

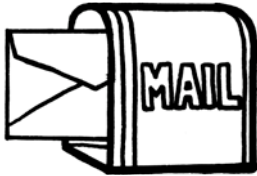


Overview: Kids will test and compare how dust resistant different materials are.

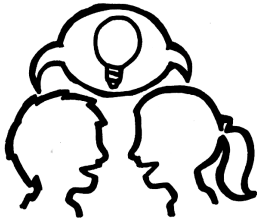
Note to Educator: In this adventure, kids attach materials to both sides of a vinyl glove to further develop glove-construction skills while testing materials. Be sure that the sponges are dry so that tape will adhere to them.

Save the materials, *Testing Results* chart, and Testing Stations for Adventures 5 and 6.

Duo Update (5 min)



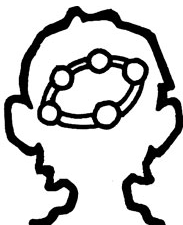
Set the Stage (5 min)



Activity (30 min)



Reflect (5 min)



Materials

For the entire group:

- Message from the Duo*, track 7 or Engineering Journal, p. 17
- Engineering Design Process* poster
- Testing Results* chart and marker

Materials Table:

- 2 pieces of cheesecloth, 8.5" x 11"
- 2 sheets of craft foam, 8.5" x 11"
- 2 sheets of felt, 8.5" x 11"
- 2 sheets of foil, 8.5" x 11"
- 2 sheets of transparency, 8.5" x 11"
- 4 rolls of masking tape
- 4 sponges
- 40 straws
- 60 cotton balls

Testing Stations:

- 1 container of UV glow powder
- 1 roll of paper towels
- 1 tablespoon measure
- 2 aluminum trays, 12" x 10"
- 2 black lights, handheld
- 2 craft sticks
- 2 cups of gravel
- 2 hand lenses
- 6 cups of sand
- 8 resealable plastic bags, quart size
- 10 washers, 1 1/4"

For each pair of kids:

- 1 pair of scissors
- 1 vinyl glove

For each kid:

- Engineering Journal

Preparation

Time Required: 30 minutes

1. Post the *Engineering Design Process* poster.
2. Have the *Message from the Duo* ready to share.
3. Update the *Testing Results* chart from Adventure 3 by adding "Dust" as the title of the next column, as shown on p. 52 in this guide. Post the updated chart.
4. Set up a Materials Table with the materials listed above.
5. Prepare 2 Testing Stations by following the instructions on *Dust Testing Station*, p. 56 in this guide.

Journal Pages for Adventure 4

Message from the Duo, p. 17

Adventure 4 **Message from the Duo**

← reply → forward 📁 archive ✖ delete

from: engineeringadventures@mos.org
to: You
subject: Dangerous Dust 3:08 PM

Hi engineers!

I talked more with our friend Maru, a materials engineer at NASA's testing site in Antarctica. She let me know that engineers also have to think about dust-resistant materials when designing spacesuits. Maru said a dust-resistant material is any material that prevents dust from sticking to it.

It may not seem like much of a hazard to find dust in living and working spaces here on Earth, but dust from the surface of other planets and moons can be a big problem for astronauts. Dust can get into things in the spacecraft that need to stay clean and cause damage to the electronics and equipment inside. On top of that, the dust can be dangerous for the astronauts to breathe. Engineers need to choose materials that dust does NOT stick to so astronauts bring as little of it as possible into their spacecraft.

We sent you some materials so you can test how dust resistant they are. Try attaching one layer of these materials to both sides of your glove, test it out, and see if you think it would be a good choice for making a dust-resistant model space glove!

Talk to you soon,
Jacob

In Good Hands: Engineering Space Gloves 17 © Museum of Science

Dust Test Procedure, p.18

Adventure 4 **Dust Test Procedure**

1. Cut your material.
2. Use loops of masking tape to attach **1 layer** of the material to **both sides of the glove**.
3. Open the plastic bag.
4. Use your glove to dig through the dust and find the 5 metal washers.
5. Use your glove to place the 5 metal washers into the plastic bag.
6. Use a paper towel to wipe off any extra dust from your glove.
7. Look at the palm side of your glove with the hand lens and black light to find the places that glow. How many areas have glowing dust?
8. Record your results in your Engineering Journal.
9. Reset the station for the next group: bury the 5 metal washers back in the sand and mix the sand using the craft stick.

In Good Hands: Engineering Space Gloves 18 © Museum of Science

Dust Protection, p. 19

Adventure 4 **Dust Protection**

Directions:
Using the hand diagram below, find out how many areas of your glove's material has glowing dust. (Example: There is glow powder in areas A & C, or a total of 2 areas, so it is "good" at protecting against dangerous dust.)

Is your material good at protecting against dust?

Not Good	Good	Great
4+ areas	2-3 areas	0-1 area

Did You Know?
Dust on Earth is a mixture of sand, dead skin cells, tiny hairs, dander, pollen, dust mites, and minerals from space.

Test Results		
Test Material	Number of Areas	Is your material good at protecting against dust?

Reflect
Which materials were great at protecting against dust?

Why do you think these materials worked well?

In Good Hands: Engineering Space Gloves 19 © Museum of Science

Chart for Adventure 4

Testing Results			
Material	Cold	Impact	Dust
cheesecloth	<i>Cold Results from Adventure 2</i>	<i>Impact Results from Adventure 3</i>	
cotton balls			
craft foam			
felt			
foil			
sponges			
straws			
transparency			



Kids will learn:

- Dust contamination can be a hazard for astronauts and equipment in space.
- Some materials prevent dust from sticking to them better than others.



Message from the Duo (5 min)

1. Tell kids that Jacob sent them another message about space gloves.
2. Have kids turn to *Message from the Duo*, p. 17 in their Engineering Journals, to follow along. Play track 7.
3. To check for understanding, ask:
 - **Why is dust a hazard for astronauts in space?** *Dust can damage things inside the spacecraft that astronauts depend on. It can also be dangerous for astronauts to breathe.*
 - **What does it mean if a material is “dust resistant”?** *A dust-resistant material is a material that prevents dust from sticking to it.*
 - **What does Jacob want us to do?** *Test different materials to see which ones are the most dust resistant.*



Set the Stage (5 min)

1. Gather kids at the Testing Station. Have kids *imagine* that they are astronauts working on another planet. They are repairing their spacecraft and dropped some parts on the ground.
2. Turn on the black light and pass it over the trays. Ask:
 - **What do you think the glowing powder represents?** *Areas where there is dangerous dust.*
3. Show kids the testing materials and ask:
 - **Do you think the dangerous dust will stick to these materials? Why or why not?**
4. Explain that each group will be given another glove and assigned a different material to test. This time, groups will use the material to design both sides of the glove.
5. Turn to *Dust Test Procedure*, p. 56 in this guide. Have kids turn to *Dust Test Procedure*, p. 18 in their Engineering Journals. Review each step of the dust test.
6. Show kids the “Dust” column on the *Testing Results* chart. Let them know they will record their results on the chart after they test their material.

Tip: If kids have difficulty seeing the UV glow powder under the black light, try turning off the overhead lights in the room.



Ask: Which Material Is Best? (30 min)

1. Organize kids into pairs.
2. Provide a glove and assign a material to each group.

Tip: If there are fewer than 8 groups, assign some groups 2 materials so all materials are tested.



3. Have groups collect their materials from the Materials Table and begin working. Remind them that during glove construction, their fingers must be able to move to complete the final task.
4. Circulate around the room and ask:
 - **Do you think this material will pick up a lot of dust? Why or why not?**
5. Have groups record their results on *Dust Protection*, p. 19 in their Engineering Journals, and on the *Testing Results* chart by writing “not good,” “good,” or “great” based on the number of areas the glow powder was identified.

Tip: Have groups use a hand lens to examine the parts of their glove that picked up the most dust. Encourage them to look closely at their material to see how the dust gets trapped in the creases and fibers.

Tip: Add 1/2 tablespoon of glow powder between tests.



Reflect (5 min)

1. Gather groups together in front of the *Testing Results* chart to share their observations. Ask:
 - **Which materials picked up a lot of dust? What do these materials have in common?** *Some have similar textures. Some are porous or fuzzy and caught dust in their creases and fibers.*
 - **Which materials were the most dust resistant? What do these materials have in common?** *They are smooth so dust shakes off easily. There are not a lot of fibers or rough texture in the material for dust to get stuck in.*
 - **Which materials are good at protecting from cold, impact, and dust hazards in space?**
 - **How easy was it to complete the task? Why might this be important for engineers to consider?** *The materials we choose should protect from dust without getting in the way of astronauts' work. Comfort and usability are important for engineers to keep in mind.*
2. Have kids gather around the *Engineering Design Process* poster. Ask:
 - **What step of the Engineering Design Process did we focus on today?** *We asked questions about dust-resistant materials.*
3. Let kids know that next time they will learn about the different missions that Maru and her friends at NASA need their help with. They will get to design a model space glove that can protect astronauts from the many hazards of space.
4. Save any leftover materials, the Testing Stations, and the *Testing Results* chart for use in Adventures 5 and 6.



reply



forward



archive



delete

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to: You
subject: Dangerous Dust



3:08 PM

Hi engineers!

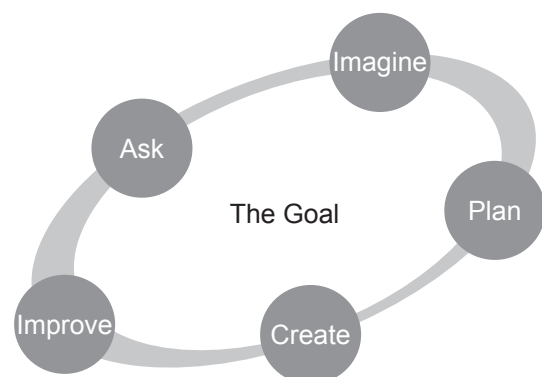
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Talk to you soon,

Jacob



Dust Testing Station Set Up

1. Prepare 2 Testing Stations for groups of 2 to share.
2. For each Testing Station, combine 1 cup of gravel, 3 cups of sand, and 1 tbsp. of glow powder in a 12" x 10" aluminum tray.
3. Mix thoroughly using a craft stick.
4. Bury 5 washers in each tray. The tester wearing the glove will need to uncover them to complete the task.
5. Place a black light, a craft stick, 4 resealable plastic bags, and a few paper towels near each tray.



Dust Test Procedure

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