Teachers of Science are Agents of Change

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Michigan Science Teachers Association Conference
Lansing, Michigan
March 6, 2020
This work is supported in part by the Towsley Endowment for Science and Math Teachers and a grant from the USDA National Institute of Food and Agriculture (2015-68007-23133).

Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the Towsley Foundation or the United States Department of Agriculture.
Imagine we are each a bacterium living in a bottle.

The bacteria double in number every minute.

If there’s one bacterium in the bottle at 11:00 a.m. and then the bottle is full at 12:00 noon, at what time was the bottle half full?

*In a fast-changing world we all have to be agents of change*
In a fast-changing world
when do you realize you have to be an agent of change?

If you were a bacterium
at what time would you
realize there’s a problem?

At 12 noon the bottle is full
One minute before it’s ½ full
Two minutes before it’s ¼ full
Then 1/8 and 1/16 full
At five minutes before noon
the bottle’s only 3% full
The times they are a changin' in only 40 years.
I. Per capita CO₂ emissions (tonnes CO₂ equivalent/yr)

+2.15%/10 yr


4.6  4.4  4.2  4.0  3.8

d. Surface temperature change (°C)

+0.183 °C/10 yr

0.25  0.50  0.75  1.00

0.50  0.75  1.00

Imagine an apple represents Earth. How much of the apple represents land we have for growing food?

Let’s do it! – Activity Handout
Earth’s surface for growing food

There is no Planet B
Design your students’ future world
WHAT TO KNOW
WHAT TO DO
HOW TO SEE

Using 3D Science Learning
**Performance Expectation:** Students who demonstrate understanding can communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment. (K-ESS3-3)

<table>
<thead>
<tr>
<th>Core Idea</th>
<th>Practice</th>
<th>Crosscutting Concept</th>
</tr>
</thead>
<tbody>
<tr>
<td>Things that people do to live comfortably can impact the world around them.</td>
<td>Communicate knowledge and solutions (orally, in drawings)</td>
<td>Cause and effect</td>
</tr>
<tr>
<td>But people can make choices that reduce their impacts on the land, water, air, or other living things.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Performance Expectation:** Students who demonstrate understanding can apply scientific methods to design a method for monitoring and minimizing a human impact on the environment. *(MS-ESS3-3)*

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<th><strong>Core Idea</strong></th>
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<tr>
<td>Typically as human populations and pre-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities &amp; technologies involved are engineered otherwise.</td>
<td>Constructing explanations and designing solutions</td>
<td>Cause and effect</td>
</tr>
</tbody>
</table>
Choose a fruit:
- Banana
- Applesauce
- Orange
- Apples
- Berries

Choose a grain:
- Tortilla chips
- Bun
- Pita bread
- Pita chips
- Bread

Choose a dairy:
- Ice cream
- Cheese stick
- Sour cream
- Milk
- Yogurt

Choose a vegetable:
- Carrots
- French fries
- Green salad
- Peppers
- Potato chips

Choose a protein:
- Hummus
- Mexican Chicken
- Cheeseburger
- Egg Salad
- Pulled Pork

Our food choices impact the environment.

U.S.D.A. My Plate

Let’s do it!
Activity
Handout
Carbon Footprints of Protein Choices

- Cheese burger
- Pulled Pork
- Mexican Chicken
- Egg Salad
- Hummus
Water Footprints of Protein Choices

- Cheese-burger
- Pulled Pork
- Mexican Chicken
- Egg Salad
- Hummus
Water Footprints of Grains
Our actions impact the environment.
We can make different decisions to lessen our environmental impacts.
We can make different decisions to lessen our environmental impacts. . . . . . but how to know what to do?

Use principle-based decision-making!

<table>
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<tr>
<th>It takes energy to change matter.</th>
<th>It often takes water to change matter.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The more changes, the more energy involved.</td>
<td>The more changes, the more water involved.</td>
</tr>
<tr>
<td>The energy to change matter usually comes burning fossil fuels.</td>
<td></td>
</tr>
<tr>
<td>The more fossil fuels burned, the more $\text{CO}_2$ that gets made &amp; emitted to the air.</td>
<td>The more water used, the more substances added to the water.</td>
</tr>
<tr>
<td>The more $\text{CO}_2$ in the air, the longer thermal energy stays in the air.</td>
<td></td>
</tr>
</tbody>
</table>
No can do

Feeling powerless?

Feeling empowered!

KNOW CARE DO
We grew greens.
We grew protein.
We grew grain.
Planting Crop Circles For Healthy Plates
We grew a Mexican-style Healthy Plate = Healthy Planet lunch.
We can use less water IF we keep the water we have in the soil where the plant roots are.

Compost (= decomposing plant parts) mixed IN the soil holds on to water so it doesn’t get pulled down too far.

Mulch (= grass clippings) lying ON top of the soil holds on to water so it doesn’t move to the air.
Effect of Compost and Mulch on Added Water and Mass of Food

**Added Water (ml)**

- Nothing
- Compost
- Mulch
- Both

**Edible Mass (g) of Sugar Peas**

- Nothing
- Compost
- Mulch
- Both
Nick

Milk
Egg
Bacon
Bread (Wheat)
Corn
Corn
Apple
Chicken
Beef Burger
Cheese (Cow)
Potato
Bun (Wheat)

Food Web of a Person’s Daily Food Intake
**Green Outline** = Land to grow beans for one bean burrito lunch/week for one year.

**Blue Outline** = Land to grow corn to feed chickens for one chicken burrito lunch/week for one year.

**Red Outline** = Land to grow corn to feed cattle for one beef burrito lunch/week for one year.
**Place-Based approach with place = person**

Maddie’s Daily Carbon Footprint

Pounds of CO2/day

<table>
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<tr>
<th>Current</th>
<th>Reduced</th>
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<tbody>
<tr>
<td>Electrical</td>
<td>Food</td>
</tr>
<tr>
<td>Heating</td>
<td>Food</td>
</tr>
<tr>
<td>Transportation</td>
<td>Food</td>
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Switched from a high meat diet to a low meat diet

Now carpool with one person
Which science practices?

Ask questions and define problems
Develop and use models
Plan and carry out investigations
Analyze and interpret data
Use math and computational thinking
Construct explanations & design solutions
Engage in argument from evidence
Obtain, evaluate, and communicate information

Which crosscutting concepts?

Patterns
Cause and effect
Scale, proportion, and quantity
Systems and system models
Energy and matter in systems
Structure and function
Stability and change of systems
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3 days (9:00-3:15)
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On campus at Michigan State
Free housing (first come, first served)

Day One
Experience 3D Science Learning
You as a directed 3D science learner
Pre-Selected Topic

Day Two
Practice 3D Science Learning
You as a self-directed 3D science learner
Your Choice of Topic

Day Three
Design 3D Science Learning
You as a 3D science teacher
Your Classroom Unit

Middle & High School Teachers
Jun 26-28, 2020

Elementary & Middle School Teachers
Aug 6-8, 2020