National Aeronautics and
Space Administration

GRADES 9–12

# Supplemental Space Shuttle Tile Lesson

Aeronautics
Research
Mission
Directorate

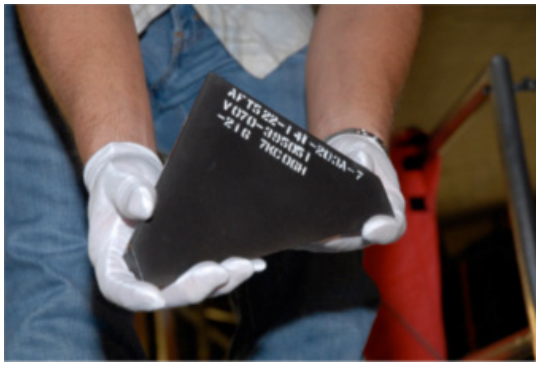
Museum in a BOX Series

www.nasa.gov

# Supplemental Activity 1

## A Piece of History: Space Shuttle Thermal Tiles

**GRADES 9–12**



### Activity Overview:

Approximately 24,300 tiles were installed on each Space Shuttle, and each tile was designed to survive 100 trips to space and back. Varying in thickness from 1 inch (2.54 centimeters [cm]) to 5 inches (12.7 cm) depending on the heating they would be subjected to, the tiles collectively protected the orbiter from temperatures as high as 2,300 degrees Fahrenheit during its reentry into Earth's atmosphere.

The silica tile material is referred to as LI-900. It insulates heat so well that tiles can be held bare-handed on one side even while the opposite side is still red hot. Educators can demonstrate that ability in the classroom, substituting a blowtorch for the reentry-generated heating.

LI-900 has a density of 9 pounds per cubic foot (144.2 kilograms per cubic meter [kg/m$^3$]). It is made from pure silica glass fibers, but 94 percent of the volume of each tile is pure air, making each tile incredibly light and strong!

**Problem 1**—If the dimensions of an average tile are 15 cm × 15 cm × 6 cm, what is the total volume of the Space Shuttle heat shield provided by the 24,300 tiles in cubic meters?

**Problem 2**—About what is the mass, in grams, of one average tile?

**Problem 3**—What is the total mass of the Space Shuttle heat shield in

A) kilograms?

B) pounds? (if 1 pound = 0.453 kg)

Space Math, *http://spacemath.gsfc.nasa.gov*

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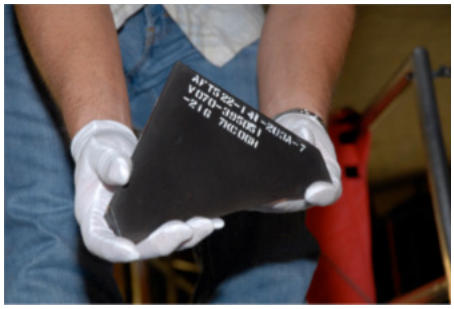
## A Piece of History: Space Shuttle Thermal Tiles

**GRADES 9–12** Answer Key



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**Problem 1**—If the dimensions of an average tile are 15 cm × 15 cm × 6 cm, what is the total volume of the Space Shuttle heat shield provided by the 24,300 tiles in cubic meters?

Answer:

A single average tile has a volume of

V = 0.15 m × 0.15 m × 0.06 m

V = 0.00135 meters$^3$

So the total volume occupied by 24,300 tiles is about

V = 24,300 × 0.00135 = 32.8 cubic meters

**Problem 2**—About what is the mass, in grams, of one average tile?

Answer:
Mass = Volume × Density

Mass = 0.00135 m$^3$ × 144.2 kg/m$^3$

Mass = 0.195 kilograms

Since 1 kilogram = 1,000 grams, we have a mass per tile of about 195 grams

**Problem 3**—What is the total mass of the Space Shuttle heat shield in

Answer:

A) kilograms? Mass = volume × density

Mass = 32.8 m$^3$ × 144.2 kg/m$^3$ = 4,730 kg

B) pounds? (if 1 pound = 0.453 kg) 4,630 kg × (1 pound/0.453 kg) = 10,441 pounds (or about 5 tons!)

# SPACE SHUTTLE TIRES LESSONS: NATIONAL SCIENCE STANDARDS

## 9–12

### UNIFYING CONCEPTS AND PROCESSES

All students should develop an understanding of

- Systems, order, and organization

### SCIENCE AND TECHNOLOGY

All students should develop

- Understandings about science and technology

### PERSONAL AND SOCIAL PERSPECTIVES

All students should develop an understanding of

- Science and technology in local, national, and global challenges
- Science as a human endeavor

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# structures and materials

EP-2010-12-483-HQ