Heat Energy

Take-home lesson: The heat energy of a substance is determined by how active its atoms and molecules are.

A hot object is one whose atoms and molecules are excited and show rapid movement. A cooler object's molecules and atoms will be less excited and show less movement. When these guys are in the excited state, they take up a lot of space because they're moving around so fast. When the atoms and molecules settle down, or cool down, they take up less space.

Materials:
Heat energy worksheet (1 per student)
Pencil (1 per student)
Crayons/color pencils (can also sketch with regular pencil)
Empty bottle (1 per pair of students)
Balloon (1 per pair)
water
rubbing alcohol (~1/4 of plastic bottle; try to underestimate first to make sure we have enough)
plastic drinking straw (1 per pair)
modeling clay (1 per pair)
food coloring (~1-3 drops for thermometer)

Access to hot water bath (spread out in classroom)

Water Molecules on the Move Demonstration (15 mins)
This experiment is great for testing if hot water molecules really move faster than cold ones. Pour some water, drop in some food coloring and compare results.
What you'll need:
A clear glass filled with hot water
A clear glass filled with cold water
Food coloring
An eye dropper
Instructions:
Fill the glasses with the same amount of water, one cold and one hot.
Put one drop of food coloring into both glasses as quickly as possible.
Watch what happens to the food colouring.
What's happening?
If you watch closely you will notice that the food coloring spreads faster throughout the hot water than in the cold. The molecules in the hot water move at a faster rate, spreading the food coloring faster than the cold water molecules which mover slower

Warm Air Needs More Room (10 mins)
As its temperature rises, air starts to act a little differently. Find out what happens to a balloon when the air inside it heats up with this fun science experiment for kids. Note: The activity is very simple so try to ask questions about energy and heat. Think about applications like hot air balloons and thermometers.
What you'll need:
Empty bottle
Balloon
Pot of hot water (not boiling)
Instructions:
Stretch the balloon over the mouth of the empty bottle.
Put the bottle in the pot of hot water, let it stand for a few minutes and watch what happens.
What's happening?
As the air inside the balloon heats up it starts to expand. The molecules begin to move faster and further apart from each other. This is what makes the balloon stretch. There is still the same amount of air inside the balloon and bottle, it has just expanded as it heats up.

Warm air therefore takes up more space than the same amount of cold air, it also weighs less than cold air occupying the same space. You might have seen this principle in action if you've flown in or watched a hot air balloon.

Making a Thermometer (20 mins)
MATERIALS:
clear, plastic bottle
water
rubbing alcohol
clear plastic drinking straw
modeling clay
food coloring
PROCESS:
Fill about 1/4 of the bottle full with equal parts of water and rubbing alcohol.
Add a few drops of food coloring.
Put the straw in the bottle, but don't let it touch the bottom.
Use the modeling clay to seal the neck of the bottle, so the straw stays in place. (Make sure the straw does not touch the bottom of the bottle.)
Hold your hands on the bottom of the bottle and watch the mixture move up through the straw.
Explanation: Bulb thermometers rely on the simple principle that **a liquid changes its volume relative to its temperature**.

Wrap-up Discussion (10 min)
As a group, we can pretend to be molecules. When it is cold, molecules are close-packed and move slowly. When it is warmer, molecules move quickly and spread out over a large area (volume).