

# Stem

On a Shoestring

## What's the Matter?

Have you ever struggled with what “matter” is and how it is classified as either a solid, a liquid or a gas?

This activity is a way to study the states of matter and have fun doing it making “armpit fudge”. Kids and adults alike will love this activity and how the states of matter will literally change before their eyes.

### QUICK GUIDE:

Prep Time:	20-30 minutes
Activity Time:	2 to 3 hours
Est. Cost:	\$20 to \$25 depending on group size
Age range:	4 years – adult

# Stem

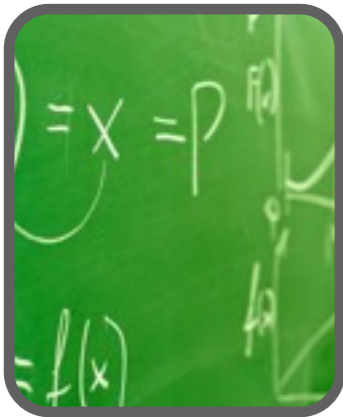
On a Shoestring

## What's the Matter?

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This activity is gross, delicious, and a great lesson in the states of matter.

What better way to study the states of matter and have fun doing it than to make "armpit fudge"!

# Armpit Fudge

## Directions



## Things You Need

Instant chocolate pudding

measuring spoons

Milk

Plastic spoon

Zip-type sandwich bags

Coconut (optional)

Mini chocolate chips (optional)

1. Measure 2T of instant pudding and 2T milk in a zip bag.
2. Squeeze extra air out of the bag, and then put it inside another zip bag.
3. Talk about what causes changes in states of matter, such as heat and friction.
4. Put the zip bag under the armpit area and apply friction to mix the pudding. Continue until mixture is in a semi-solid state. Eat and enjoy.
5. For the “gross” effect of making fudge under your arm....add coconut for “armpit hair” and the mini chocolate chips for the “razor stubble”.

## Tips



This activity can be rolled on a flat surface to make a batch of fudge, and then compared to the method of applying heat and friction under the armpit area. How are they the same or different? What would happen if you add the coconut and chocolate chips to the mixture before you mix it?

# What is Matter?

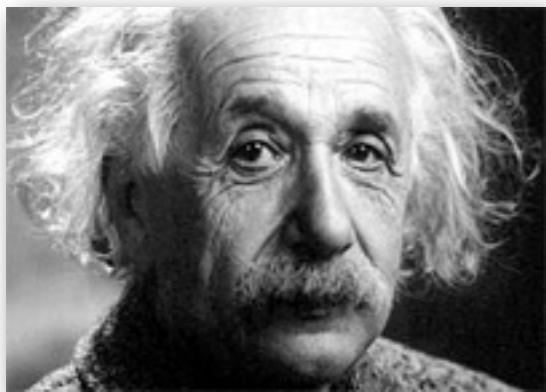
Put simply, matter takes up space. We, as humans take up space. Your house takes up space, the oceans, mountains, all take up space.

The common definition of **matter** is anything that has both mass and volume (occupies space). For example, a car would be said to be made of matter, as it occupies space, and has mass.

## The States of Matter

In the science of **physics**, there are four distinct **states of matter** that we see in our everyday life: liquid, solid, gas and plasma.

Sometimes, the state of matter can change. Water (a liquid) can freeze and become a solid. Or, an ice cube (solid) can melt and become a liquid.



**Albert Einstein**, a famous physicist, proved that all matter can become energy. His formula is known throughout the world as  $E = mc^2$ , where E is the energy of a piece of matter of mass m, times  $c^2$  the speed of light squared.

Albert Einstein became so famous that today, when we think of a scientist, many people still draw a person that looks like him!

Image: States of Matter



Wikipedia defines the four fundamental states of matter. Clockwise from top left, they are solid, liquid, plasma and gas, represented by an ice sculpture, a drop of water, electrical arcing from a tesla coil, and the air around clouds respectively.

# The Scientific Method

The Scientific Method is a way to ask questions and achieve answers by making observations, performing tests and doing experiments.

Q

Question

What happens to the mixture when heat and friction is applied?

R

Research

What causes changes in the states of matter? What is a state of matter?

H

Hypothesis

What would happen if the milk and pudding is not mixed up before the heat is applied?

T

Test

Are there other ways to change the state of matter?

A

Analyze

Compare the fudge made on a flat surface with the fudge made under the armpit. How is it different or the same?

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# Key Terms

Click on the terms below to learn more about their meanings

**Matter:** Matter is the physical material of the universe. It is the "stuff" all around you. Matter is anything that has mass and takes up space.

**Solid:** A solid is an object, or item with tightly packed molecules. Solid objects don't flow like liquids do.

**Liquid:** Liquid is the state of matter that will fill up the shape of a container and takes on the shape of the container it is in.

**Molecules:** Any time two atoms join together, they make a molecule. All the stuff around you is made up of molecules. This includes you! You are actually made up of trillions and trillions of different types of molecules.

Definitions above are sourced from Wikipedia.  
Other science terminology resources to explore:



[The Science Dictionary](#)  
[American Heritage Science Dictionary](#)

# Books about Careers

## **Police Officer Books:**

Ready, Dee. Police Officers Help, Capstone Press Publishing, 1997 Grades Kindergarten – 5th

Adamson, Heather. A Day in the Life of a Police Officer, Mankato, MN.: Capstone Publishing, 2004 Grades 1st – 3rd

White, Nancy. Police Officers to the Rescue, New York, NY: Bearport Publishing, 2012 Grades 1st – 6th

## **Firefighter Books:**

Goldish, Meish. Smoke Jumpers, New York, NY.: Bearport Publishing, 2014 Grades Pre K – 3rd

Goldish, Meish. Firefighters to the Rescue, New York, NY.: Bearport Publishing, 2014 Grades 1st- 6th

Goldish, Meish. City Firefighters, New York, NY.: Bearport Publishing, 2014 Grades 2nd – 7th

White, Nancy. Aviation Firefighters, New York, NY.: Bearport Publishing, 2014 Grades 2nd – 7th

## **Engineering Books:**

Parmalee, Thomas. Genetic Engineering, Edina, MN.: ABDO Publishing, 2008 Grades 6th – 8th

Farrell, Courtney. Green Jobs, North Mankato, MN.: ABDO Publishing, 2011 Grades 9th – 12th

Hamen, Susan E. Engineering, Edina, MN.: ABDO Publishing, 2011 Grades 9th – 12th

## **Scientist:**

Hanson, Anders. Scientist's Tools, Minneapolis, MN.: ABDO Publishing, 2011 Grades 3rd – 5th

McMullin, Ruth. EXPEDITIONS Scientist in the Field (Science Adventures from Nature and Science Magazine), Natural History Press, 1969 Grades 6th – 8th

## **Chef Books:**

Butterworth, Christine; Gaggiotti, Lucia. How Did That Get in My Lunchbox?: The Story of Food, Somerville, MA.: Candlewick Pub., 2011 Grades 3rd – 5th

Laurentiis, Giada De. Naples! (Recipe for Adventure #1), Grosset & Dunlap Publishing, 2013 Grades 5th – 8th

## **Pilot/ Aviation Books:**

Simons, Lisa M.B. The Kids' Guide to Military Vehicles, Mankato, MN.: Capstone Press Publishing, 2010 Grades Kindergarten – 1st

Anderson, Jameson; Whigham, Rod; Barnett, Charles. Amelia Earhart: Legendary Aviator, Mankato, MN. Capstone Press Publishing, 2010 Grades 3rd – 4th

Hamilton, John & Sue. UAVs: Unmanned Aerial Vehicles, Minneapolis, MN.: ABDO Publishing, 2012 Grades 6th – 8th

### **Veterinarian Books:**

Salzmann, Mary Elizabeth. Veterinarian's Tools, Minneapolis, MN.: ABDO Publishing, Grades 3rd – 5th

Riddle, John. Veterinarian, Broomall, PA.: Mason Crest Publishing, 2003 Grades 3rd – 8th

Thomas, William Veterinarian, Pleasantville, NY.: Gareth Stevens Publishing, 2009 Grades 6th – 8th

### **Dentist Books:**

Stockham, Jessica. Dentist, Childs Plan Intl. Publishing, 2011 Grades Pre K – 3rd

Salzmann, Mary Elizabeth. Dentist's Tools, Minneapolis, MN.: ABDO Publishing, 2011 Grades 3rd – 5th

### **Energy Books:**

Wheeler, Jill C. Eye on Energy Series, Edina, MN.: ABDO Publishing, 2008 Grades 3rd – 6th

Orme, Helen, Energy for the Future, New York, NY.: Bearport Publishing, 2009 Grades 3rd – 5th

Society of Petroleum Engineers. Oil and Natural Gas, DK Publishing, Inc., 2007 Grades 6th – 8th

Marcovitz, Hal. Energy Security, Edina, MN.: ABDO Publishing, 2011 Grades 6th– 8th

### **Architecture Books:**

Stern, Steven L. Building Greenscapes, New York, NY.: Bearport Publishing, 2010 Grades 3rd – 6th

Sandler, Michael Freaky Strange Buildings, New York, NY.: Bearport Publishing, 2012 Grades 3rd – 6th

Stevenson, Neil. Architecture, New York, NY.: DK Publishing, 1997 Grades 6th – 8th

### **City Planning Books:**

Leardi, Jeanette. Making Green Cities, New York, NY.: Bearport Publishing, 2010 Grades 3rd – 6th

Macaulay, David. City: A Story of Roman Planning and Construction, Houghton Mifflin Harcourt, 1983 Grades 6th – 8th

Chapnick, Samantha. Around New York City with Kids, New York, NY. Fodor's Travel Publishing, 2011 Grades 3rd – 6th

### **Computers and Gaming Books:**

Petrie, Kristin. Computers, Edina, MN.: ABDO Publishing, 2009 Grades 3rd – 5th

Ray, Michael. Gaming: From Atari to Xbox, New York, NY.: Britannica Publishing, 2012 Grades 6th – 12th

Wilkinson, Colin. Gaming: Playing Safe and Playing Smart, New York, NY.: Rosen Central Publishing, Grades 6th – 12th





The following alignments link the What's the Matter activity to the Next Generation Science Standards. For more information, click on each section.

### **Disciplinary Core Ideas: Physical Science**

Grades K-5 Structures and Properties of Matter

2-PS1-2 Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

5-PS1-1 Develop a model to describe that matter is made of particles too small to be seen.

5-PS1-3 Make observations and measurements to identify materials based on their properties.

### **Disciplinary Core Ideas: K-5. Engineering Design**

Grades K-5: Engineering

K-2-ETS1-3 Analyze data from test of two objects designed to solve the same problem to compare the strengths and weaknesses of how each perform.

3-5-ETS1-1 Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2 Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5-ETS1-3 Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

### **Disciplinary Core Ideas: Middle School Physical Science**

Middle School: Matter and its Interactions

MS-PS1-1 Develop models to describe the atomic composition of simple molecules and extended structures.

MS-PS1-2 Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

### **Disciplinary Core Ideas: Structure and Properties of Matter**

Middle School:

MS-PS1-3 Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.

MS-PS1-4 Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

### **Disciplinary Core Ideas: MS. Engineering Design**

MS-ETS1-1 Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people, and the natural environment that may limit possible solutions.

# Career Connect

This activity is a fun way to learn about matter.

Many careers are built around science, technology, engineering and math fields. Architecture is the discipline of constructing buildings and requires expertise in all four of the STEM fields.

Career Connect Video: Lisa Chronister



STEM, women in science

## Lisa Chronister Architect

Lisa Chronister is an architect. Her firm specializes in designing public buildings and schools. Click on the video at right to hear her story.



STEM on a Shoestring was developed through the generous support of the Kirkpatrick Foundation.

It is a project of the Oklahoma Afterschool Network.



Thank you!