ADVANCED MANUFACTURING AND PROTOTYPING, INTEGRATED TO UNLOCK POTENTIAL (AMP-IT-UP)

CENTER FOR EDUCATION INTEGRATING SCIENCE, MATHEMATICS AND ENGINEERING (CEISMC) AND GRIFFIN-SPALDING COUNTY SCHOOLS

Award # 1238089
AMP-IT-UP OVERVIEW

• A National Science Foundation Math and Science Partnership to promote workforce development and cultivate the next generation of creative STEM innovators.

• Partnership with the Griffin Spalding County School System
  Impact: > 11,000 students over 5 years

• Middle school STEM Innovation and Design (STEM-ID) courses that enable students to explore their creativity using robotics and rapid prototyping

• Middle school math and science modules that promote inquiry and connect with Georgia Tech
• Connect STEM-ID course themes and contexts to the science and math course learning goals and standards
• Promote inquiry and situated learning to contextualize and make relevant the science and mathematics disciplinary content
  • Science modules use data analysis to reinforce math standards
  • Math modules use science/engineering context and data to teach standards
• Modules stand separate in science and math classrooms but are connected
  • Focus on practices implemented in both courses
  • Pacing is flexible for implementation of modules
## AMP-IT-UP: SCIENCE AND MATH MODULES

<table>
<thead>
<tr>
<th>AMP Crosscutting Integrated Theme</th>
<th>Earth Science (6th Grade)</th>
<th>Life Science (7th Grade)</th>
<th>Physical Science (8th Grade)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Experimental Design</strong></td>
<td>Science</td>
<td>Molten Madness</td>
<td>Oil Spill Drill</td>
</tr>
<tr>
<td></td>
<td>Math</td>
<td>Some Assembly Required</td>
<td>It’s Game Time</td>
</tr>
<tr>
<td><strong>Data Visualization</strong></td>
<td>Science</td>
<td>Shake and Break</td>
<td>Don’t Wreck the Reef!</td>
</tr>
<tr>
<td></td>
<td>Math</td>
<td>Data Saves the Whales!</td>
<td>Aquarium Friend or Foe?</td>
</tr>
<tr>
<td><strong>Data Driven Decision Making</strong></td>
<td>Science</td>
<td>Snow Day</td>
<td>Under the Sea</td>
</tr>
<tr>
<td></td>
<td>Math</td>
<td>Sweet Machines</td>
<td>Perfecting Your Craft</td>
</tr>
</tbody>
</table>
3-D LEARNING IN AMP-IT-UP

Science and Engineering Practices

Authentic Problems

Disciplinary Core Ideas

Crosscutting Concepts
1. **Experimental Design**
   - Planning and Carrying Out Investigations (NGSS Practice 3)
   - Make Sense of Problems (SMP #1); Use Appropriate Tools Strategically (SMP #5)

2. **Data Visualization**
   - Analyzing and Interpreting Data (NGSS Practice 4)
   - Make Sense of Problems (SMP #1); Model with Mathematics (SMP #4)

3. **Data Driven Decision Making**
   - Constructing Explanations and Designing Solutions (NGSS Practice 6)
   - Engaging in Argument from Evidence (NGSS Practice 7)
   - Make Sense of Problems (SMP #1); Construct Viable Arguments (SMP #3)
Georgia Standards of Excellence and NGSS Core Content Standards are supported throughout each module.

**SUPPORTED CORE IDEAS**

**Life Science**

- Interdependent Relationships in Ecosystems
- Ecosystems: Interactions, Energy, and Dynamics
**Challenge:** Students engage as environmental engineers to assist coastal Georgia communities to develop a procedure to develop the fastest, most efficient way to remove oil after a spill.

**Time:** This module takes 4-5 days.

**Essential Questions:**
- How do scientists solve problems?
- How can consistent procedures be developed?
- What affect do changes in the environment have on organisms?

**Georgia Tech Research Connection:** ECOGIG (Ecosystem Impacts of Oil and Gas Inputs to the Gulf) research consortium.
OIL SPILL DRILL: EXPERIMENTAL DESIGN

• Focus on modeling
• Design a procedure to remove at least 20 milliliters of oil from the water in a one minute time period.
• Analyze class results using a histogram
• Redesign a consistent class procedure and complete the investigation
• Analyze the redesign
• Communicate the results
Challenge: Students assist the people of Fiji to understand what factors are degrading their reef. Students investigate a model of the food web at the coral reef to generate and then project species population data. They then take this data to help the people of Fiji decide how many fishing permits need to be allowed to keep the reef safe.

Time: This module takes 4-5 days

Essential Questions:
What affect do changes in the environment have on organisms?
How is matter transferred within the environment?
How do organisms depend on each other and on their environment for survival?
How can we communicate scientific data to the public?

Georgia Tech Research Connection: Dr. Mark Hay – Department of Biology
Students are introduced to the context and content of the challenge
Engage in a simulation modeling the food web
Analyze their data
Make decisions based on data and communicate those decisions to the public
Students represent data in multiple ways and realize that different types of visualizations allow people to extract different meaning from the evidence.

Data must be presented in a form that reveals any patterns and relationships—raw data has very little meaning.

A major practice for scientists is to organize, visualize, and interpret data (e.g., bar graph) to bring out the meaning and relevance of data, transforming it into evidence.

**Focus on NGSS:** Analyzing and Interpreting Data (NGSS Practice 4)
**Challenge:** Students analyze photos of corals to determine the effect of the Deepwater Horizon Oil Spill on Deep Sea Communities

**Time:** This module takes 4-5 days

**Essential Questions:**
What affect do changes in the environment have on organisms?
How is matter transferred within the environment?
How do I express a pattern to show a relationship

**Georgia Tech Research Connection:** ECOGIG (Ecosystem Impacts of Oil and Gas Inputs to the Gulf) research consortium
• Students are introduced to the Deepwater Horizon oil spill, the ecology of the Gulf of Mexico, and ECOGIG’s research into how the oil spill affected the ecosystem

• Students are introduced to the challenge (assisting ECOGIG with analyzing images of coral to determine the amount of damage)
### DEEP SEA CHALLENGE: EXPLORE

#### Creating a Rubric: Student Sheet #1

<table>
<thead>
<tr>
<th>Categories</th>
<th>0 (would not touch this burger)</th>
<th>1 (okay burger)</th>
<th>2 (amazing burger)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bun</td>
<td>Soggy and flat</td>
<td>Fresh but not fluffy</td>
<td>Toasted and fluffy</td>
</tr>
<tr>
<td>Meat</td>
<td>Flat, gray, and looks old</td>
<td>Sufficient, fresh, cooked appropriately</td>
<td>*</td>
</tr>
<tr>
<td>Toppings</td>
<td>*</td>
<td>Toppings look fresh and include normal toppings: lettuce, tomato, and cheese</td>
<td>Topping are fresh and include extra toppings such as avocado or bacon</td>
</tr>
<tr>
<td>Patty</td>
<td>One-three ounce patty</td>
<td>Quarter pounder</td>
<td>*</td>
</tr>
</tbody>
</table>
**Coral Characteristics: Student Sheet #4**

<table>
<thead>
<tr>
<th>Characteristics of a Healthy Coral</th>
<th>Characteristics of an Impacted Coral</th>
</tr>
</thead>
<tbody>
<tr>
<td>More color and life</td>
<td>Has floc all over the coral</td>
</tr>
<tr>
<td>Starfish are all over</td>
<td>The brittle star are at the bottom</td>
</tr>
<tr>
<td>The water and seafloor look clean</td>
<td>The water and seafloor look polluted</td>
</tr>
<tr>
<td>No floc</td>
<td></td>
</tr>
<tr>
<td>The brittle star is spread out</td>
<td>Brittle star is packed in a small space</td>
</tr>
<tr>
<td>more Full</td>
<td></td>
</tr>
</tbody>
</table>
DEEP SEA CHALLENGE: EXPLAIN

Students will review spatial and temporal data and standardize their rubrics to evaluate photos of corals from three different sites at three different timestamps (2011, 2013, 2015).
# DEEP SEA CHALLENGE: EXPLORE

Coral Colony Site Location:

Using your rubric evaluate images of your coral over a six-year period. For each box enter the impact rating from your above rubric.

<table>
<thead>
<tr>
<th>Categories</th>
<th>2011</th>
<th>2015</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floc (Example)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floc</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Color</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Size</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Texture</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Surroundings</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hydroids</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Brittle Star</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total Points (Impact Score)</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

NAME: Coleh Brown

STUDENT #: 760920

DATE: 5.16

TEACHER: Mr. White
<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Healthy coral, Yellow color, Extended polyps</td>
<td>![Example of healthy coral with yellow color and extended polyps]</td>
</tr>
<tr>
<td>Black</td>
<td>Schlerite enlargement, No extended polyps, Some color in tissue</td>
<td>![Example of coral with schlerite enlargement and some color in tissue]</td>
</tr>
<tr>
<td>Red</td>
<td>Bare Skeleton, Excess mucous coverage, Hydroid growth</td>
<td>![Example of bare skeleton with excess mucous coverage and hydroid growth]</td>
</tr>
</tbody>
</table>
DEEP SEA CHALLENGE: EVALUATE

Data Visualization Questions: Student Sheet #7

1. What information does the impact score tell you about the health of your P.Biscaya coral colony?

2. What information does color-coding tell you about the health of your P.Biscaya coral colony?

3. How are these two methods different in quantifying data from an image?

4. Which method would you recommend to the ECOGIG team to use when determining if a P. Biscaya coral colony ecosystem is in recovery? Why?
CROSSCUTTING CONCEPTS

The modules include crosscutting concepts through students engaging in the practices.

Example of Crosscutting Concepts in the Deep Sea Challenge

- **Patterns**
  - *Use of rubrics and coding schema to classify changes in corals over time and space due to the 2010 Deepwater Horizon Oil Spill*

- **Cause and Effect**
  - *Using visual images to determine the differences in corals before and after the 2010 Deepwater Horizon Oil Spill. Investigating the effects of oil/floc on deep sea corals*

- **Stability and Change**
  - *Exploring changes in the deep sea Gulf ecosystems over a period of 5 years after the 2010 Deepwater Horizon Oil Spill*
AMP-IT-UP CURRICULUM SUPPORT MATERIALS

Module Curriculum Includes:

- Student texts
- Student pages
- Annotated Teachers Edition
- Teacher Prep Guide
- Videos
- Material List
- Supplemental Materials
AMP-IT-UP IN THE CLASSROOM
AMP-IT-UP NSTA PRESENTATIONS

• Earth Science Modules:
  • Today 2:00pm-3:00pm
    Georgia World Congress Center, A305

• Life Science Modules:
  • Saturday 12:30-1:30
    Georgia World Congress Center, C207

• Physical Science Modules:
  • Saturday 11:00am-12:00pm
    Georgia World Congress Center, C302

• STEM-ID Course:
  • Saturday 11:00am-12:00pm
    Georgia World Congress Center, C213
THANK YOU!