



A PIECE OF CAKE

ENGAGE

After the Columbia disaster, NASA engineers had to figure out how astronauts could fix damaged heat shield tiles in space using an adhesive. Astronaut Cady Coleman knew that trying to apply sticky substances in zero gravity would be harder than it looked. So, she brought engineers slices of cake and frosting and asked them to put the cake back together using only the frosting as a simple Earth-based simulation of tile repair in space. The result: a messy, eye-opening challenge that changed how NASA approached space repair tools.

Essential Questions:

Why would applying frosting, or glue, be difficult in space?
What role does gravity play in applying adhesives?
What tool(s) could be used to apply layers of glue in space?
Why is teamwork important in extreme environments like space?

EXPLORE

The Challenge: 10 Minute "Heat Shield" Repair. Students will have 10 minutes to construct a tool to apply the "glue" and re-assemble your cupcake. The goal is to have your cupcake to be able to turn each direction (including upside down) without coming apart. Students will reassemble the cake pieces using frosting, but without smashing the pieces together. Optional constraint: Use one hand only, or wear gloves to simulate space suit limitations.

EXPLAIN

After students complete the challenge have them reflect on the following questions:

- What were the biggest challenges you faced?
- What challenges do you think you would face during an Extra Vehicular Activity (EVA) repairing shield tiles?
- What important properties should the adhesive and the tool you created have for application in space?

EVALUATE & ELABORATE

Design a better solution: challenge the teams to design a new way astronauts could apply the adhesive in space. Consider how you could contain the adhesive, how could you apply it precisely, and how you could complete the task wearing pressurized gloves. Teams can sketch ideas and write short explanations. Teams can share ideas with the class or create a class bulletin board labeled "NASA Tool Lab".

ADDITIONAL RESOURCES

[Orion Heat Shield \(Video\)](#)
[Build a Heat Shield Activity](#)

GRADE LEVELS

Any grade level

SUPPLIES

- cup cakes
- frosting
- paper plates
- various building supplies like spoons, popsicle sticks, tape, etc.

LEARNING GOALS

- Use the engineering design process to develop a tool.
- Communication
- Teamwork
- Modeling

A PIECE OF CAKE

Name

Question: Why would applying glue be difficult in space?



CHALLENGE: You are an astronaut and you have to design a tool that you can use to apply adhesive to repair heat tiles. You have 10 minutes to create your tool using the materials available and repair your cupcake.

Sketch a picture of your ideas:

Evaluate your results. How well did your tool work and did your cupcake survive the challenge?

Redesign: If you could redesign your tool, how would you improve it?