Changes of State

Phase Changes
Chapter 3, Section 2

Review from last Time

- 1. What are the 5 states of matter?
  - Solid
  - Liquid
  - Gas
  - Plasma
  - BEC (Bose Einstein Condensate)
- 2. How do the molecules move in the 3 main states?
  - 3 Main States of Matter

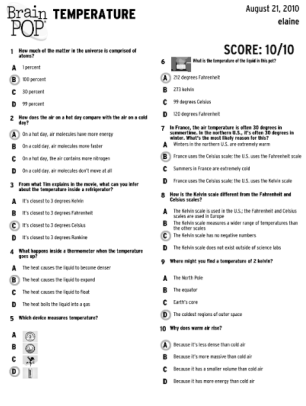
1. States of Matter

States & phases

- Each of the 5 states is also known as a **phase**.
- Elements and compounds can move from one phase to another phase when special physical forces are present.
- One example of those forces is **temperature**.
- The phase or state of matter can change when the temperature changes.
- Generally, as the temperature rises, matter moves to a more active state.

What about temperature??? Tell us about it Tim & Moby!

- Click here



Brain POP **TEMPERATURE**

August 21, 2010
elaine

SCORE: 10/10

1 How much of the matter in the universe is comprised of plasma?
A 1 percent
B 100 percent
C 30 percent
D 99 percent

2 How does the air on a hot day compare with the air on a cold day?
A On a hot day, air molecules have more energy
B On a cold day, air molecules move faster
C On a hot day, the air contains more nitrogen
D On a cold day, air molecules don't move at all

3 From what Tim explains in the movie, what can you infer about the temperature inside a refrigerator?
A It's closest to 3 degrees Kelvin
B It's closest to 3 degrees Fahrenheit
C It's closest to 3 degrees Celsius
D It's closest to 3 degrees Rankine

4 What happens inside a thermometer when the temperature goes up?
A The heat causes the liquid to become denser
B The heat causes the liquid to expand
C The heat causes the liquid to flood
D The heat boils the liquid into a gas

5 Which device measures temperature?
A
B
C
D

6 What is the temperature of the liquid in this pot?
A 212 degrees Fahrenheit
B 273 kelvin
C 99 degrees Celsius
D 120 degrees Fahrenheit

7 In France, the air temperature is often 20 degrees in summer. What is the equivalent of 20 degrees in winter. What's the most likely reason for this?
A Winters in the northern U.S. are extremely warm
B France uses the Celsius scale; the U.S. uses the Fahrenheit scale
C Summers in France are extremely cold
D France uses the Celsius scale; the U.S. uses the Kelvin scale

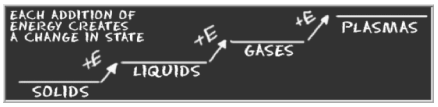
8 How is the Kelvin scale different from the Fahrenheit and Celsius scales?
A The Kelvin scale is used in the U.S.; the Fahrenheit and Celsius scales are used in Europe
B The Kelvin scale measures a wider range of temperatures than the other scales
C The Kelvin scale has no negative numbers
D The Kelvin scale does not exist outside of science labs

9 Where might you find a temperature of 2 kelvin?
A The North Pole
B The equator
C Earth's core
D The coldest regions of outer space

10 Why does warm air rise?
A Because it's less dense than cold air
B Because it's more massive than cold air
C Because it has a smaller volume than cold air
D Because it has more energy than cold air

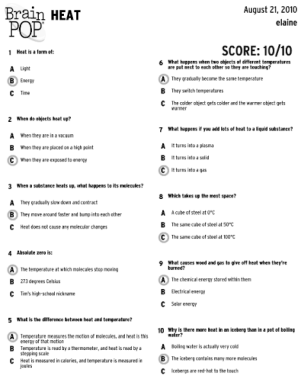
It's all about the energy!

- It's totally possible to go from a solid to a liquid to a gas, and back again.
- These are called state changes or phase changes.
- But it's all about the energy.
- Which state you go to depends on whether you are adding or removing energy.



States & Energy

- During a change of state, the energy of the substance **changes**.
- This is related to how the particles move.
- If you add energy to a substance, the particles **speed up**.
- If you remove energy from a substance, the particles **slow down**.
- In fact, **temperature** is a measure of the speed of particles.
- BrainPop: Heat



Brain POP **HEAT**

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1 **Heat is a form of:**
A Light
B Energy
C Time

2 **When do objects heat up?**
A When they are in a vacuum
B When they are placed on a high point
C When they are exposed to energy

3 **When a substance heats up, what happens to its molecules?**
A They gradually slow down and contract
B They move around faster and bump into each other
C Heat does not cause any molecular changes

4 **Absolute zero is:**
A The temperature at which molecules stop moving
B 273 degrees Celsius
C Tim's high-school nickname

5 **What is the difference between heat and temperature?**
A Temperature measures the motion of molecules, and heat is this energy of that motion
B Temperature is read by a thermometer, and heat is read by a stopping watch
C Heat is measured in calories, and temperature is measured in joules

6 **What happens when two objects of different temperatures are put next to each other or they are touching?**
A They gradually become the same temperature
B They switch temperatures
C The colder object gets colder and the warmer object gets warmer

7 **What happens if you add lots of heat to a liquid substance?**
A It turns into a plasma
B It turns into a solid
C It turns into a gas

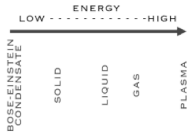
8 **Which takes up the most space?**
A A cube of steel at 0°C
B The same cube of steel at 50°C
C The same cube of steel at 100°C

9 **What causes wood and gas to give off heat when they're burned?**
A The chemical energy stored within them
B Electrical energy
C Solar energy

10 **Why is there more heat in an iceberg than in a pot of boiling water?**
A Boiling water is actually very cold
B The iceberg contains many more molecules
C Icebergs are red-hot to the touch

See, proof!

- Each state has a different energy "requirement".
- In order to be a plasma, you need a ton of energy because your particles better be moving!
- In order to be a solid or BEC, the particles are fine just chilling - so they don't need as much energy.

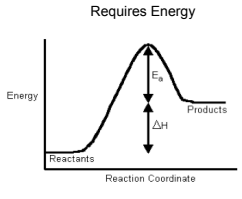


Two Types of Energy Change

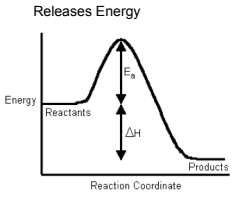
1. **Endothermic**: energy is absorbed, or taken in, by a substance (absorbs heat - feels **colder**)

2. **Exothermic**: energy is removed, or taken out, of a substance (releases heat - feels **warmer**)

Endothermic and Exothermic



Endothermic



Exothermic

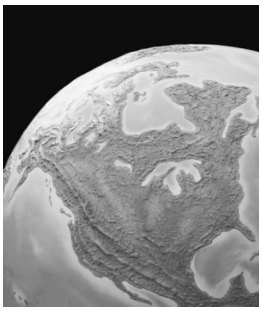
2. An Endothermic Experiment

- **Endothermic**: energy is absorbed, or taken in, by a substance (absorbs heat - feels **colder**)
- Think of the ice bags the coach gives you if you get hurt

3. An Exothermic Experiment

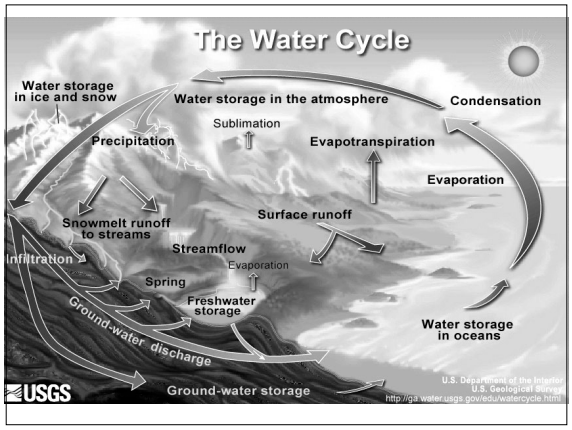
Exothermic: energy is removed, or taken out, of a substance (releases heat - feels **warmer**)

IS THAT A FACT????



Did you know, water is the only substance on Earth that can be found as a solid, liquid, and a gas at normal surface temperatures.

4. The Phases of Water

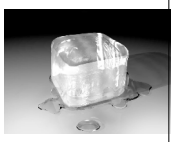


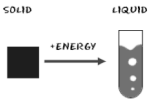
Brainpop: Tim & Moby

- The Water Cycle

Melting: **Solid** to **liquid**

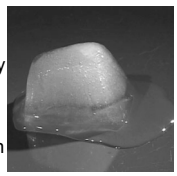
- Let's start with an ice cube.
- This ice cube starts off as a solid.
- When we add heat (energy), it begins to melt into a liquid.



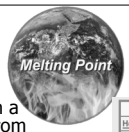


How does melting work?

- When a substance is heated, it absorbs energy and its atoms and molecules begin oscillating, or moving.
- Eventually, they move so much that they break some of their bonds of attraction which are holding them tightly in place.
- They move *so* vigorously that they begin to move past one another, flowing like a liquid.
- Thus, as energy is being absorbed, this is an **endothermic** change.



- The **melting point** of a substance is the temperature at which a substance changes from the solid to liquid.
- Melting points range from low temps to very high temps.
- The melting point is typically a very unique property of a substance.
- We can use melting points to determine the identity of a substance.



Name	Sym	#	Melting Point	
Helium	He	2	0.95K	-272.2°C
Hydrogen	H	1	13.81K	-259.34°C
Neon	Ne	10	24.56K	-248.59°C
Fluorine	F	9	53.53K	-219.62°C
Oxygen	O	8	54.85K	-218.3°C
Nitrogen	N	7	63.25K	-209.9°C
Argon	Ar	18	83.8K	-189.35°C
Krypton	Kr	36	115.77K	-157.38°C
Xenon	Xe	54	161.36K	-111.79°C
Chlorine	Cl	17	171.65K	-101.5°C
Radon	Rn	86	202.15K	-71.8°C
Mercury	Hg	80	234.32K	-38.83°C
Bromine	Br	35	265.95K	-7.2°C
Francium	Fr	87	300.15	27°C
Cesium	Cs	55	301.65K	28.5°C
Gallium	Ga	31	302.91K	29.76°C
Rubidium	Rb	37	312.46K	39.31°C
Phosphorus W	P	15	317.35K	44.2°C
Potassium	K	19	336.65K	63.5°C

Awful Science Humor

- A small piece of ice which lived in a test tube fell in love with a Bunsen burner.
- "Bunsen! my flame! I melt whenever I see you" said the ice.
- The Bunsen burner replied: "It's just a phase you're going through."

Vaporization: **Liquid** to **Gas**

- Now let's take that water and put it into a pot over flame.
- Eventually, the water will start to boil and turn into a gas.
- Vaporization is the name of this process.
- **Boiling** is vaporization that occurs throughout a liquid.
- The temperature at which a liquid boils is its **boiling point**.
- The boiling point of water = **100ºC**

How does boiling work?

- When you're heating a pot of water, the heat energy is making the water molecules move faster and faster.
- When enough thermal energy (heat) is added, the intermolecular forces in the substance are completely overcome and the liquid becomes a gas.