

SUGGESTED REFERENCES

- How Does Reverse Osmosis Work?
<http://www.howstuffworks.com/question29.htm>
- How Stuff Works
<http://www.howstuffworks.com>
- Gases, Liquids, and Solids
[http://www.chemistrycoach.com/tutorials-6.htm#Liquids and Solids](http://www.chemistrycoach.com/tutorials-6.htm#Liquids%20and%20Solids)
- Matter
<http://www.Chem4Kids.com/matter/index.html>
- States of Matter
<http://www.chemtutor.com/sta.htm>
- Solutions
<http://www.chemtutor.com/solution.htm>
- Tanner's General Chemistry
<http://www.tannerm.com/>

NATIONAL SCIENCE EDUCATION STANDARDS

K - 4

Physical Science

Properties of objects and materials

**Source: National Science Education Standards, 1996, National Academy Press*

5 - 8

Physical Science

Properties and changes of properties in matter

CREDITS

The producers thank Channel 4 Television Corporation/4 Learning for materials used in this program.

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SCIENCE SCREEN REPORT FOR KIDS

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STATES OF MATTER: SOLID, LIQUID AND GAS



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Junior Engineering
Technical Society
www.jets.org

SYNOPSIS

Anything that takes up space or has mass is matter. And, all forms of matter, elements or compounds, have specific chemical and physical properties. Under the right conditions, matter can occur as solid, liquid, gas, or plasma. When it is heated or cooled it can change state, going from solid to liquid, liquid to solid, or even solid to gas.

This edition of SCIENCE SCREEN REPORT looks at the three most common states of matter - solid, liquid, and gas - showing how physical forces cause state changes at boiling, melting, freezing and dew points. It also demonstrates how different states of matter can be combined in suspensions and solutions, and how such mixtures can be taken apart.

CURRICULUM UNITS

- CHEMISTRY
- PHYSICAL SCIENCE
- PHYSICS

RUNNING TIME

16:48

BACKGROUND

Unlike a physical change, a chemical change alters the way a substance behaves, turning it into something completely different. But, an element or compound can move from state to state and still be the same substance.

This report explores the differences between solids, liquids and gases. Solids hold their shapes because their atoms are packed closely together in a fixed arrangement. The atoms of solids cannot be compressed any further. Liquids, on the other hand, don't have a definite shape. Though still held closely together, their atoms are free to tumble over each other, allowing liquids to take on the shape of the container they are in. Liquids also cannot be compressed. Unlike solids and liquids, gases can fill a container of any size or shape. However, because their particles are so spread out, gases can be compressed.

The difference between states of matter has to do with energy. The atoms in liquids have more energy than the atoms in solids, and the atoms in gases have more energy still. By adding energy we can turn solids into liquids, allowing the atoms to break free of the fixed arrangement and move around. Experiments demonstrate how different materials can have different melting and freezing points as solids become liquids and vice versa.

Liquids can be turned into gases by evaporation or by boiling. When enough heat is added, the particles gain energy and the liquid becomes a gas. The drop of water in popcorn that suddenly explodes into a gas is used to demonstrate this. Other demonstrations show how different liquids boil at different temperatures including liquid nitrogen shown boiling on a tray of ice. We also see a balloon placed in liquid nitrogen so that the air inside condenses.

Not all substances are clearly solids, liquids or gases. Most are mixtures. We find mixtures everywhere, even in our kitchens. Whipped cream, for instance, is made up of tiny solids and pockets of gas suspended in a liquid. Another type of mixture, solutions, is also discussed. By illustration, we see how suspended particles are filtered out of seawater and how, when the filtered water is heated, salts are left behind.

Substances that change phase are chemically unchanged even though they may look and behave very differently as solids, liquids and gases. Exploring the physical and chemical properties of matter gives us deeper insight into nature. It also provides insights into how scientists and engineers use this knowledge to shape our world.

ADVANCED ORGANIZERS

Prior to viewing this video, students should have some understanding of the following Benchmarks for Science Literacy, Oxford University Press which are excerpted and, in some cases, abbreviated below. Refer to the Benchmarks for more information.

Benchmark 4: The Physical Setting

Section D - The Structure of Matter

Know by Grade 5

- Heating and cooling causes changes in the properties of materials. Many kinds of changes occur faster under hotter conditions.
- When a new material is made by combining two or more materials, it has properties that are different from the original materials. For that reason, many different materials can be made from a small number of basic kinds of materials.

Know by Grade 8

- The atoms of any element are alike, but are different from atoms of other elements. Atoms may stick together in well-defined molecules or may be packed together in large arrays. Different arrangements of atoms into groups compose all substances.
- Atoms and molecules are perpetually in motion. Increased temperature means greater average energy... In solids, the atoms are closely locked in position and can only vibrate. In liquids, the atoms or molecules have higher energy, are more loosely connected, and can slide past one another... In gases, the atoms or molecules have still more energy and are free of one another except during occasional collisions.

*Benchmarks can be found at <http://www.project2061.org/tools/benchol/bolintro.htm>

CRITICAL THINKING EXERCISES

1. After showing the video, ask your students the following:
 - a| What are the states of matter?
 - b| What makes solids, liquids and gases behave differently?
 - c| What is the difference between the melting point and the freezing point?
 - d| What is the difference between the boiling point and the dew point?
 - e| How does a solution combine solids and liquids?
2. Discuss hydraulic brakes and why liquid is used rather than gas.
3. Discuss the difference between physical change and chemical change.
4. Discuss water as the universal solvent and what that means.
5. Have students research different methods of purifying water.
6. Have students create food mixtures in class, and discuss the physical forces that could be used to take them apart.
7. Have students research the salt compositions of the Atlantic Ocean and the Dead Sea. Make up these mixtures and then see how buoyancy is affected.
8. Refer to the appendix of your Physical Science or Chemistry textbook and look up the boiling points of three different compounds.

VOCABULARY

- Boiling point** Temperature at which a solid turns into a gas
- Condense** To reduce the volume of something
- Dew point** The temperature at which air becomes saturated and produces dew
- Evaporate** To convert or change into a vapor
- Filter** A porous substance through which a liquid or gas is passed to remove suspended matter
- Freezing point** The temperature at which a liquid turns into a solid
- Melting point** Temperature at which a solid turns into a liquid
- Mixture** The composition of two or more substances that are not chemically bound to each other
- Solution** The state of being dissolved
- State** A condition of being in a stage or form
- Suspension** A relatively coarse dispersion of solid particles in a liquid
- Water vapor** Water diffused as a vapor in the atmosphere, at a temperature below the boiling point

CAREER POSSIBILITIES

- CHEMICAL ENGINEER
- CHEMIST
- INVENTOR
- MATERIALS SCIENTIST