Heat.

Properties :

- Materials that are heated expand and get a lower density.
-

Heat: air/gas.

- Heated air takes up more place than cold air.
- Heated air had a lower density than cold air and rises.

  ⇨ This difference in pression results in forces.
- Evaporation makes colder.
- While burning, oxygen is needed.
- Friction causes heat.
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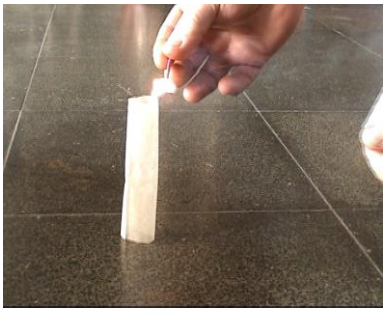
Heat: metals, solid materials.

- Some materials expand more than other ones.
- Metals are good heat conductors.
- Other materials almost don't conduct heat. They are isolators.

1. The flying tea-bag.



Material:

Tea-bag, matches.

Action:

Empty the tea-bag, unfold it and put up the roll.
Light the top of the tea-bag.

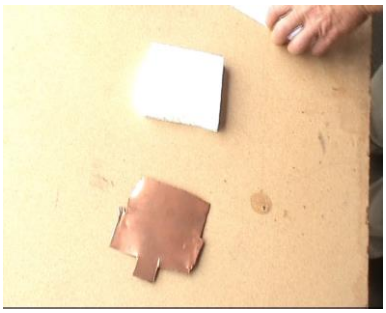
What will happen?

The ashes of the bag rise.

Why?

While burning, the air is heated and rises together with the ashes.

2. Fire.



Material:

A piece of polystyrene, a sheet of metal (copper or iron), two pieces of paper, matches.

Action:

Put a piece of paper on the thin plate of metal. The other piece of paper is put on the polystyrene. Lay a burning match on each piece of paper.

What will happen?

The piece of paper on the polystyrene will catch fire, but the one on the metal plate will not.

Why?

Metal is a heat conductor. The metal takes up the heat from the match, so the paper won't become very hot. Meanwhile, the polystyrene nearly doesn't take up any heat. The material contains a lot of air, which is a bad heat conductor. The piece of paper on the polystyrene heats up and catches fire.

3. The hot bottle.

Material:

A glass bottle, a Bunsen's burner or a good fire, matches, a bucket with cold water.

Action:

Heat the bottleneck well by slowly turning it around above the source of heat. Then quickly put the bottle upside down in the bucket with water.

What will happen.

The bottle will burst.

Why?

The bottleneck has become larger because of the heat. By quickly cooling it down in the water, the glass shrinks again. The cooling down doesn't happen gradually, so the glass doesn't shrink equally fast over the whole bottleneck. This causes the bottle to burst.

4. The long and the short spring.

Material:

A bimetallic strip (two pieces of metal – here aluminium and iron – bound together) with a wooden handle, a Bunsen's burner or a good fire, matches, a metal thermometer (with spring).

Action:

Heat the bimetallic strip.

What will happen?

The strip bends because of the unequal expansion of the two metals.

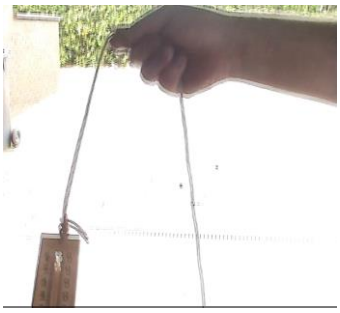
Why?

Iron is a better heat conductor than aluminium.

Bimetallic strips are used in metal thermometers, coffee machines, thermostats,…

5. Respiration.





Material:

A thermometer on a thread, some cotton-wool, ether (or water).

Action:

Read the temperature on the thermometer.
Fasten a piece of cotton-wool on the reservoir at the bottom of the thermometer and put some ether (or water) on it.
Whirl the thermometer about while holding the thread.
Now read the temperature again.

What will happen?

Whirling the thermometer about helps the cotton-wool to dry. The ether (or water) evaporates faster because of the movement. The temperature will sink.

Why?

In order to evaporate, a fluid needs heat. This heat is subtracted from the near environment. In this case, heat is subtracted from the fluid in the thermometer.
When we sweat, our body cools down. The sweat subtracts heat from our body to evaporate.

6. Galileo's thermometer.

Material:

Galileo's buoyancy thermometer is a cylinder filled with water. Glass bulbs float around in the water. They are filled with a (coloured) fluid. All bulbs have their own, exact density. When all bulbs are floating, this means that the temperature of the water in the cylinder (which is also the temperature of the environment) is low. As the temperature goes up, more and more glass bulbs sink to the bottom of the cylinder. The real temperature of the water is shown on the bulb which indicates the lowest temperature of the bulbs that are still floating. This bulb can float deeper in the cylinder than other floating bulbs, but it has not reached the bottom yet.

Action:

Look at the glass bulbs in the thermometer and read the temperature.
Then hold the cylinder for a while with both hands, in order to heat it.

What will happen?

The glass bulbs will sink.

Why?

The density of the water varies with the temperature. Heat makes the water expand and lowers its density. Because the bulbs all have a different density, they will go up or down in this changing environment. When their density is higher than that of the water, they sink. This happens when the water is heated. When the density of the fluid in the bulbs is lower than that of the water, they float. This is the case when the temperature is low.

7. The locked up candle.



Material:

Two half plastic bottles that fit into each other: the bottom half is wider and the top half contains the bottleneck with the opening of the bottle. A small candle, matches, some water, a metal sheet in the shape of a T.

Action:

1. Put the burning candle in the bottom half of a bottle. Cover with the open top half of another bottle that is less wide.
2. Pour some water in the bottom half of a bottle and put a burning candle in it. Cover with the open top part.
3. Repeat what you did the second time, but now hang the metal plate as a separation in the opening of the bottleneck.
4. Remove the metal sheet and close the bottle.

What will happen?

Different things will happen in the different cases.

1. The candle keeps on burning.
2. The candle slowly extinguishes.
3. The candle keeps on burning.
4. The candle extinguishes and the water rises in the bottle.

Why?

1. There is enough oxygen. While burning, oxygen is needed.
2. Apparently the oxygen didn't enter the bottle through the top hole. It came in at the bottom of the bottle. This way is now blocked by the water. New air with oxygen can not enter the bottle through the top hole because the hot air in the bottle rises and uses this hole to get out.
3. By separating the opening at the top of the bottle, hot air can get out on one side of the metal plate, while cold air with oxygen is able to get in on the other side.
4. When all oxygen in the bottle is used up, the candle stops burning. The space that was taken up by the oxygen can be filled with water.

8. The weak can.



Material:

An empty can (which used to contain soda) with only a small opening at the top, a bit of water in the tin, a bucket of water, a Bunsen's burner or fire, a pair of tongs to hold the can.

Action:

Hold the tin with the fire-tongs and heat it in the flame of the Bunsen's burner or fire. Continue until you see vapour or smoke escaping.
Then very quickly plunge the tin upside down in the bucket with water.

What will happen?

The can collapses.

Why?

By heating the tin which contains some water, you create a lot of vapour inside. When the can is cooled down really fast, this vapour becomes water again, which takes up less space than the vapour. The opening of the tin is blocked by the water in the bucket, so no fresh air can get in to fill this space. The water does not get in fast enough to prevent the breaking down of the tin. It collapses because the pressure outside is higher than the pressure inside. This pressure pushes so much on the sides of the can that it breaks down.

9. The phantom from the bottle.

Material:

A cold glass bottle with a small bottleneck, a coin.

Action:

Make sure the bottleneck is a bit wet before you put a coin over the opening which fully closes the bottle.
Put your hands around the cold bottle to heat the air inside.

What will happen?

The coin jumps up.

Why?

The air in the bottle expands, it needs more space because it is heated. Some air needs to escape from the bottle, so it pushes against the coin in order to get out.

10. The balloon that doesn't melt.

Material:

Two balloons, a candle, some water.

Action:

1. Put some water in a balloon and blow it up further. Hold the balloon above the burning candle.
2. Blow up the second balloon without putting water in it. Now also hold it above the burning candle.

What will happen?

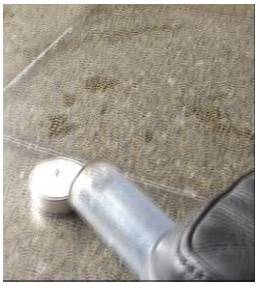
Does the material of the balloon melt or not?

1. The balloon doesn't melt.
2. The balloon melts. Bang!

Why?

1. The balloon can pass on the heat to the water. By doing this, the balloon itself doesn't get so hot.
2. The balloon becomes very hot and melts. It pops.

11. The running fire.


Material:

A thick but not too wide plastic hose (preferably translucent), a candle, a match, some acetone or dissolvent, a small syringe.

Action:

Light the candle and bring the opening of the hose close to the flame so the air in the hose is heated. Hold the other opening of the hose high up in the air.
Take some acetone or dissolvent (0,5 ml) from the bottle with a syringe and spray it into the hose through the opening you're holding up.

What will happen?

A flame comes out of the hose!

Why?

Properties of acetone or dissolvent: evaporates quickly, is highly inflammable and its vapour is heavier than air.
The acetone or dissolvent evaporates almost instantly. Because the vapour is so heavy, it goes down in the hose. When it reaches the flame at the other opening, the vapour catches fire and the flame finds its way out of the hose through the top opening.

12. The burning soap-bubble.


Material:

Soap-suds, gas, matches.

Action:

Put some soap-suds on the palm of somebody's hand. With gas from a gas-jet, you make soap-bubbles onto the hand. Then bring a burning match near the bubbles.

What will happen?

The hand seems to catch fire!

Why?

Because of the heat, the soap-bubbles pop. The gas that was inside them catches fire. The hand is not burned because it is wet and it is underneath, not above the flame.

13. The Oxfam boat sails on hot water.




Material:

A small boat with a tube in the shape of a loop, a candle.

Action:

Fill the tube with water. (You can use a syringe to do this.) Put the burning candle under the tube.

What will happen?

The ship sails.

Why?

Heated water expands. The pressure in the tube gets higher and the water leaves the tube through the top opening. It pushes against the surrounding water which causes the boat to move.

14. The lovely thermometer.


Material:

A small glass bottle with a heart, filled with red fluid.

Action:

Hold the bottle firmly with one hand.

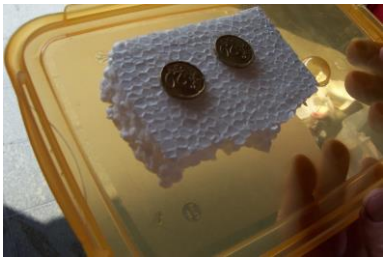
What will happen?

The fluid rises and fills the heart.

Why?

By holding the bottle, the air in the bottle is heated. Heated air expands and pushes on the red fluid, which causes it to rise.

15. The hot coin.



Material:

A piece of polystyrene, two equal coins.

Action:

Put the coins on the polystyrene. While you're not watching, let somebody pick up one of the coins and hold it for a minute. Then this person has to put it back.You have to guess which coin was picked up.

What will happen?

The coin that is held for a minute is heated. To guess which coin it was, you pick up both coins and hold them against your lips, that are very sensitive to heat.

Why?

The coins are made out of metal, which is a good heat conductor. So coins easily become warm. The heated coin doesn't lose a lot of heat to its environment, the polystyrene, since this is an isolator or bad heat conductor.

16. Burning sticks.



Material:

A wooden stick, wrapped up in paper. A metal stick, as long and thick as the wooden one, also wrapped up in paper. A burning candle.

Action:

Hold both sticks in the flame of the candle.

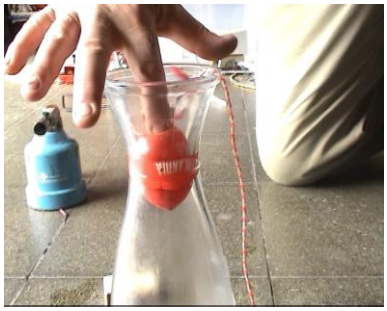
What will happen?

The paper around the wooden stick will catch fire first.

Why?

The heat conductivity of metal is greater than that of wood. The metal picks up the heat, so the paper around it doesn't get heated so quickly.

17. Balloon in the bottle.



Material:

A bottle with a bottleneck in the shape of a funnel, a balloon, a Bunsen's burner or gas-jet, matches, a bit of water.

Action:

Blow a little air in the balloon and make a knot.
Try to push the small balloon through the bottleneck.
If this doesn't work, heat the air in the bottle, using a Bunsen's burner of gas-jet.
Now try to push the balloon through the opening again. You can make the balloon slightly wet to make it easier.

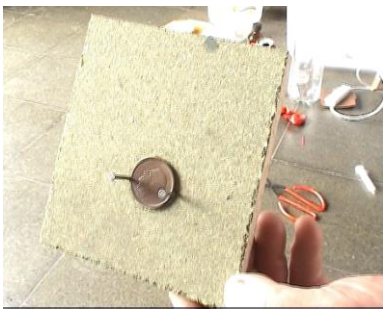
What will happen?

When the air in the bottle is heated first, you can manage to push the balloon in.

Why?

Heat makes the air in the bottle expand, but when it cools down, it shrinks again and there is more space in the bottle. Normally, new air will enter the bottle. When this is closed because of the balloon, the balloon will practically be pushed into the bottle by the air outside, because the pressure outside is higher than the one inside the bottle. Making the balloon slightly wet can help because then it will better close the opening of the bottle, preventing any air coming in.

18. The coin between two nails.



Material:

A coin, a burning candle, a piece of wood with two nails that are placed at a certain distance from each other so the coin exactly fits in between them.

Action.

Let the piece of wood slope. The coin can shove exactly between the nails.
Now heat the coin in the flame of the candle. Put it back on the piece of wood and let it slide through the nails.

What will happen?

The coin doesn't fit in between the nails anymore.

Why?

When the coin is heated, it expands. It becomes too big to pass through the gate of nails. When it cools off, it will fit again.