



# Science and Innovation

A Boeing/Teaching Channel Partnership

## EXTREME BIOSUITS Teacher Handbook

## Extreme Biosuits

### Days 9 and 10: Biosuit Testing, Presentation, and Reflection

Grade Level	Middle School
Lesson Length	Two 50-minute sessions



#### Lesson Overview

During the final two lessons, students accomplish their performance task by completing their biosuit models. They also finish and give their team presentations.



#### Connecting to the Next Generation Science Standards

On Days 9 and 10, students demonstrate understanding of the performance expectations and three dimensions developed throughout the entire module. These lessons serve as a performance assessment in which all the performance expectations and dimensions are addressed in the final presentation. Please reference the performance expectations, disciplinary core ideas, science and engineering practices, and crosscutting concepts referenced in this module's front matter.



#### Basic Teacher Preparation

The culminating project assumes that students give presentations to an authentic audience, which could include other teachers and adults from outside the classroom, such as parents, guardians, family members, and volunteers (engineers and scientists) from the community. Secure their participation in advance. Prepare the materials for the testing stations ahead of time.



#### Helpful Tip

Depending on the number of groups, student presentations may last beyond Day 10.

Review the **Biosuit Environments and Tasks** on pages 11 and 12 in the **Extreme Biosuits Student Handbook** and the **Testing Stations Guide** in the **Suggested Teacher Resources** at the end of this lesson. Also, if you plan to spread the team presentations over two class sessions, announce which groups are on each day to ensure they are ready.

Review **Final Presentation** on page 30 of the **Extreme Biosuits Student Handbook** to remind students of the presentation expectations.

Required Preparation	Links/Additional Information
<input type="checkbox"/> Gather or purchase the required materials for the lesson	Refer to the <b>Materials List</b> below
<input type="checkbox"/> Review suggested teacher preparation resources, the recommended websites, and <b>Testing Stations Guide</b>	Refer to the <b>Suggested Teacher Resources</b> at the end of this lesson
<input type="checkbox"/> Ensure appropriate computer technology is available for student presentations	



## Materials List

Item	Description/Additional Information	Quantity	Where to Locate/Buy
Baby pools or fish tank	These are used to conduct underwater assembly tasks	4 per class	Have students bring from home or purchase <a href="#">[Web Link]</a>
PVC pipe		1 or 2 per class	Purchase <a href="#">[Web Link]</a>
PVC elbows		3 or 4 per class	Purchase <a href="#">[Web Link]</a>
Dirt		3 or 4 per class	Bring from home or environs
Food coloring		1 box	Bring from home or buy at store
KNEX®, Legos®, or other plastic blocks		10–12 feet per class	Bring from home or purchase <a href="#">[Web Link]</a>
Small rubber hammer		1 per class	Purchase <a href="#">[Web Link]</a>
Ice block	Make at home and embed a rock or fossil	1 per class	Make at home
Tweezers		1 or 2 per class	Bring from home or purchase <a href="#">[Web Link]</a>
Rocks		Several	Gather from environs
Sand		1 bag	Purchase <a href="#">[Web Link]</a>
Plastic fish or fishing worms		2 or 3	Purchase rubber fish <a href="#">[Web Link]</a> or plastic fish <a href="#">[Web Link]</a>
Vegetable oil		1 bottle	Bring from home or buy at local store
Stuffed bird or rubber ducks		1 or 2	Bring from home

## Day 9: Biosuit Testing, Presentation, and Reflection



### Introduction (10 minutes)

Use **Final Presentation** on page 30 in the **Extreme Biosuits Student Handbook** to review final presentation expectations with students. In addition, give each group 15 minutes to prepare for their final performance test. Remind students that their presentations must be presented before they attempt the performance test. This time may also be used for last-minute biosuit model construction and fitting.



### Design Work: Biosuit Presentations and Performance Tests (40 minutes)

Have each group give their presentations, either in a previously assigned order or have groups volunteer. Groups must first give their digital presentations, outlining their design, research, constraints, and budget details. After the presentation, the group performs their assigned test with the biosuit model they created. Only one team member should attempt the performance test.

Each group's presentation and testing should last approximately 5 minutes. Sufficient time should be provided for audience questions. Use the **Presentation Rubric** (see **Appendix C**) to grade each team's performance. You may need to modify the rubric to meet your needs.

## Day 10: Biosuit Testing, Presentation, and Reflection



### Design Work: Biosuit Presentations and Performance Tests (30 minutes)

Each student team has 5 minutes to give their presentations and test their biosuit models. Allow time for questions from the audience.

After all the presentations have been completed, engage the class in a discussion around their successes and challenges as they worked as engineering teams throughout the module.



*Image provided by Renee Crawford.*



### Mini-Lesson: Project Reflection and Design Optimization (10 minutes)

After all teams have presented and tested their biosuits, instruct students to individually complete their **Project Reflection and Design Optimization** on page 31 in the **Extreme Biosuits Student Handbook**. Then, give students an additional 5 minutes to Think-Pair-Share their answers.



### Lesson Close (10 minutes)

Popcorn around the room and have students share some of their responses to the first three questions on **Project Reflection and Design Optimization**. Remind students that as part of the engineering design process, they would engage in multiple testing, presentation, and redesign iterations before their biosuits would be ready for client presentation. Conclude the discussion with student answers to, *If you had to do the project again, what would you change about it and why?*



## Assessment

Use the final presentation as a summative assessment for the unit. A **Presentation Rubric** is available in **Appendix C**.



## Community Connections

If audience members from the engineering community (or elsewhere) are invited, ask them to share situations in their work setting where they present and test their ideas.



## Suggested Teacher Resources

Presentation Rubric	Extreme Biosuits Teacher Handbook, Appendix C
Extreme Biosuits Student Handbook	<a href="#">[Resource Link]</a>



## Testing Stations Guide

Each team will need a specific setup to conduct their performance test, based on their assigned task. The four testing areas should be prepared before presentations begin.

### Oil Pipeline Engineer—Alaska

The Oil Pipeline Engineer test requires a large plastic bin of cold muddy (brown) water that contains a PVC pipe attached to another with a damaged PVC elbow. Students must take apart the two pipes and replace the damaged elbow with a new one while seeing and breathing underwater. In addition, students must keep their hands and heads dry and warm.

*Students do not submerge their entire heads, and they breathe using a snorkel, as if it is attached to an air tank.*

### Glaciologist—Antarctica

The Glaciologist test requires a large block of ice with many rocks frozen in it. The ice is submerged in clear water. Students must work with their hands, wearing protective gloves they created and using tool(s) they constructed, to retrieve the rocks from the ice while breathing underwater. In addition, students must keep their hands and heads dry and warm.

*Students do not submerge their entire heads, and they breathe using a snorkel, as if it is attached to an air tank.*

### Deep Sea Biologist—Pacific Ocean

The Deep Sea Biologist test requires of a large plastic bin with water dyed black that contains rocks, sand, and plastic fish at the bottom. Students construct a tool that can “see” underwater and collect a specimen while keeping it alive and returning it to the outside of the bin while breathing underwater. Students must protect their hands and head during the task.

*Students do not submerge their entire heads, and they breathe using a snorkel, as if it is attached to an air tank.*

### Material Engineer—Gulf of Mexico

The Material Engineer test requires a bin of water that contains an “oil spill” (vegetable oil and food coloring) as well as small stuffed birds. Students must clean up as much oil as possible wearing their mask/helmet and gloves, using the tool(s) and clean up materials they created.

*Students do not submerge their entire heads, and they breathe using a snorkel, as if it is attached to an air tank.*