WISE and WISEngineering Connections Between NGSS Content and Practices

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• Provide technology-enhanced 3D NGSS curricular resources to help connect practices with content
• Combine curricula, assessment, teacher tools
• Engineering DCIs and practices

Can we enhance our curriculum with cyberlearning resources?  YES
Design Challenge

• Create a school garden
• Must grow some edible plants and be student maintained
• Total space = 20’ x 20’
• Total budget = $400
• Total time = 2 weeks

What would your next steps be?
NGSS Practices

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information
WISE: Web-based Inquiry Science Environment: https://wise.berkeley.edu
Supporting NGSS practices

Features to support NGSS DCI’s and CC’s

Inquiry

Map

Embedded Simulations
Features to support NGSS DCI’s and CC’s

Automatic feedback
Features to support NGSS DCI’s and CC’s

**CHALLENGE QUESTION**

**QUESTION**
Which of the following can happen to sunlight energy when it hits the earth's surface?

Check all that are true.

**ANSWERS**
- Reflected as Infrared radiation
- Transforms to heat energy
- Reflected as sunlight

Incorrect. Please revisit the model.

Incorrect. Please revisit the model.
Supporting NGSS practices

Asking questions

**Questionnaire**

1. Which do you think will be more useful in analyzing a crash, the POSITION–TIME graph or the VELOCITY–TIME graph? Explain.

2. Why do you think shorter drivers are more at risk for harm from an airbag than taller drivers?

3. Is a driver more likely to be harmed by an airbag in a high speed or low speed collision? Explain.

4. How do you think a car’s ability to crumple affects a driver’s risk for harm from an airbag?
Supporting NGSS practices

Developing and using models
Supporting NGSS practices

Planning and Carrying out Investigations

Let's explore how the amount of light energy affects the amount of glucose produced.
1. Click on "FULL SCREEN" above.
2. Scroll down and enter your predictions about how much glucose the chloroplast would produce in each condition (none, small, medium or large).
3. Test your predictions and record your observations.
Supporting NGSS practices

Analyzing and Interpreting Data

Graphing Stories (without motion probes)

Match & Sequence

Event 1: The girls leave their lunch spot at 3:00 and meet the bear 20 minutes later.

Event 2: The girls sprint back to the lunch spot after seeing the bear and then wait there for ten minutes.

Event 3: The girls creep slowly back to where they saw the bear.
Supporting NGSS practices

Constructing Explanations

WISE v4

Chemical Reactions: How Can We Slow Climate Change?

1. What Causes Climate Change?
2. Greenhouse Investigation
   2.1: What is the Greenhouse Effect?
   2.2: Understanding the Greenhouse Model
   2.3: Greenhouse Model
   2.4: Check Your Understanding
   2.5: The Energy Balance
   2.6: Add New Evidence to Your Basket
   2.7: Predict the Effect of Adding CO₂?
   2.8: Add Gases to the Model
   2.9: Check Your Understanding
   2.10: What is the Effect of CO₂?
   2.11: Draw the Greenhouse Effect

Based on the model, add some evidence to your basket about how energy from the sun warms the earth.

Idea Basket

<table>
<thead>
<tr>
<th>Idea</th>
<th>Source</th>
<th>Icon</th>
<th>Delete</th>
</tr>
</thead>
<tbody>
<tr>
<td>This is great</td>
<td>Everyday Observation</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Energy in = energy out</td>
<td>Visualization or Model</td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

Trash (0) (Click to show)
Supporting NGSS practices

Constructing Explanations

Look over your ideas. Which of them do you think you can use to explain why seasons happen? Drag and organize your ideas using the space below.

<table>
<thead>
<tr>
<th>Your Ideas</th>
<th>Flag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth is tilted on its axis</td>
<td>🟢</td>
</tr>
<tr>
<td>Planets move around the sun</td>
<td></td>
</tr>
</tbody>
</table>

HELPFUL

- Earth is tilted on its axis

NOT HELPFUL

NOT SURE

- Planets move around the sun

How did you decide whether an idea would be helpful or not helpful to use?

ADD NEW IDEA +

SAVE
Engaging in argument from evidence
Obtaining, evaluating, communicating
Teacher Supports

- Student Monitors/progress
- Automatic scoring of student work
Features to support teachers

- Scoring of student work
- Feedback/displaying student work
• Authoring and research tools
• Defining problems, designing solutions?

• NGSS means also teaching engineering!
www.wisengineering.org
Supporting Engineering Design

**Design Challenge**

We all use electricity at home, at school, and elsewhere. Electric power stations transform various kinds of energy into electricity. There are many different kinds of power stations (click on the pictures to learn more).

Your challenge is to design a water-driven electric generator that converts mechanical energy to electrical energy given the materials provided to you.

Project goals are to: (1) Output the largest amount of electricity, as measured by average maximum voltage. (2) Demonstrate your model and describe how it works, paying special attention to energy transformations. Your generator must be water-powered.

You will be provided with an electric motor and some materials to construct your generator in class. You have up to one and a half class periods to complete the challenge.
Defining problems

Specifications and Constraints

To design a solution to our challenge, we need to know the specifications and constraints.

Specifications are what your solution must do. They are the requirements.

Constraints are things that limit your solution. For example, a constraint may be how much you can spend or how much time you have to complete the challenge.

Where are the specifications and constraints for this challenge?

Hint: You may need to go back to the Introduction.

1. List all the specifications:

   The specifications of this challenge are...

2. List all the constraints:

   The constraints of this challenge are...

Submit the Questionnaire
Developing and using models
Using mathematics and computational thinking

Dance Party!

Everything from cell phones, videogames, and even your electricity depends on software engineering. **Software Engineers** make a difference by designing programs that tell computers what to do, resulting in videogames, cell phones, and even how power gets to your house or school.

**Your challenge** is to work as a software engineer and make a program for a dance party. You are given an environment called Scratch. Your program needs:
- Have one dancer do at least two dance moves
- Play two different instruments as part of your program
- Have your dancer say something by pressing a button

The design cycle is shown on the left side of the page.
Planning and carrying out investigations

You will be testing four different potato chips: Chips A, B, C, and D. It is essential to make sure that the chips are about the same size when testing for each quality. When comparing different chips, you want to make sure the test is "fair".

You will be ranking these chips from 1 to 4 (1 = the worst, 2 = a little better, 3 = pretty good, 4 = the best) based upon your preference. Each chip must be ranked a different number.

You will test all four potato chips for one quality, before moving to the next quality.
Designing solutions
Engaging in argument from evidence

Community Garden Design Challenge

A local company has just agreed to donate some of its field area to design a community garden. The company is looking for young engineers and mathematicians who can help design the garden. Students at your school, as well as 50 others, have been selected to submit a potential design.

Your challenge is to design a model of the garden using 3D pop-ups to represent the vegetables. The company is looking for a design that will produce the greatest amount of vegetables at the lowest cost to feed those in need in the community.

Your model must be a 3D, pop-up model, must be no larger than 5400 square cm. There must be at least 20 plants and no more than 32 plants in the garden, and must contain corn, tomatoes, squash, zucchini and carrots. Your budget is $50 from the Community Garden fund to purchase the plants, and you have 6 class periods to complete the challenge.
• Currently have Common Core mathematics (TEM), NGSS Science units (STE), Informal activities with tablet computers
• Working on integrating math and science in schools
• Engineering is applying science to real-world problems – science teachers already do this well
• Potentially very motivating for students
• Difficult to assess, implement
Thank you!
WISE and WISEngineering teachers
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