Educator Guide

Engineering Adventure 4: Ready for Impact: Protecting Against Impact

Educator Preview

Adventure Snapshot

Learners test how well different materials protect against impact hazards.

Timing | 50 minutes

Get Ready & Team Up	5 min.
Which Material Is Best?	35 min.
Reflect & Wrap Up	10 min.
Total	**50 min.**

Level Up Activities 5 min. each

Prep Snapshot*

Prep Time 40 min.

- Set up materials stations.
- Print handouts.

**See Materials & Preparation for full info.*

21st Century Skills

Connection

- Critical Thinking

Habits of Mind

- Apply science knowledge to problem solving.
- Investigate properties and uses of materials.

Guiding Question

Which materials are good at protecting against damage from heavy moving objects?

Learners Will Do

Test how materials protect against impacts and consider which to use in a space glove.

Learners Will Know

Engineers must learn how different materials work for different uses.

Connecting Across Adventures

Adventure 3: Protecting Against Cold	Adventure 4: Protecting Against Impact	Adventure 5: Protecting Against Dust
Last time, learners tested how well different materials protect against cold.	**Today**, learners test how well different materials protect against impact. Later, they'll use collected data to design space gloves.	**Next time**, learners will test how well different materials resist dust.

Activity Resources

Access videos and digital resources using the link or QR code below. More information for teaching this curriculum is available in the Educator Guide Introduction (pgs. iii–xxvi). Access more PLANETS units, research, and pathways at https://planets-stem.org/.

weblink: https://hov.to/7e4eaf79

Materials and Preparation

Materials

For the whole group

- *Our Ideas* poster (on paper or a shared digital document) Examples | Templates
- 1 glove, vinyl, large
- 2 aluminum trays
- 2 deli containers, round, with lids, 16 oz.
- 2 rulers
- 2 skewers, wooden
- 2 boxes of spaghetti
- 200 metal washers, 1.25"

For the Materials Table

- 1 piece of cheesecloth, 8.5" × 11"
- 1 sheet of craft foam, 8.5" × 11"
- 1 sheet of felt, 8.5" × 11"
- 1 sheet of foil, 8.5" × 11"
- 1 sheet of transparency
- 2 sponges
- 4 rolls of masking tape
- 20 straws
- 30 cotton balls

For each pair of learners

- 1 pair of scissors
- 1 vinyl glove
- Engineering Adventure 4 Impact Test Procedure Handout, pg. 62

For each learner

- Engineering Notebook (PDF)

Adventure 4 Materials Preparation (40 min.)

Ahead of Time

1. Review the "In-Use Example" in the Prep & Setup Guide (PDF) to help you think about what to add to the *Our Ideas* poster during the discussions in this adventure.
2. Make 1 copy of Engineering Adventure 4 Impact Test Procedure Handout, pg. 62, for each pair of learners.

In Your Space

3. Place the *Our Ideas* poster in a visible place in your learning setting or prepare to share it digitally.
4. See Impact Test Setup Instructions, pg. 61.
5. Set up a Materials Table. See list above.
6. Place 1 piece of pasta in each finger of a vinyl glove for demonstrating.

Teaching Tip

In this adventure, learners attach materials to a vinyl glove to develop construction skills and think about wearable designs. Be sure sponges are dry so tape will stick to them.

Adventure Guide

Get Ready & Team Up (5 min.)

1. Ask: **If you did the last activity, what did you do and why?** *(We measured how well different materials protected against cold.)* Draw learners' attention to their work on the *Our Ideas* poster about protection against cold.
2. Say: **Today you will continue the Ask phase of our engineering design process. You will explore how well glove materials protect against damage from heavy moving objects.** Share the Guiding Question with learners aloud and write it on the *Our Ideas* poster (using multiple languages as needed): **Which materials are good at protecting against damage from heavy moving objects?**
3. Organize learners into pairs and distribute Engineering Notebooks.

Support Learner Differences

- If new learners are joining you, lead an inclusion activity (pgs. xx-xxi) and use other engagement strategies as necessary (pgs. viii–xviii).
- If you have learners who speak multiple languages, encourage them to share the words for something hitting something else in their preferred languages. If you can, provide an example from a language you know. Take time to learn learners' words and use them throughout the adventures.
- Encourage learners to identify their own strengths and the roles they would like to play during testing, and form pairs that can play a variety of roles. For example, one learner can specialize in attaching materials to the glove and another learner can pick up and count the pieces of pasta.

Support Thinking

To give learners more context about this hazard, show the video Micro-Impacts and Low Gravity. Read the Educator Science Background (weblink) for more information.

Which Material Is Best? (35 min.)

4. Gather learners at a Testing Station. Show the demonstration glove. Say: **The weight represents a heavy moving object, the pasta pieces represent the bones in a hand, and the skewer represents a tool the hand is holding.**
5. Give each pair a copy of Engineering Adventure 4 Impact Test Procedure Handout, pg. 62. Demonstrate the test procedure and record the result in the "None" row on the *Our Ideas* poster. As needed, allow learners to feel the test setup.
6. Point out the Materials Table. Tell learners they will test one material three times and record results on *Impact Protection*, pg. 16 in their Engineering Notebooks. They will write the highest result in the "Final" column.

Support Thinking

If learners would benefit from an additional visual of the testing procedure, play How to Design and Test Space Gloves (1:00–1:33).

7. Assign each pair a different material than the one they tested in Adventure 3. Let pairs get materials and start working.
8. Say: ***Impact* is a word that means damage from heavy moving objects.** Write *impact* on the *Our Ideas* poster, along with translations into learners' preferred languages and relevant images. Have pairs record results on *Impact Protection* and in the "Impact" column on the *Our Ideas* poster. They should write whether the material was "not good," "good," or "great" at protecting against impact.

Reflect & Wrap Up (10 min.)

9. Revisit the Guiding Question on the *Our Ideas* poster: Ask: **Which materials are good at protecting against damage from heavy moving objects (impact)?** *(Thick, cushiony materials like cheesecloth, cotton balls, sponges, and foam are good.)* **Why?** Ask: **Which materials were not good? Why?** *(Thin, flexible materials like foil did not protect against impact.)*
10. Tell learners that next time, they'll explore dust as a hazard.

After the Adventure

1. Clean up:
   - Keep the *Our Ideas* poster for use in Adventure 5.
   - Dispose of broken pasta and other materials that cannot be reused.
   - Save the Impact Testing Stations and materials for Adventures 6 and 7.
2. Plan for Engineering Adventure 5. See Engineering Adventure 5 Preparation on pg. 67. Note that you will need to prepare two Dust Testing Stations. Setup will likely take at least 30 minutes.
3. Take time to reflect on the following educator prompt. **What strategies did you use to help learners understand what the model hand represented?**

Support Learner Differences

As needed, provide groups with a tub or other container to hold their materials. Give learners time to examine the materials before they begin testing.

Support Thinking

To help learners visualize which materials are better at protecting against impact, have them post a sample of each material on a wall in a spectrum from "not good" at one end to "great" at the other. Consider photographing this spectrum and printing copies for learners to reference later.

Level Up!

- Refer to the Engineering Design Process poster (PDF). Ask: **What phases of the Engineering Design Process did you use today?** *(The Ask phase. We asked which materials are best at protecting against impact.)* (5 min.)
- If you can, show the video clip NASA has big 'guns' to study micrometeorite & space debris impacts - See test fires (2:33–2:53) to help learners understand how NASA tests materials to protect against impacts. (5 min.)
- Ask this story prompt: **Can you tell me a story about something creative you did to protect yourself from getting hurt?** Tell learners, if anyone asks what they did today, they can say "We tested which materials protected model bones made of spaghetti from falling weights" and ask the above story prompt. Consider returning to learners' ideas at the start of the next adventure. (5 min.)

Space Hazards Additional Resources

Resources include All Downloads, All Videos, Family Connections, and more.

weblink: https://hov.to/940428f7

Impact Test Setup Instructions

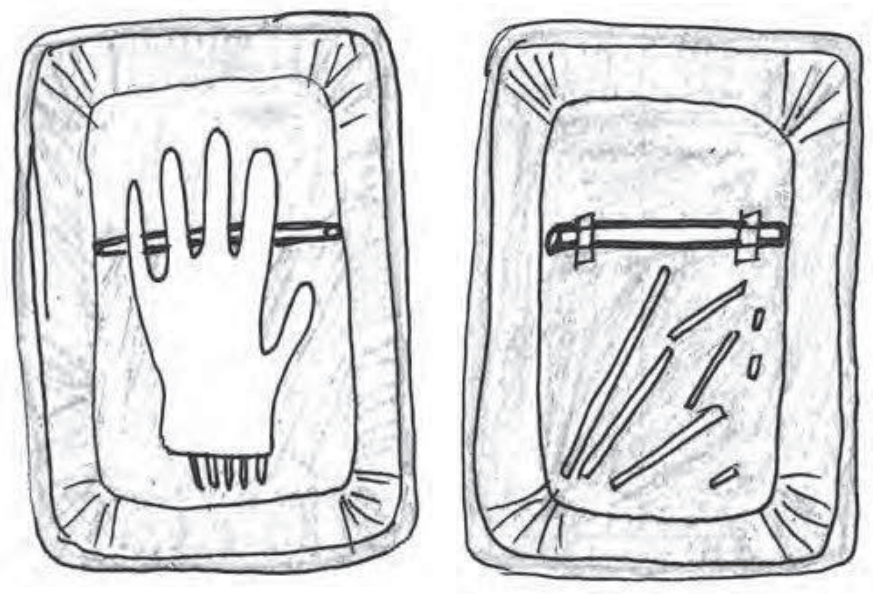
Set up two testing stations for learners to test how well their gloves protect against impact.

Materials for each setup:

- 1 box of spaghetti
- 1 aluminum tray
- 1 deli container, round, with lid, 16 oz.
- 1 ruler
- 1 skewer, wooden
- 100 metal washers, 1 1/4"

Prepare Testing Stations

1. Fill each deli container with 100 washers.
2. Seal the lids of the containers with masking tape.
3. Tape a skewer to the bottom of each tray.



4. Place a box of spaghetti and a ruler at each Testing Station.

Impact Test Procedure

1. Cut your material in half.
   Tape 1 half to 1 side of your glove.
   Do not tape material to the other side.

2. Flip the glove over.
   Put 1 piece of pasta in each glove finger.
   Snap off extra pasta that is sticking out.

3 Place your glove in the tray. Make sure the fingers are on the wooden skewer.

4 Lift the weight 1 foot above the center of your glove.

5 Drop the weight.

6 Carefully empty the pasta out of the glove and count the number of pieces.

7 Record results.

8 Repeat 2 more times for a total of 3 tests.

9 Record the highest number in the "Final" column.
How well did your glove protect against the impact?