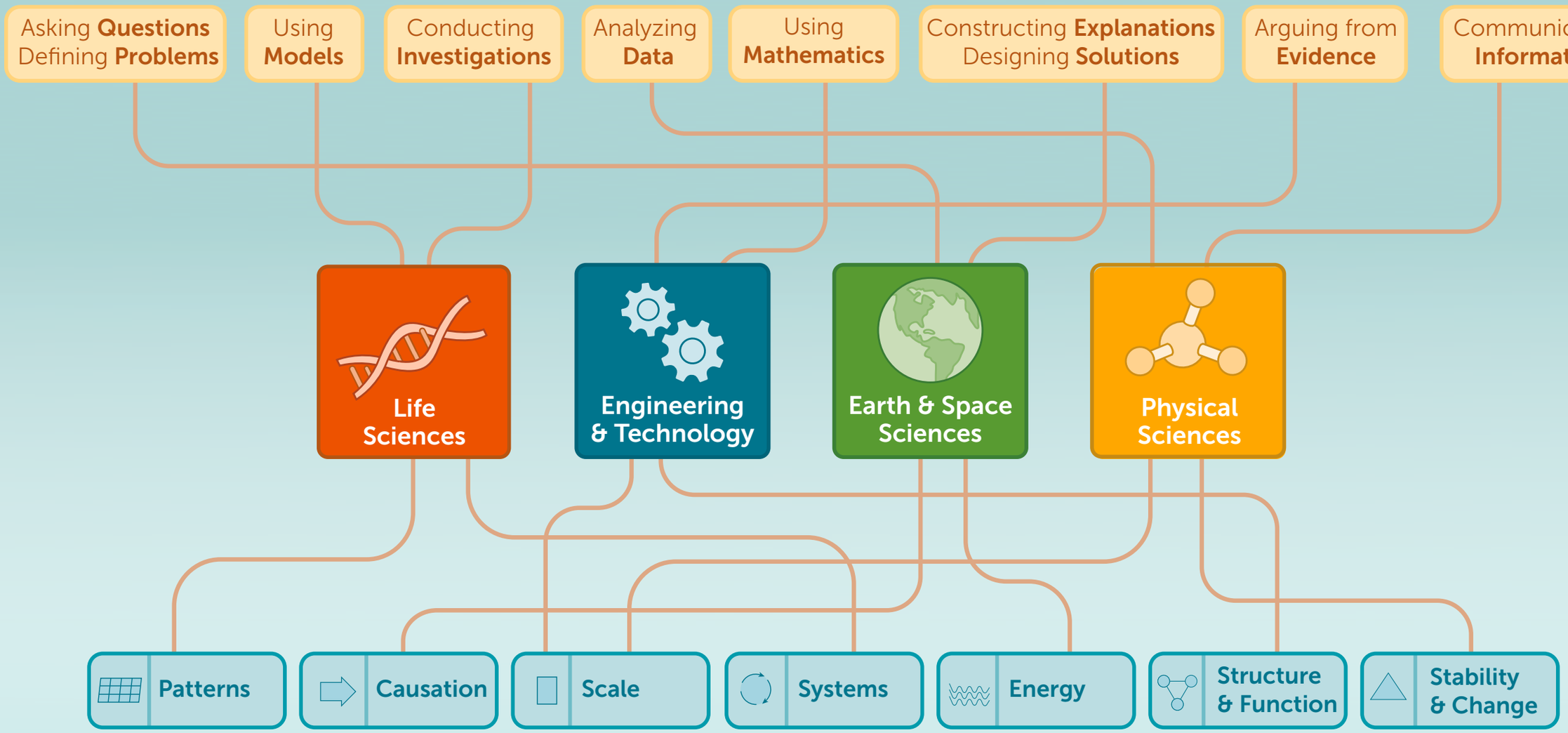


Molecular Workbench Co-Design Workshop

Have you dreamed up molecular

HTML


Google



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LASTBAG

The Concord Consortium

Thanks to our many collaborators, including: Parkland College, NANO-LINK, BIO-LINK, MATEC, OP-TEC, Center for Engineering Education and Outreach at Tufts University, the Boston Museum of Science, Purdue University, Hofstra University, Boston College, BSCS, MMSA, University of California, Berkeley, University of Toronto, and, of course, the National Science Foundation.

This material is based upon work supported by the National Science Foundation under Grant Nos. DRL-0822213, DRL-0733264, DRL-0929540, DRL-0918449, DRL-0733299, and DRL-0946582. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

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