HEAT

INTERACTIVE NOTEBOOK ACTIVITIES

THANK YOU FOR BUYING THIS PACKET. I HOPE YOU AND YOUR STUDENTS ENJOY IT. I REALLY APPRECIATE YOUR CUSTOM. I'D BE GRATEFUL IF YOU COULD LEAVE FEEDBACK (YOU GET CREDITS TOWARDS FURTHER PURCHASES FROM TPT). IN THE UNLIKELY EVENT YOU FIND A TYPO OR MISTAKE I'D BE GRATEFUL IF YOU COULD EMAIL ME AT ACORNTPT@GMAIL.COM SO THAT I CAN FIX IT. ADDITIONALLY IF YOU HAVE ANY IDEAS THAT YOU'D LIKE TO SEE ME CREATE PLEASE LET ME KNOW.

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Cut out both sliders along the solid lines using a scissors.

HEAT

TEMP

Cut along the dotted line

Cut slots along the two pairs of double lines.

is a form of energy (J)

HEAT/TEMP

a measure of hotness

Thread the sliders through the slots.

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HEAT AND HEAT TRANSFER

COMIC BOOK STYLE!

PAGES 5-8 ARE THE MATERIALS FOR THE HEAT AND TEMPERATURE COMIC.

THERE ARE DIFFERENT APPROACHES YOU COULD TAKE WITH THIS COMIC. THE FIRST PAGE OF THE COMIC IS COMPLETED AND READY TO GO. YOU COULD USE THIS IF TIME IS A FACTOR. THE STUDENTS CAN GLUE THIS INTO THEIR INTERACTIVE NOTEBOOKS AND COLOR IT IN. IT'S ALSO HANDY WHEN YOU WANT TO SHOW THEM WHAT THE COMPLETED COMIC SHOULD LOOK LIKE.

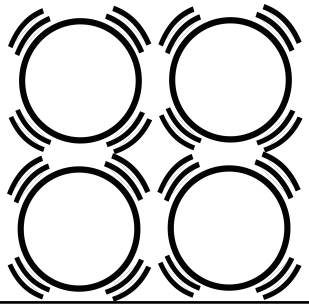
THE SECOND PAGE IS A BLANK COMIC TEMPLATE WITH CAPTIONS. STUDENTS WILL GLUE THIS INTO THEIR INTERACTIVE NOTEBOOKS. STUDENTS WILL READ THROUGH THE TEXT AND COMPOSE THEIR OWN COMICS USING THE IMAGES SUPPLIED OR YOU COULD LET THEM ADD THEIR OWN DRAWING. LET THEIR CREATIVITY SHINE!

THE FINAL PAGE IS DIFFERENTIATED. WITH THIS VERSION THE TEXT IS SUPPLIED AND THE STUDENTS HAVE TO MATCH THE IMAGE TO THE PANEL.

THE EXPANSION OF SOLIDS, LIQUIDS AND GASES (9-12) AND HEAT TRANSFER (13-16) ARE DEALT WITH IN THE SAME WAY.

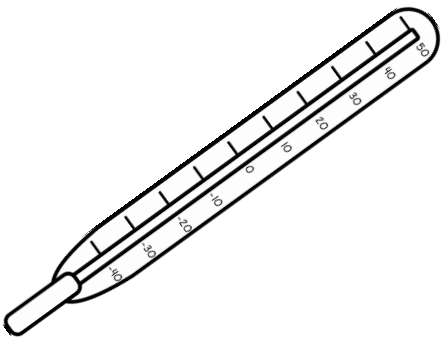
HEAT IS ENERGY

EVERYTHING IS MADE UP OF ATOMS OR MOLECULES. THESE TINY PARTICLES MOVE A LOT. THEY JIGGLE. THE MORE ENERGY THEY HAVE THE MORE THEY JIGGLE. THIS IS WHAT HEAT IS, A FORM OF ENERGY.



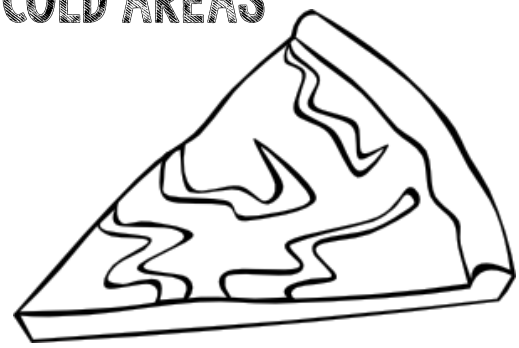
ENERGY CAN MAKE SOMETHING MOVE

IF SOMETHING HAS ENERGY THEN IT MEANS IT CAN DO WORK, THAT IS IT CAN MAKE SOMETHING MOVE.



IF YOU PLACED A THERMOMETER INTO YOUR HAND WHAT WOULD HAPPEN? HOW DOES THIS PROVE THAT HEAT IS ENERGY?

HEAT MOVES FROM HOT AREAS TO COLD AREAS



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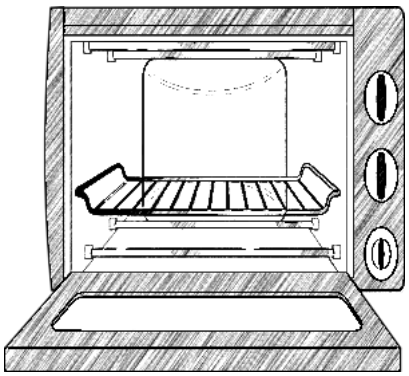

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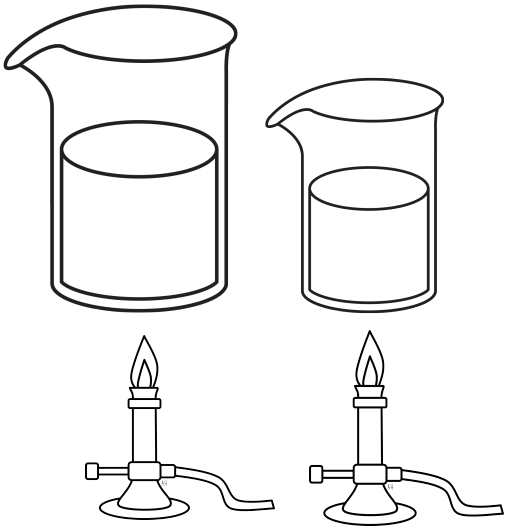

EVEN THOUGH BOTH FLASKS GET THE SAME AMOUNT OF HEAT THE SMALLER FLASK WILL HAVE A HIGHER TEMPERATURE READING. THIS IS BECAUSE THERE ARE FEWER ATOMS TO SHARE THE HEAT ENERGY WITH SO THEY GET MORE ENERGY MORE QUICKLY.

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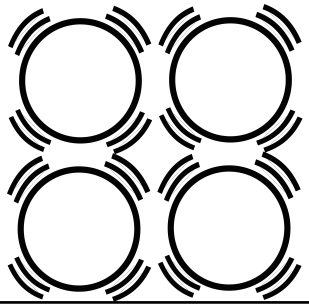

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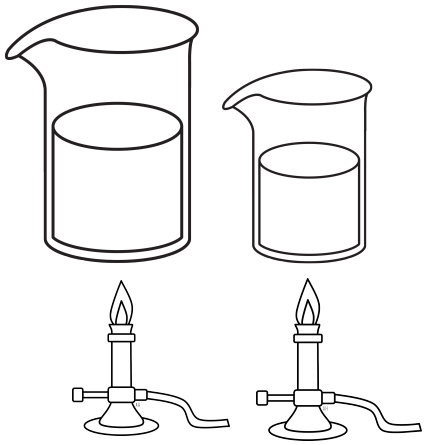

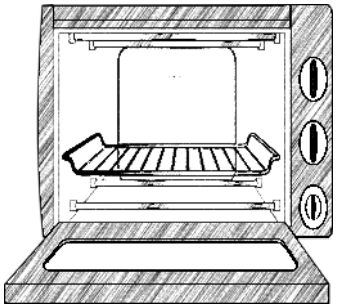

If something has energy then it means it can do work, that is it can make something move.
If you placed a thermometer into your hand what would happen? How does this prove that heat is energy?
What happens to your hot slice of pizza if you leave it for too long? Yep it gets cold. Nice cold slice of pizza you got there. Where does the heat go? Into the surroundings (which are...yep, colder than the pizza!).
If you wanted to heat up your pizza again you'd put it into something that was hotter like an oven so that heat would move from the hot oven into the cold pizza.
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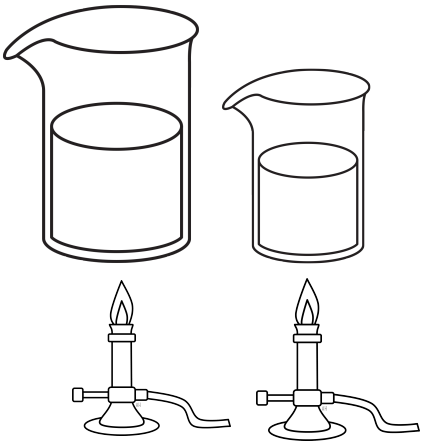
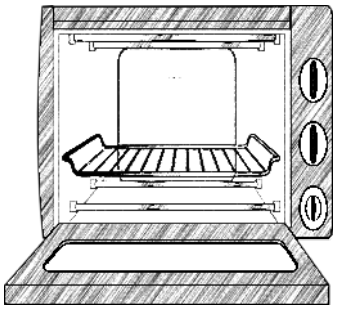
Even though both flasks get the same amount of heat the smaller flask will have a higher temperature reading. This is because there are fewer atoms to share the heat energy with so they get more energy more quickly.
It takes more energy to boil the larger beaker of water because there are more atoms.





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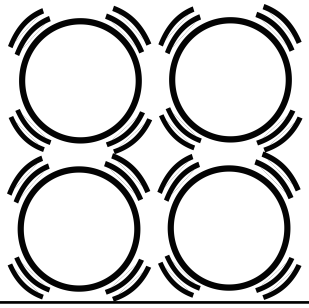

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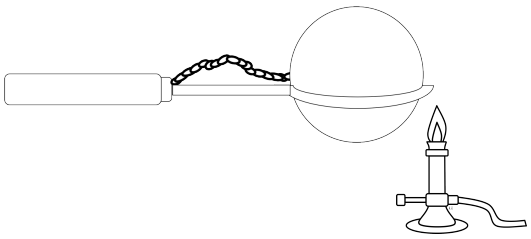
SOLIDS EXPAND WHEN HEATED



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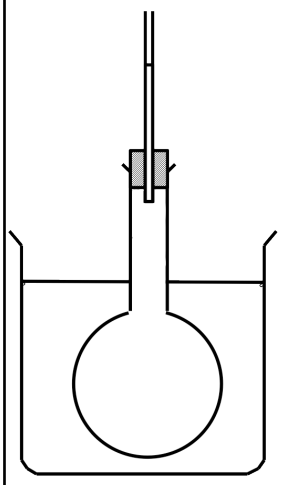

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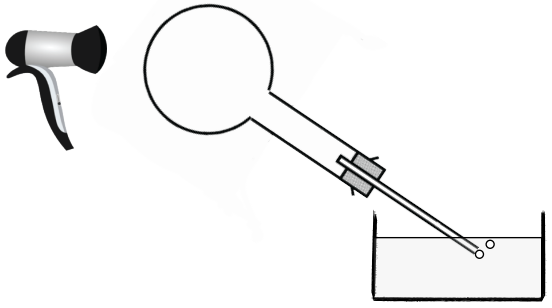
GASES EXPAND WHEN HEATED



IF YOU HEAT A FLASK OF AIR YOU'LL SEE BUBBLES APPEAR IN THE WATER TROUGH. THIS IS BECAUSE THE AIR EXPANDS WHEN HEATED.

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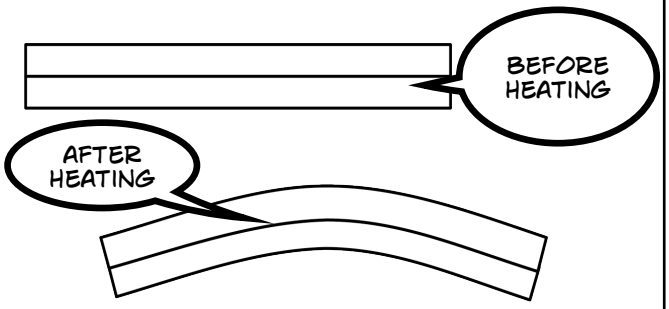
BIMETALLIC STRIP



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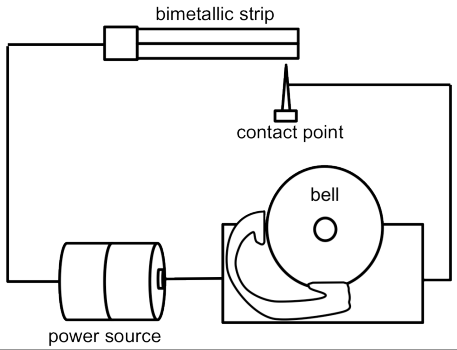
FIRE ALARM



YOU CAN SEE HOW THE BIMETALLIC STRIP IS USEFUL IN A FIRE ALARM. AT NORMAL TEMPERATURES THERE IS NO CONTACT SO THE ALARM DOESN'T SOUND. IF THE BIMETALLIC STRIP GETS HOT ENOUGH IT WILL BEND MAKING A COMPLETE CIRCUIT.

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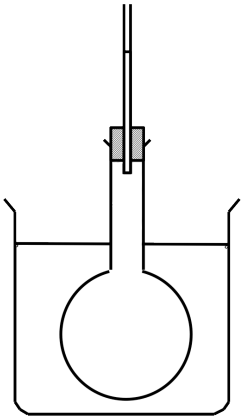
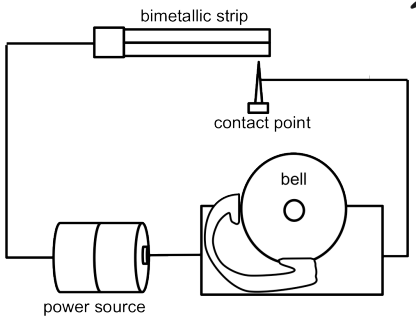
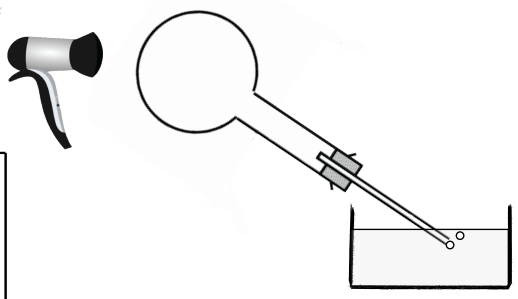
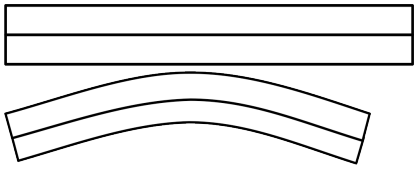
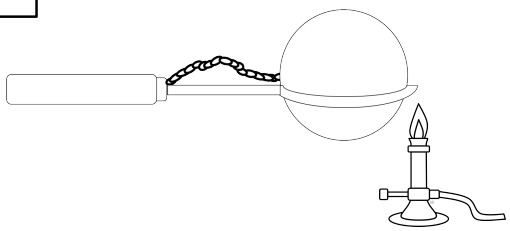






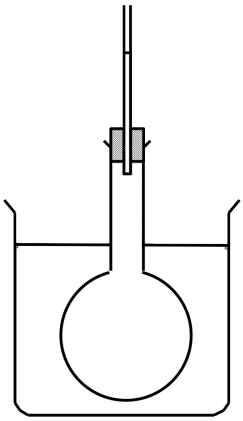


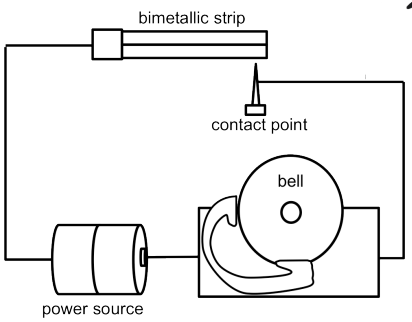


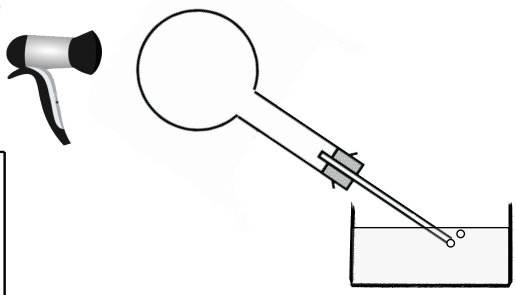
When cold the metal ball will just fit through the ring. But when you heat the ball it expands slightly and no longer fits through the ring. If you let the ball cool it will fit through the ring again proving that (a) metals expand when heated and (b) they contract when cold.

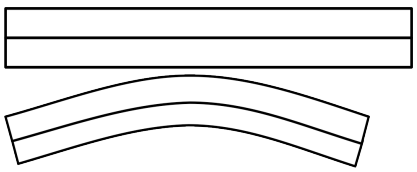
Add a few drops of food colouring to the water inside the flask. Place the flask in a trough of hot water and see what happens.
The coloured water will expand and rise up the tube. What will happen when you allow the flask to cool?
If you heat a flask of air you'll see bubbles appear in the water trough. This is because the air expands when heated.
What do you think will happen when you let the flask cool?

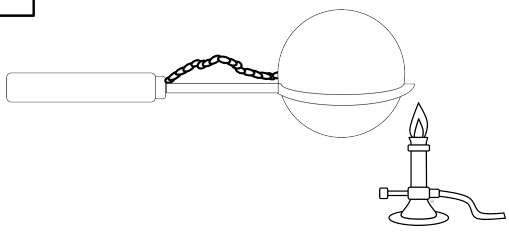
A bimetallic strip is two different metals joined together. Metals expand at different rates. When a bimetallic strip is heated one of the metals expands faster than the other bending the strip.
You can see how the bimetallic strip is useful in a fire alarm. At normal temperatures there is no contact so the alarm doesn't sound. If the bimetallic strip gets hot enough it will bend making a complete circuit.











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LIQUIDS EXPAND WHEN HEATED

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TRANSFER OF HEAT

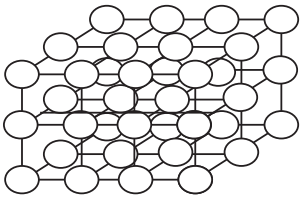
HEAT MOVES IN THREE DIFFERENT WAYS.

CONDUCTION

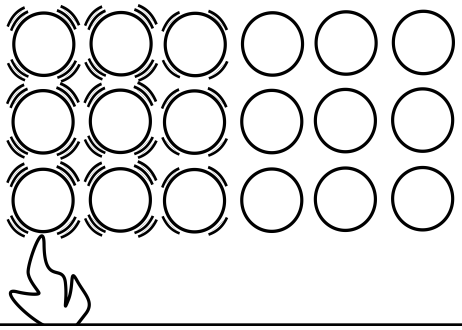
CONVECTION

RADIATION

CONDUCTION

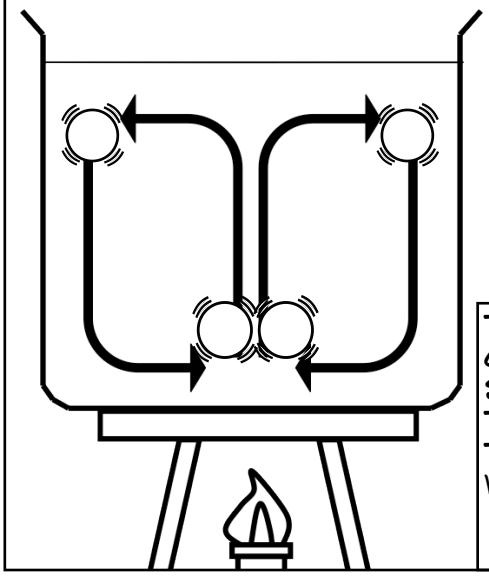


IN SOLIDS LIKE METALS THE ATOMS ARE PACKED TIGHTLY TOGETHER AND CAN'T MOVE. THEY CAN JIGGLE BUT THEY CAN'T MOVE POSITION. SORT OF LIKE TRYING TO DANCE IN A REALLY PACKED DISCO.



WHEN A METAL GETS HOT THE HEAT ENERGY PASSES FROM ONE ATOM TO THE NEXT. THE ATOMS STAY IN PLACE AND JIGGLE PASSING THE ENERGY ALONG THE METAL. THIS IS HOW A SPOON HEATS UP IN HOT LIQUID.

CONVECTION



THE PARTICLES IN A LIQUID OR A GAS ARE FREE TO SLIDE PAST EACH OTHER. THEY TRANSFER HEAT BY TAKING THE HEAT ENERGY WITH THEM AS THEY MOVE.

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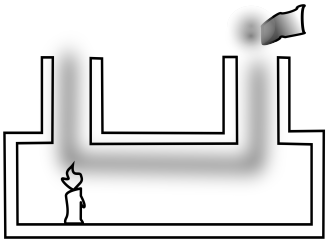
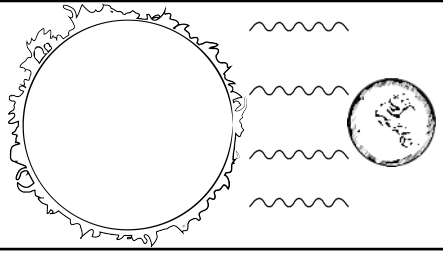


RADIATION

EVERY OBJECT GIVES OFF HEAT OR THERMAL ENERGY BY INFRARED RADIATION. THE HOTTER THE OBJECT THE MORE RADIATION IT GIVES OFF. RADIATION TRAVELS IN WAVES. RADIATION IS HOW WE FEEL THE HEAT FROM THE SUN.



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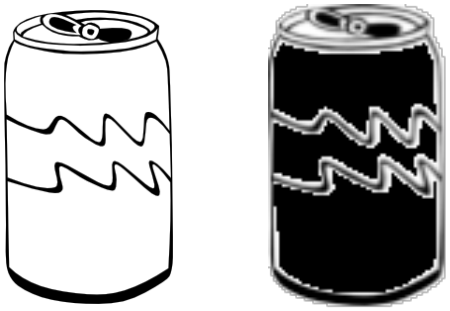

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TRANSFER OF HEAT

HEAT MOVES IN THREE DIFFERENT WAYS.

CONDUCTION

CONVECTION

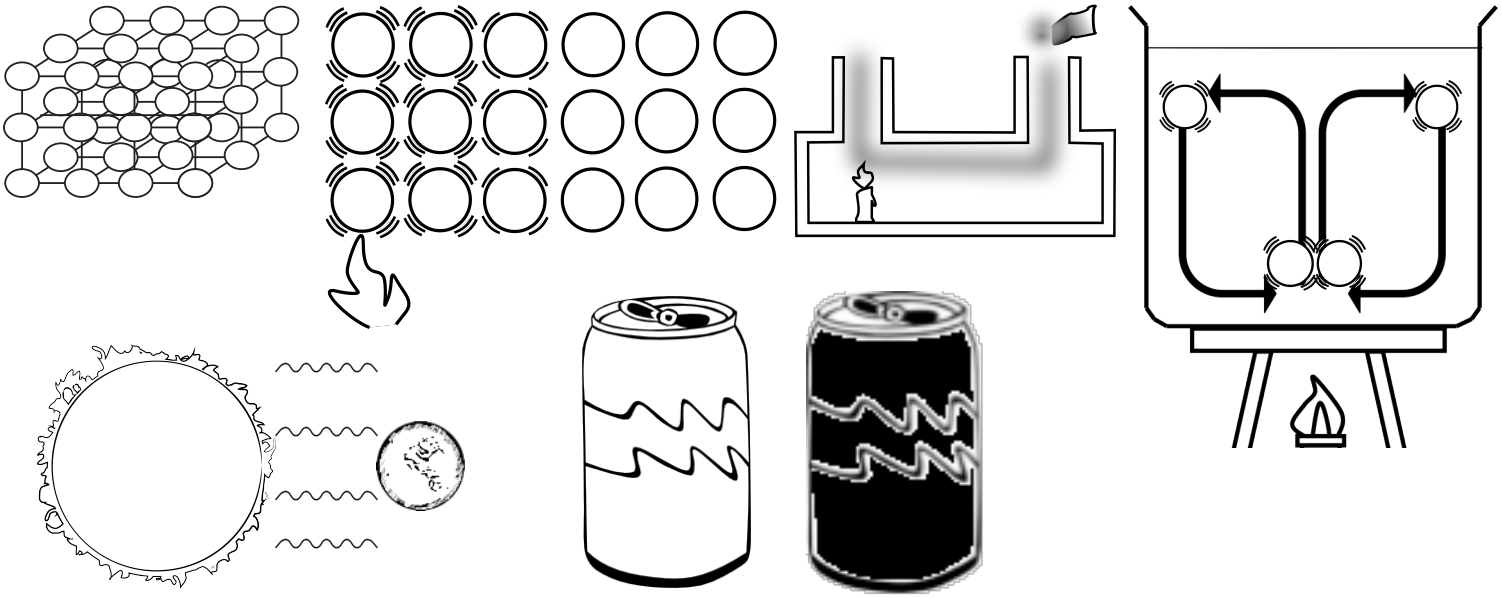
RADIATION

CONDUCTION

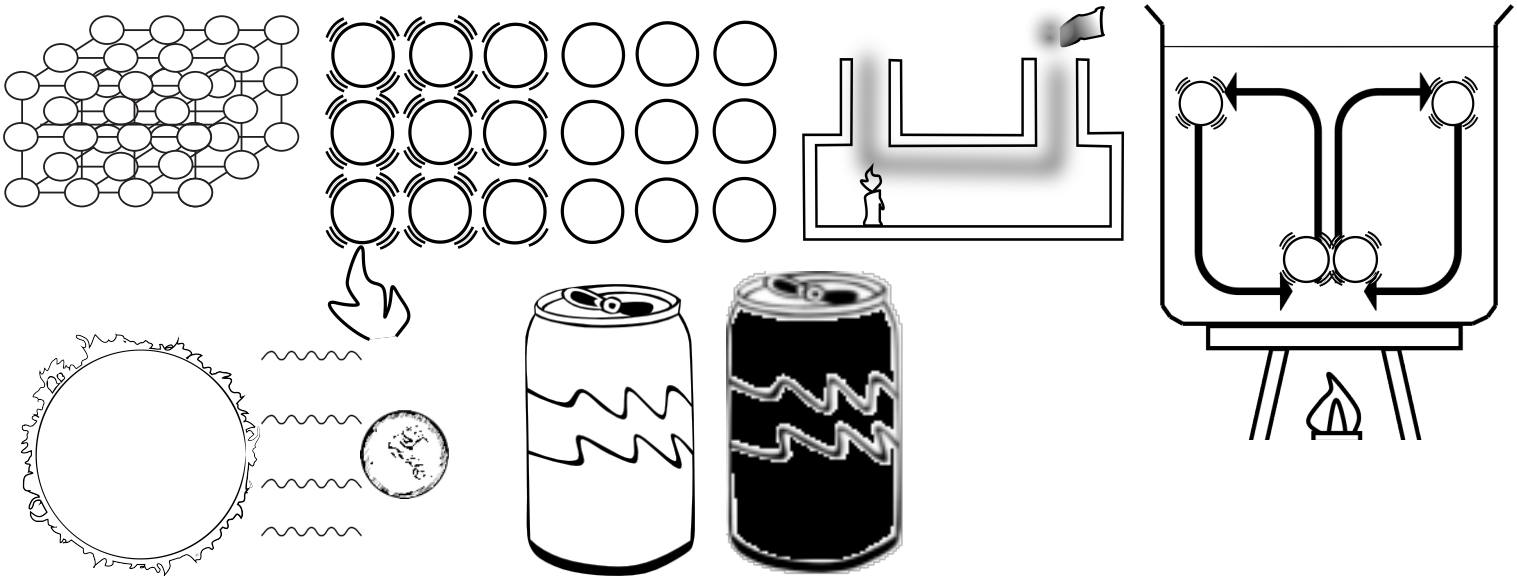
CONVECTION

RADIATION

RADIATION



In solids like metals the atoms are packed tightly together and can't move. They can jiggle but they can't move position. sort of like trying to dance in a really packed disco.
When a metal gets hot the heat energy passes from one atom to the next. The atoms stay in place and jiggle passing the energy along the metal. This is how a spoon heats up in hot liquid.
The particles in a liquid or a gas are free to slide past each other. They transfer heat by taking the heat energy with them as they move.
If you hold a smouldering piece of paper over a smoke box you'll see the smoke enter the box and leave through the other chimney. This is because heat from the candle makes the hot air rise and you can see the convection currents.
Every object gives off heat or thermal energy by infrared radiation. The hotter the object the more radiation it gives off. Radiation travels in waves. Radiation is how we feel the heat from the sun.
If you put equal amounts of hot water (at the same temperature) into a shiny can and a black can, the black can will lose heat faster than the shiny can. This is because dull surfaces are better at radiating heat.



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CONDUCTION

CONVECTION

RADIATION

CONDUCTION

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TRANSFER OF HEAT

Use the images and text on the handout to complete this accordion on the methods of heat transfer.

GLUE THIS TO YOUR INTERACTIVE NOTEBOOK

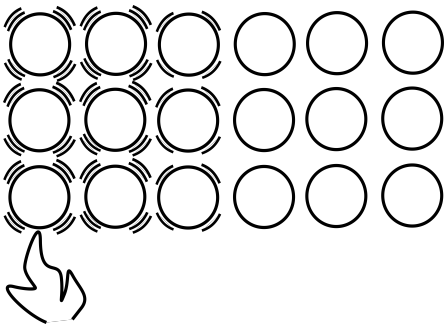
CONDUCTION

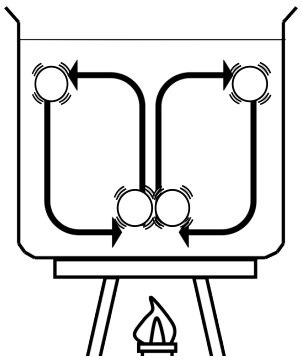
CONVECTION

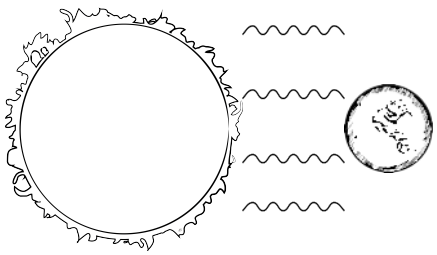
RADIATION

TRANSFER OF HEAT

Use the images and prompt questions on this handout to complete the accordion on heat transfer.
Feel free to draw/use your own examples.







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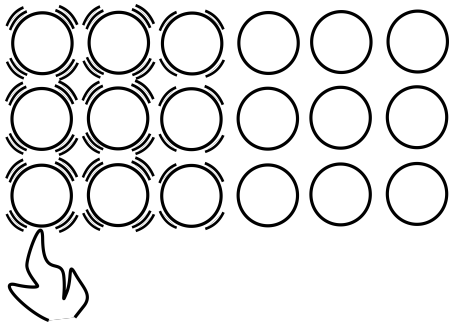

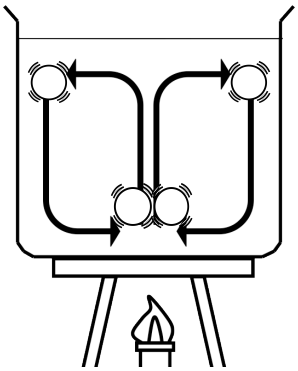

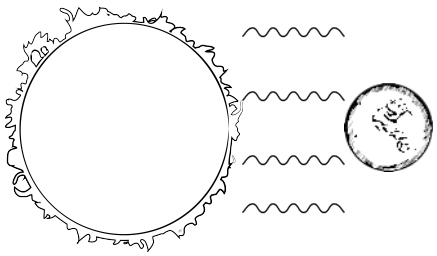

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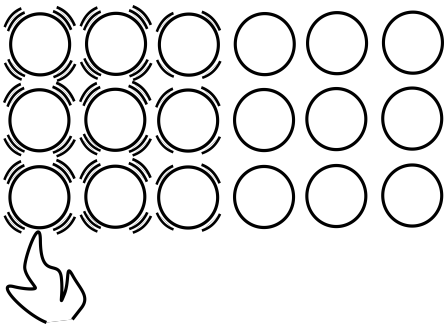

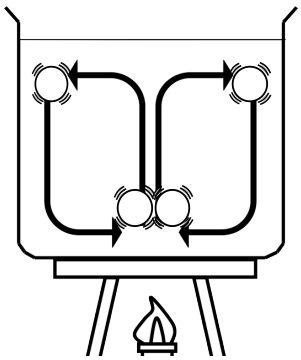

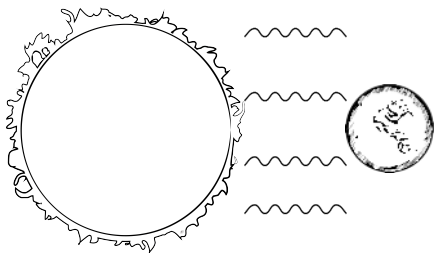

QUESTIONS TO CONSIDER.

ARE THE ATOMS IN FIXED POSITIONS OR CAN THEY FLOW?

HOW DOES THE ATOM ARRANGEMENT INFLUENCE HOW HEAT IS TRANSFERRED?

DOES THE HEAT ENERGY TRAVEL IN WAVES OR IN PARTICLES?

TRANSFER OF HEAT

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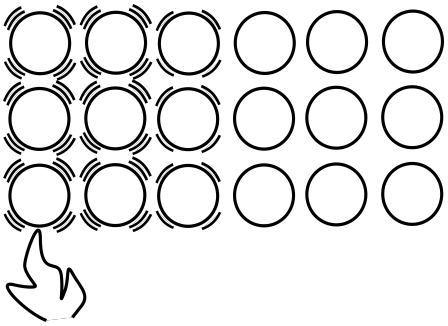

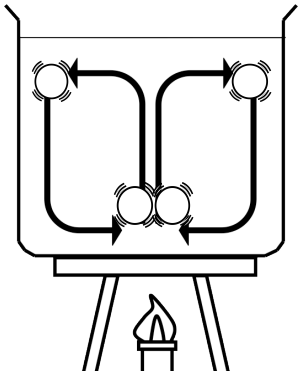

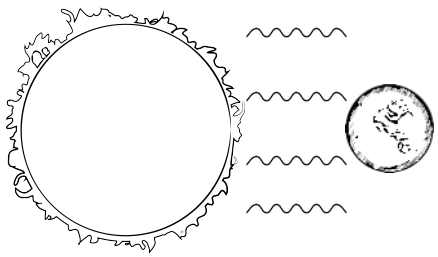

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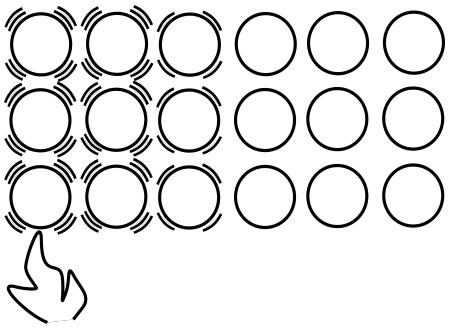
TRANSFER OF HEAT
TEACHER GUIDE

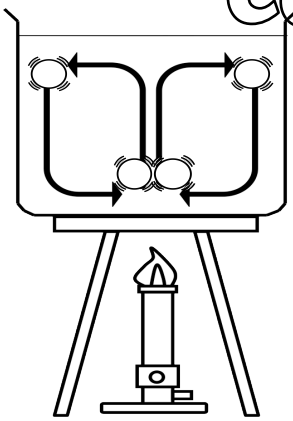
GLUE THIS TO YOUR INTERACTIVE NOTEBOOK

CONDUCTION



THE PARTICLES ARE PACKED CLOSE TOGETHER AND CANNOT MOVE FROM THEIR FIXED POSITIONS. THEY CAN JIGGLE THOUGH AND THEY PASS HEAT ENERGY FROM ONE PARTICLE TO ANOTHER. METALS ARE VERY GOOD CONDUCTORS OF HEAT.

CONVECTION



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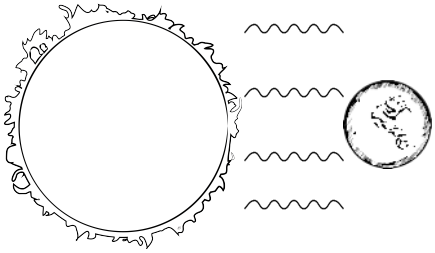
RADIATION



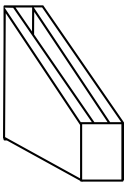
HEAT ENERGY TRAVELS BY WAVES NOT PARTICLES. THIS IS HOW HEAT TRAVELS FROM THE SUN TO EARTH.

Conductors allow heat to pass through them easily (e.g. metals). Insulators do not let heat pass through them easily (e.g. plastic). Use the images on this handout to complete the foldable. Feel free to draw/ use your own examples.

INSULATORS

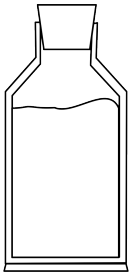
CONDUCTORS

Spoon



Double glazed windows

Copper Pan



Thermal Flask

Fur

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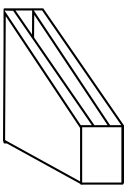

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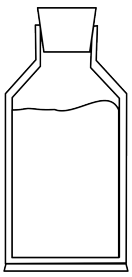

Thermal Flask

Fur

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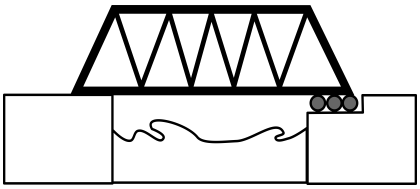
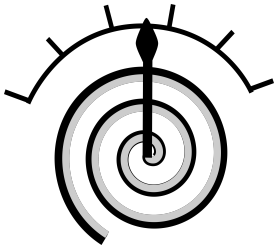
PASTE THE SHAPES INTO THE FOLDABLE AND ANSWER THE QUESTIONS THAT COME WITH EACH.



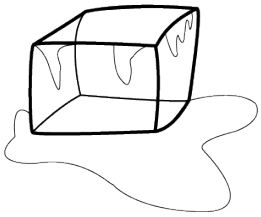
WHY IS THE BRIDGE ON ROLLERS?

WHAT METHOD OF HEAT TRANSFER IS SHOWN HERE?

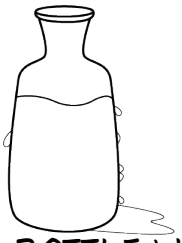


HOW DOES THIS BIMETALLIC THERMOMETER MEASURE TEMPERATURE?

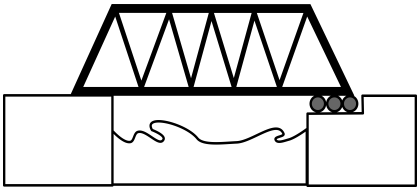
WHY IS THE FRYING PAN HANDLE MADE OF WOOD AND THE BODY MADE OF METAL?



WHY DOES ICE MELT WHEN YOU PUT IT ON YOUR HAND?



A COLD BOTTLE WILL HAVE CONDENSATION ON IT. WHY?



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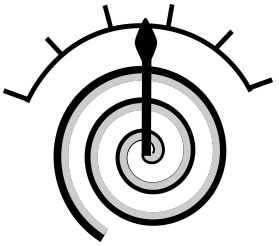

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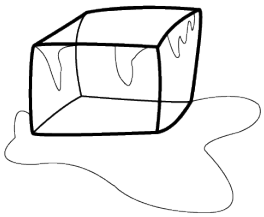

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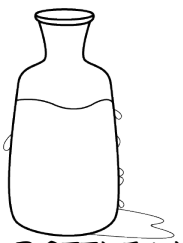

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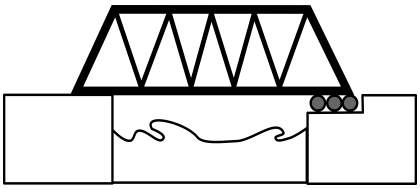
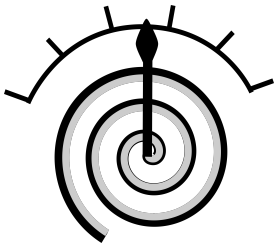


WHY IS THE BRIDGE ON ROLLERS?

HEAT CAUSES THE METAL BRIDGE TO EXPAND, THE ROLLERS ALLOW IT TO EXPAND WITHOUT BUCKLING.

WHAT METHOD OF HEAT TRANSFER IS SHOWN HERE?

CONVECTION. THE HOT STEAM SHOWS HOW HEAT IS BEING TRANSFERRED IN THE AIR.

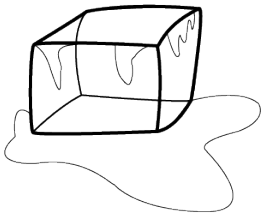


HOW DOES THIS BIMETALLIC THERMOMETER MEASURE TEMPERATURE?

HEAT CAUSES THE METALS TO EXPAND AT DIFFERENT RATES. THIS CAUSE THE SPRING TO EXPAND AND CONTRACT THUS SHOWING THE TEMPERATURE.

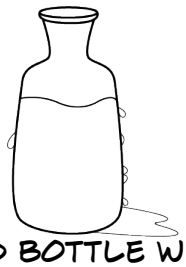
WHY IS THE FRYING PAN HANDLE MADE OF WOOD AND THE BODY MADE OF METAL?

THE BODY NEEDS TO BE ABLE TO CONDUCT HEAT, THE HANDLE SHOULD BE AN INSULATOR.



WHY DOES ICE MELT WHEN YOU PUT IT ON YOUR HAND?

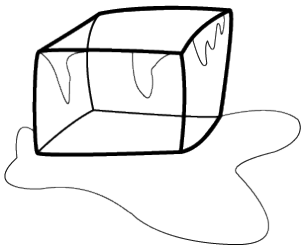
HEAT FLOWS FROM HOT TO COLD, SO IT FLOWS FROM YOUR HAND TO THE ICE. THIS GIVES THE WATER MOLECULES MORE ENERGY TO CHANGE FROM A SOLID TO A LIQUID.



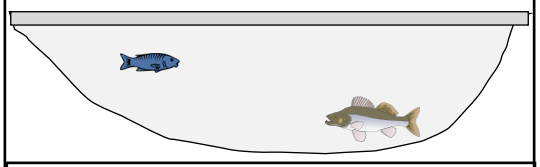
A COLD BOTTLE WILL HAVE CONDENSATION ON IT. WHY?

THE WATER VAPOUR IN THE AIR IS HOTTER THAN THE COLD BOTTLE. WHEN THIS TOUCHES THE BOTTLE IT LOSES ITS ENERGY AND TURNS FROM A GAS TO A LIQUID.

HEAT AND WATER



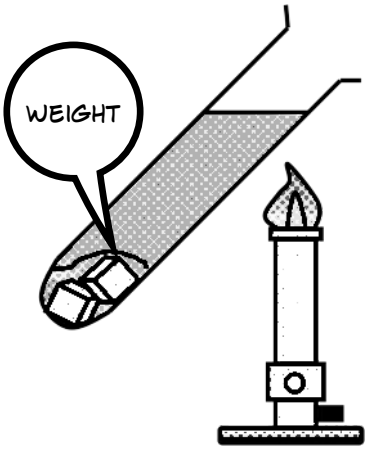
WATER IS VERY UNUSUAL. BELOW 4^{o}C WATER ACTUALLY EXPANDS. IT SOLIDIFIES AT 0C TO BECOME ICE.



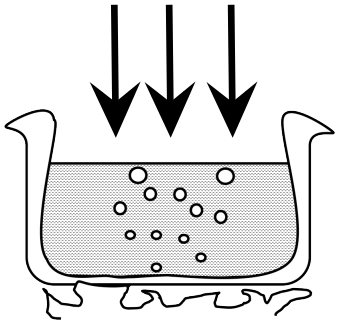
ICE IS LESS DENSE THAN WATER AND SO FLOATS ON TOP OF IT. THE ICE ACTS AS AN INSULATOR. THIS IS IMPORTANT FOR POND LIFE AS IT ALLOWS LIFE TO CONTINUE IN THE FROZEN POND.

WATER CAN EXPAND IN THE PIPES IN YOUR HOUSE DURING WINTER. THIS CAN EVEN LEAD TO BURST PIPES. YOU ONLY NOTICE THAT A PIPE IS BURST WHEN THE WATER STARTS TO THAW AGAIN.

WATER IS A POOR CONDUCTOR OF HEAT AS THIS EXPERIMENT SHOWS. EVEN WHEN THE WATER AT THE TOP OF THE TEST TUBE IS BOILING THE ICE AT THE BOTTOM WON'T MELT.



THE EFFECT OF INCREASED PRESSURE ON BOILING POINT



INCREASED PRESSURE

INCREASED BP

THE HIGHER THE PRESSURE THE HIGHER THE BOILING POINT OF WATER. THIS IS BECAUSE IT IS HARDER FOR THE WATER MOLECULES TO ESCAPE. THEY NEED MORE ENERGY TO ESCAPE.

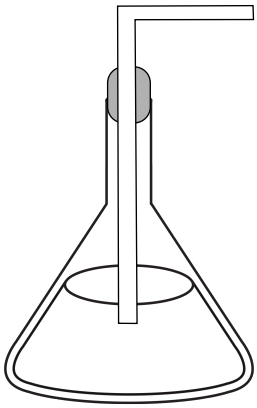
PRESSURE COOKERS MAKE USE OF THIS FACT TO COOK AT HIGHER TEMPERATURES (IT TAKES MORE ENERGY TO BOIL THE WATER SO THE FOOD COOKS FASTER).

THE EFFECT OF DECREASED PRESSURE

DECREASED PRESSURE

DECREASED BP

DECREASING THE AIR PRESSURE DECREASES THE BOILING POINT OF WATER. THIS IS NOTICEABLE ON MOUNTAINS. AS THERE IS LESS AIR PRESSURE ON THE TOP OF A MOUNTAIN WATER WILL BOIL MORE EASILY, EVEN AT 80^{o}C. IT TAKES LONGER TO COOK FOOD THOUGH.



YOU CAN SHOW HOW DECREASING PRESSURE LOWERS THE BOILING POINT OF WATER USING THIS APPARATUS.

THE VACUUM PUMP REMOVES AIR FROM THE FLASK LOWERING THE AIR PRESSURE. THE WATER WILL BEGIN TO BOIL WITHOUT THE ADDITION OF HEAT.

Make a group of 4. Take one card each and read it. When you're happy that you understand the material you must teach it to the rest of the group. Don't just read it out! Put the card face down and explain it! Each group member will write the heat fact into one of their blank cards. Then it's the next person's turn.

HEAT FACT # 1 MPEMBA EFFECT

ERASTO MPEMBA, A TANZANIAN STUDENT, DISCOVERED IN THE 1960'S THAT A HOT ICE CREAM MIXTURE FROZE FASTER THAN A COLD ONE.

AT FIRST GLANCE THIS SEEMS LIKE SCIENCE FICTION RATHER THAN SCIENCE FACT. FOR YEARS SCIENTISTS STRUGGLED TO FIND THE ANSWER. FINALLY IN 2013 THEY FOUND OUT THAT IT WAS BECAUSE OF THE HYDROGEN BONDS IN WATER.

HEAT FACT # 2 ABSOLUTE ZERO

THE COLDEST TEMPERATURE IS CALLED ABSOLUTE ZERO. IT IS 0 KELVIN WHICH IS THE SAME AS -273.15C OR -459.67F. AT THIS TEMPERATURE THERE IS NO MOVEMENT IN THE ATOMS.

HEAT FACT # 3 ABSOLUTE HOT

THE HOTTEST TEMPERATURE THAT EVER OCCURRED HAPPENED AT 10^{-43} SECONDS AFTER THE BIG BANG. THIS IS CALLED PLANCK TIME. THE TEMPERATURE WAS ABOUT 1.4 10^{32}K. IS THIS HOT? ABSOLUTELY!

HEAT FACT # 4 5TH STATE

AT TEMPERATURES CLOSE TO ABSOLUTE ZERO THE FIFTH STATE OF MATTER CAN FORM. THE BOSE-EINSTEIN CONDENSATE IS THE FIFTH STATE OF MATTER (SOLID, LIQUID, GAS, PLASMA ARE THE OTHER FOUR). THIS IS A VERY UNUSUAL STATE WHERE ALL THE ATOMS BEHAVE AS ONE (THINK OF A MARCHING ARMY MOVING IN EXACTLY THE SAME WAY). IT WAS FIRST MADE IN 1995. BECS HAVE BEEN USED TO SLOW DOWN LIGHT!

Make a group of 4. Take one card each and read it. When you're happy that you understand the material you must teach it to the rest of the group. Don't just read it out! Put the card face down and explain it! Each group member will write the heat fact into one of their blank cards. Then it's the next person's turn.

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HEAT FACT # 1 MPEMBA EFFECT

HEAT FACT # 2 ABSOLUTE ZERO

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HEAT FACT # 4 5TH STATE

TEACHER RESOURCES

This is a cool (sorry!) video showing the coldest place in the universe (a mere 177 billionths of a degree Kelvin). You might be surprised to learn where it is!

http://bit.ly/1TkkHiR

At temperatures close to absolute zero the fifth state of matter can form. The Bose-Einstein condensate is the fifth state of matter (solid, liquid, gas, plasma are the other four). This is a very unusual state where all the atoms behave as one (think of a marching army moving in exactly the same way). It was first made in 1995. BECs have been used to slow down light!

This video shows how the fifth state of matter called a Bose Einstein Condensate can be used to slow down light!

http://bit.ly/1TeYiZz

Teacher Demonstration

This is a very simple demonstration to show the effects of lowering air pressure on the boiling point of water. Fill about a quarter of a syringe with hot (not boiling!) water. Be careful not to let any air in. Cover the top with your thumb and quickly pull back the plunger to create a partial vacuum. The water will boil.

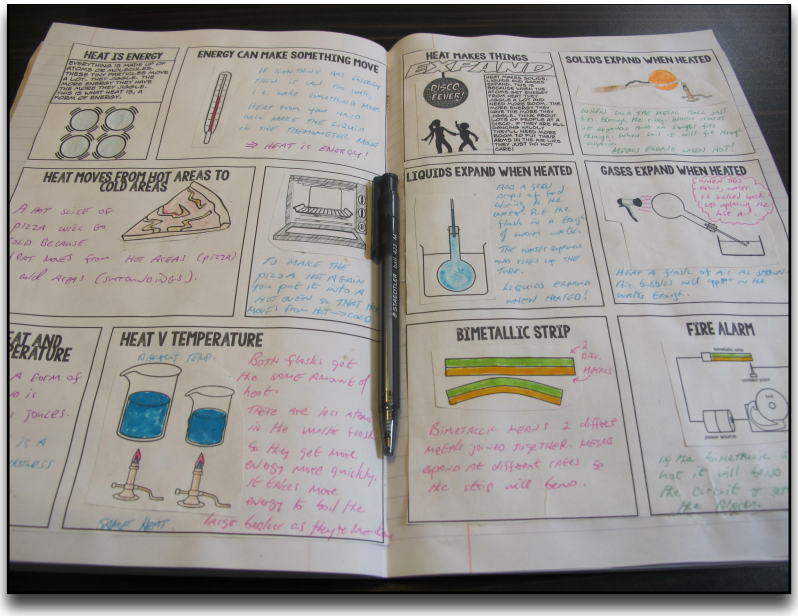
CREDITS

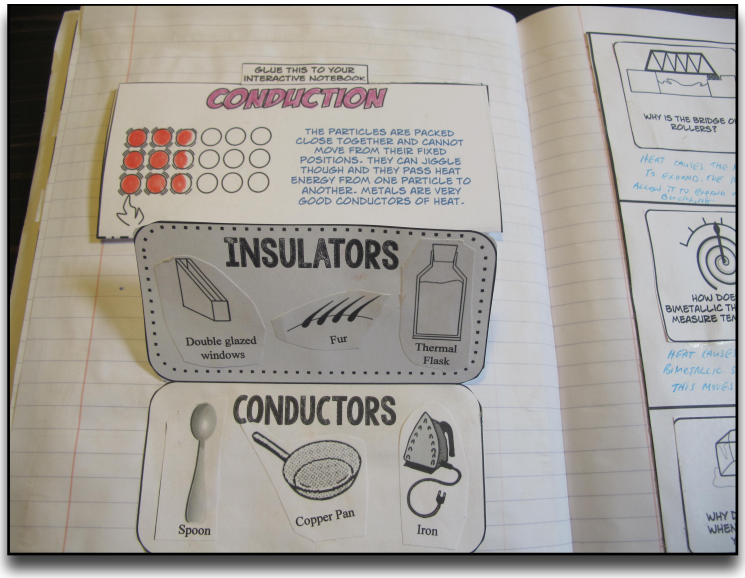
GRAPHICS BY ASHLEY HUGHES

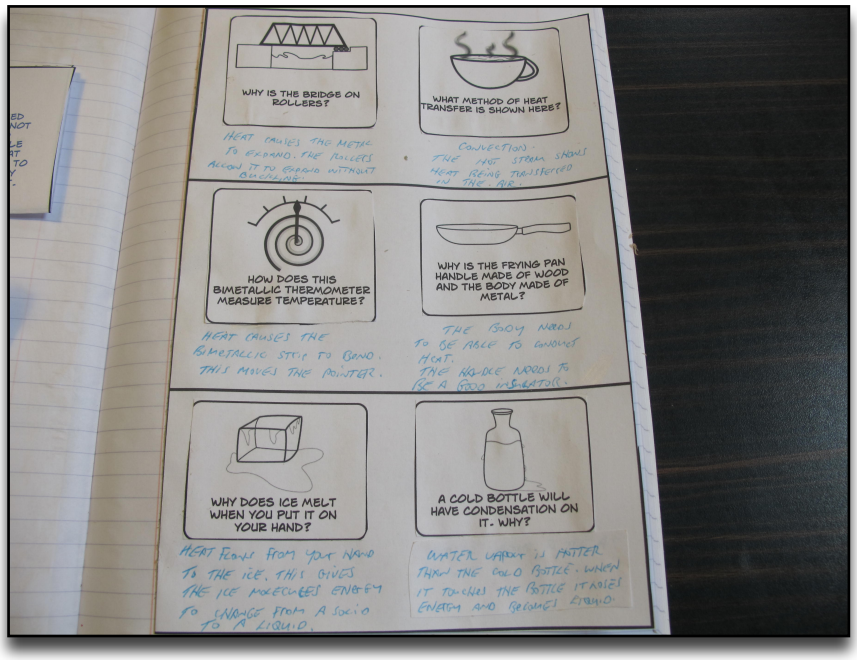
https://www.teacherspayteachers.com/Store/Maria-Okraska

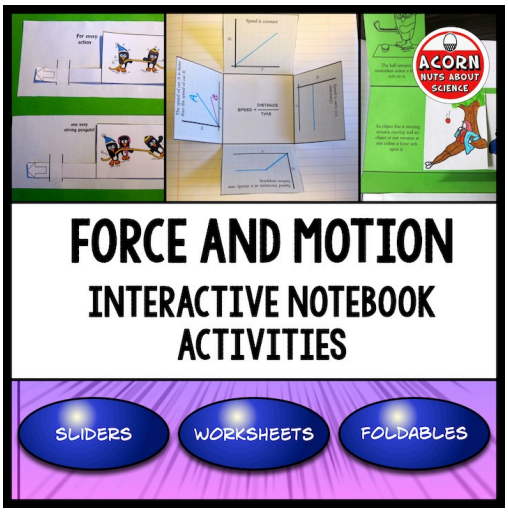
TERMS OF USE

PHOTOS

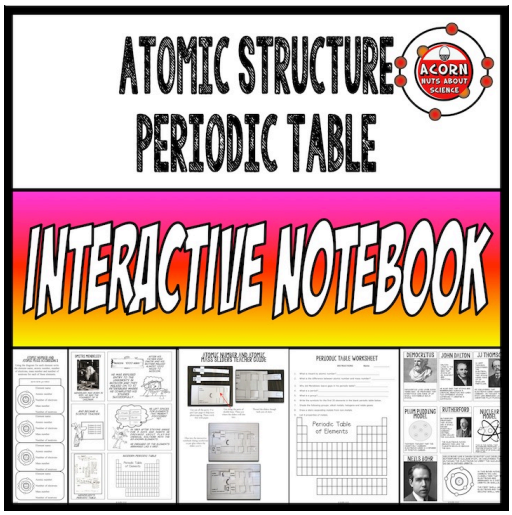

HEAT IS ENERGY
ENERGY CAN MAKE SOMETHING MOVE
HEAT MAKES THINGS EXPAND
SOLIDS EXPAND WHEN HEATED
HEAT MOVES FROM HOT AREAS TO COLD AREAS
LIQUIDS EXPAND WHEN HEATED
GASES EXPAND WHEN HEATED
HEAT V TEMPERATURE
BIMETALLIC STRIP
FIRE ALARM


GLUE THIS TO YOUR INTERACTIVE NOTEBOOK
CONDUCTION
THE PARTICLES ARE PACKED CLOSE TOGETHER AND CANNOT MOVE FROM THEIR FIXED POSITIONS. THEY CAN JIGGLE THOUGH AND THEY PASS HEAT ENERGY FROM ONE PARTICLE TO ANOTHER. METALS ARE VERY GOOD CONDUCTORS OF HEAT.
INSULATORS
Double glazed windows
Fur
Thermal Flask
CONDUCTORS
Spoon
Copper Pan
Iron

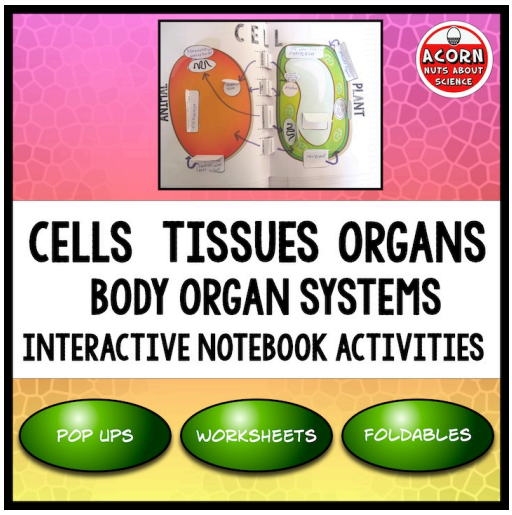

WHY IS THE BRIDGE ON ROLLERS?
WHAT METHOD OF HEAT TRANSFER IS SHOWN HERE?
HOW DOES THIS BIMETALLIC THERMOMETER MEASURE TEMPERATURE?
WHY IS THE FRYING PAN HANDLE MADE OF WOOD AND THE BODY MADE OF METAL?
WHY DOES ICE MELT WHEN YOU PUT IT ON YOUR HAND?
A COLD BOTTLE WILL HAVE CONDENSATION ON IT. WHY?



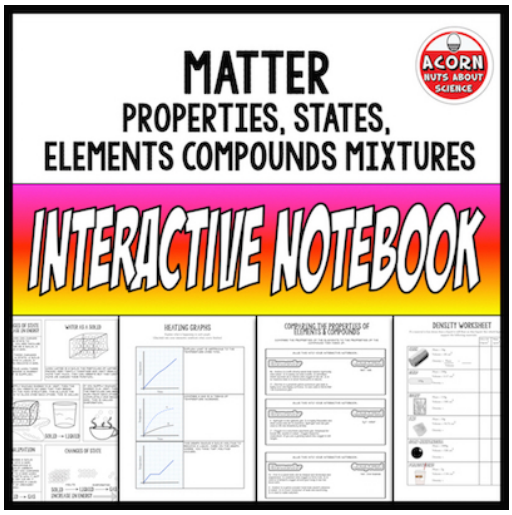
FORCE AND MOTION INB



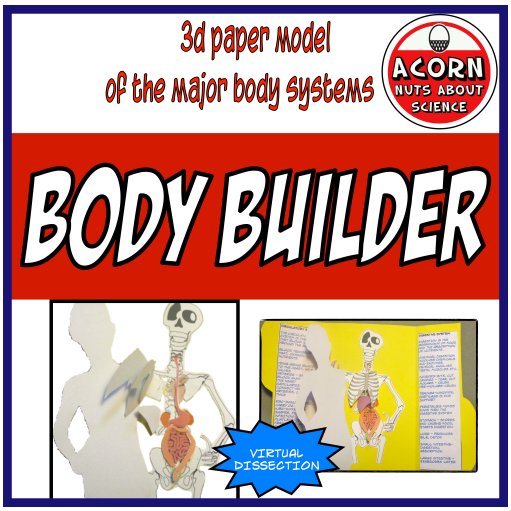
ATOM STRUCTURE PERIODIC TABLE INB



CELLS, TISSUES, ORGANS INB



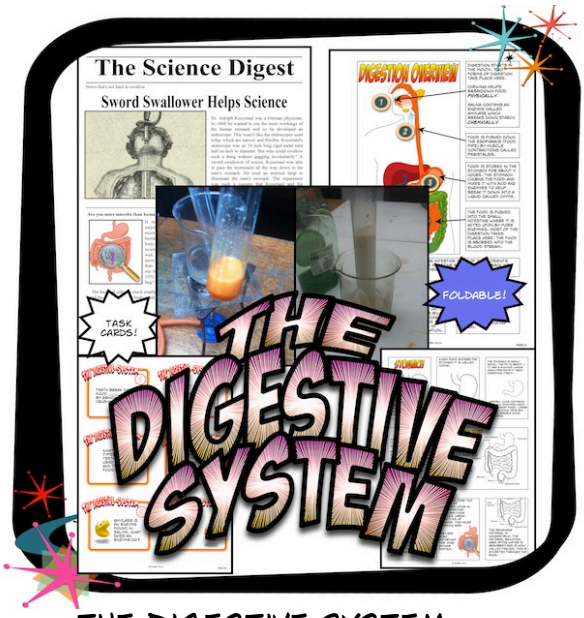
MATTER, ELEMENTS, COMPOUNDS, MIXTURES INB



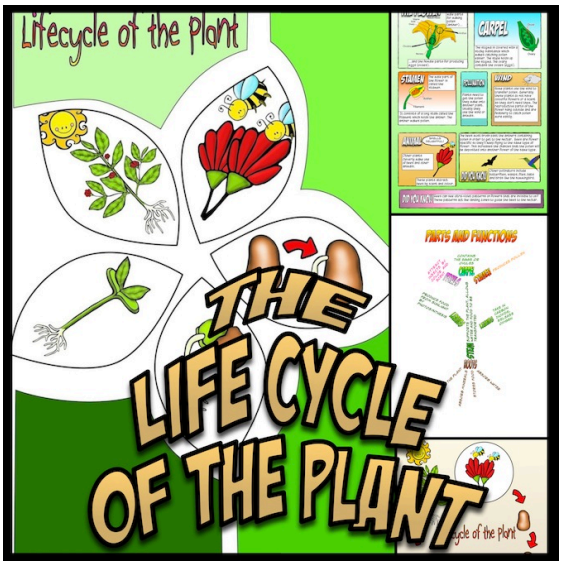
HUMAN ANATOMY PAPER MODEL VIRTUAL DISSECTION

YOU MAY ALSO BE INTERESTED IN SOME OF MY OTHER PRODUCTS.

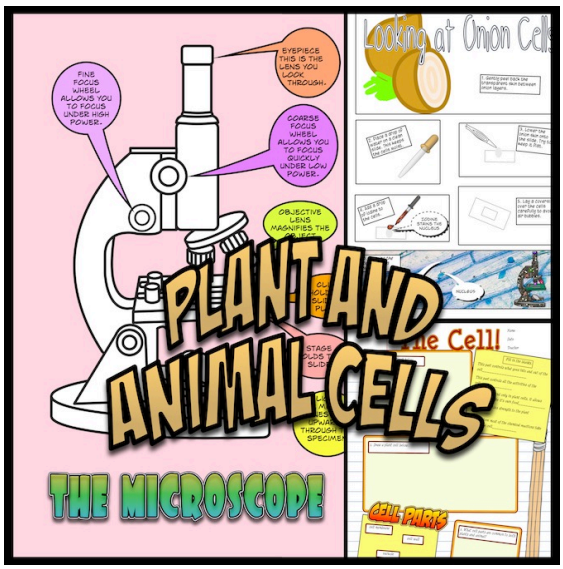
PERIODIC TABLE BINGO



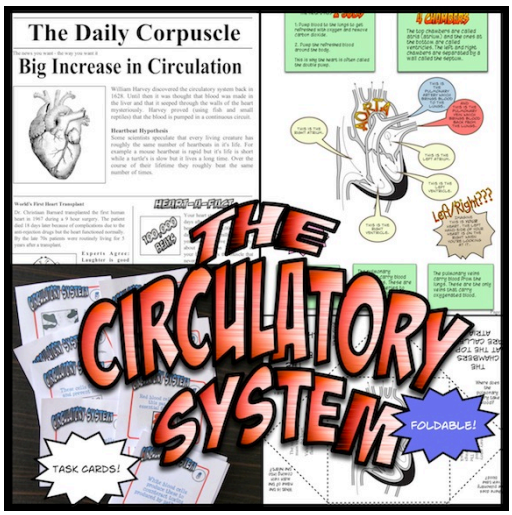
THE DIGESTIVE SYSTEM



LIFECYCLE OF THE PLANT



ANIMAL AND PLANT CELLS



THE CIRCULATORY SYSTEM

BIOLOGY BUNDLE