DoD STARBASE FLORIDA

A Department of Defense Youth Program

Name: _____

Group: _____

10 October 2023

STARBASE Code of Conduct

At **STARBASE**, we have a few important rules you need to know. Following the rules will ensure that you have a safe and enjoyable experience.

1. Have fun and learn a lot!
2. Use respectful language and behavior. Keep each other physically and emotionally safe. Keep hands, feet, and negative comments to yourself. Physical violence is cause for immediate dismissal.
3. Raise hand to be acknowledged. Listen respectfully when adults and students are speaking.
4. Food & Candy are not allowed in the classroom, especially sunflower seeds.

The **STARBASE Code** is one of **Mutual Respect, Positive Attitude, and Enthusiastic Participation** with a willingness to **Learn, Help Team-Mates, and Have Fun!**

Disciplinary Consequences

The Three **"T"'s!**

1. **T**alk to student.
2. **T**ime Out—sit out of fun activity.
3. **T**ermination—parent or principal pickup!

I fully understand the **STARBASE Code.**

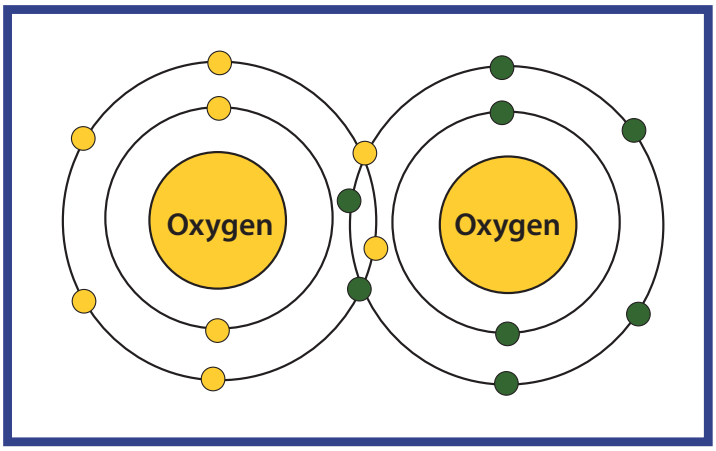
_____

Your signature.

What's the Matter?

All matter is made of small particles called _____. Atoms bond together to form _____. If all atoms in the molecule are the same kind, they form an _____. If two or more different kinds of atoms bond together, they form a _____. Most substances are _____.

Direction: Identify which model represents an element and which represents a compound. What substance is represented by each model?



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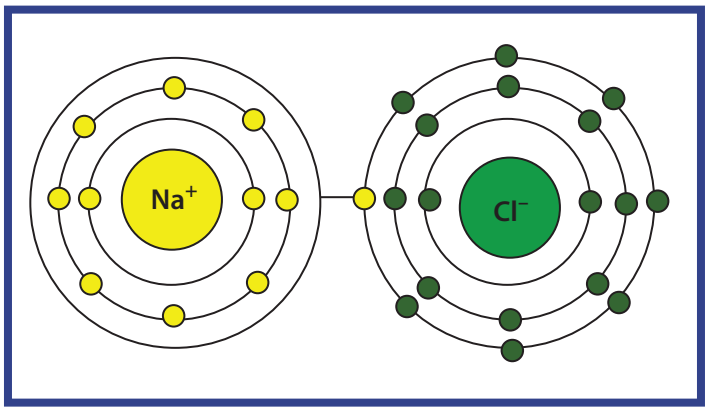


_____

1. A robot is any _____ that can be programmed to do work automatically.
2. The instructions that tell a robot what to do are called the_____
3. All robots have these three things in common:

   A. _____

   B. _____

   C. _____

4. The _____ is the program that tells the robot what to do and when to do it.
5. The _____ can be any shape from a box to something with arms and legs; it houses the mechanisms that perform the action.
6. The _____ or output is the action that the robot will perform on its own, according to the directions given.

Scoring Rubric

Goal: Move your robot from home to school without being tardy.

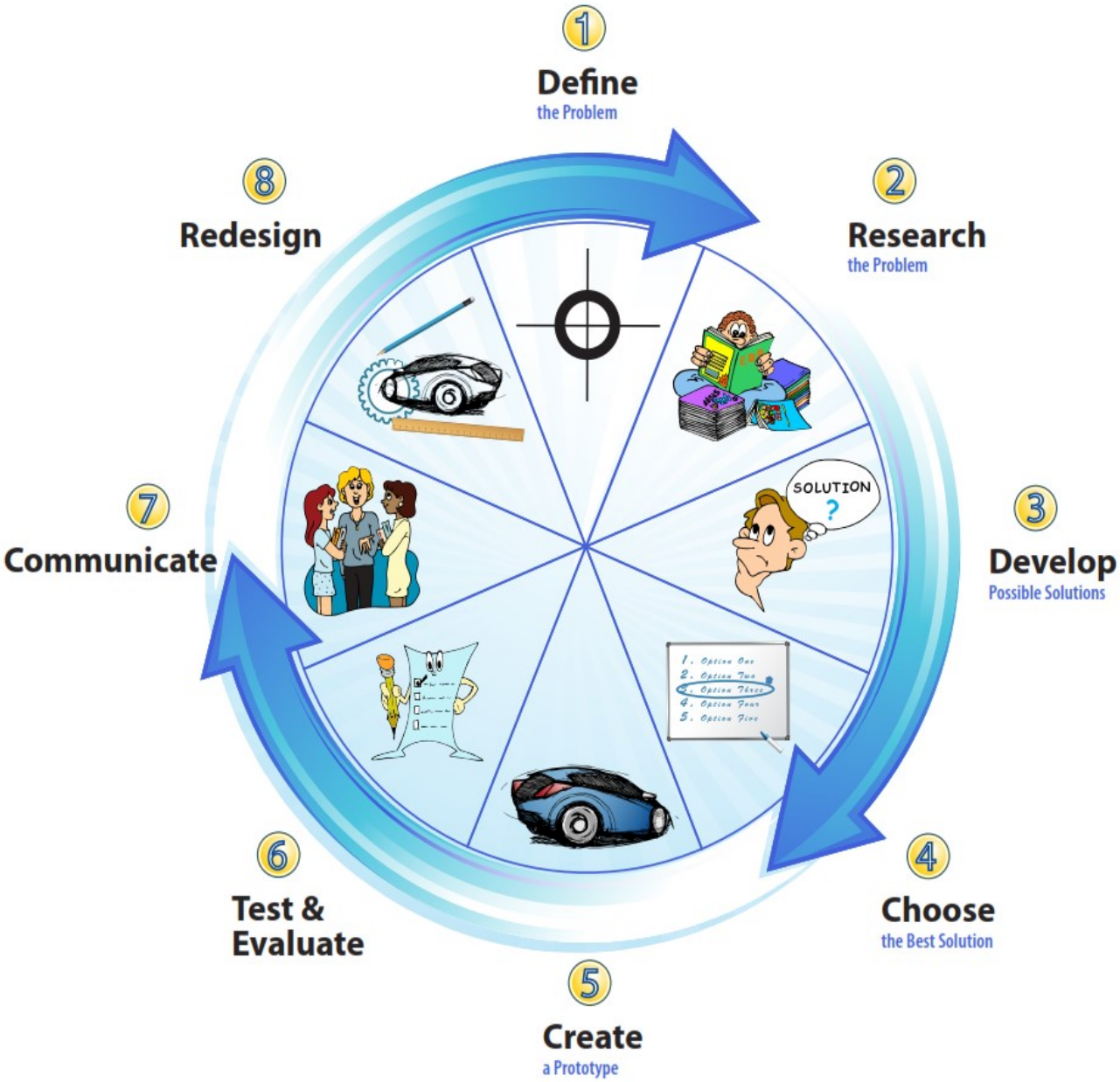
Time Limit: 20 seconds

Team Name:_____

Team Members: _____

_____

POINTS	DESCRIPTION	EARNED POINTS	
		Practice	Challenge
+50	Moved at least 50 cm from home (measured by the front wheels of the robot).		
+100	Completed mission (parked in front of the school in the road).		
+25	Reached a specified destination.		
-1	For every second you are tardy.		
-10	Ran over obstacles.		
-10	Hit Gopher's brand new car.		
-10	Hit the barrier.		
-50	Entire robot left the road.		
Eliminated	Robot left the mat.		
	TOTAL POINTS		


1
Define
the Problem
2
Research
the Problem
3
Develop
Possible Solutions
4
Choose
the Best Solution
5
Create
a Prototype
6
Test &
Evaluate
7
Communicate
8
Redesign
SOLUTION
?
1. Option One
2. Option Two
3. Option Three
4. Option Four
5. Option Five

The Engineering Design Process

1. **Define:** The Engineering Design Process always begins with a need, or a problem that must be solved. It may also involve an improvement to an existing design. The initial challenge is to define exactly what the need is, including any specific requirements. A complete understanding of the need will make the solution easier to design.
2. **Research:** Once a need has been established, the next step is to ask questions about the nature of the problem and do background research. Other people may have tried to solve a similar problem in the past. Engineers may incorporate this work into their own design process, but they must be careful to not use someone else's ideas without permission.
3. **Develop:** This is the brainstorming phase of the process. This phase give engineers the chance to be creative. It's important to remember there may be more than one solution to a problem. In many cases, there are multiple solutions. Once a list of ideas has been generated, the engineers can select the most promising one.
4. **Choose:** Planning involves taking an idea and filling in all the details that will bring the idea to life. While developing the idea, engineers will break the design into smaller parts to determine exactly how each part will function, draw diagrams, and compile a list of necessary materials. As they develop their solutions, engineers often call on their own knowledge of math and science, but they may have to do additional research to complete their design.
5. **Create:** After the planning stage is complete, engineers build a ***prototype*** of their design and come up with effective ways to test it.
6. **Test and Evaluate:** Once the design has been tested, they use the results as a basis for possible *improvements*. Engineers examine what worked, what didn't work, and what could work better.
7. **Communicate:** In this stage, engineers use the data from their tests to make improvements on their design. This is also a good time for peer review and feedback.
8. **Redesign:** Upon receiving feedback, engineers may make further improvements on their design until they are satisfied with the final version.

The process seems linear, but in practice, the steps may blend into each other, occur out of order, or repeat several times. *Engineering is the process of trying, creating, testing, and then re-trying until the design works.* It can be a lengthy and drawn-process. It is rare that a design works perfectly the first time.

Budget Math: Redesign of Restraint System for Eggbert

MISSION:

Eggbert has volunteered to gather information about the conditions near the area of the Kilauea eruption on Hawai'i, which the STARBASE team can use in planning missions. The dilemma Eggbert faces is that the landing will be very quick, and the glider will crash. To ensure the success of this mission, your crew will need to design a safety restraint system that will help Eggbert survive the landing.

Good Luck.

DIRECTIONS:

Your team has a budget of $1000.00 to spend on the materials for the redesign. Each item has a cost. You must discuss what materials you will purchase, keeping within your budget.

You must also **ALL** agree on a team design.

REMEMBER:

If more than one team has a successful design, the least expensive design will be selected as the winner.

Items Available for Purchase	Cost Per Item
Plastic Bag	$120.50
Rubber Band (2)	$99.25
String (30 cm)	$49.75
Cotton Ball (2)	$101.25
Foam (2)	$96.50
Egg (additional)	$100.00
Bubble Wrap	$83.00
Pipe Cleaners	$65.70
Sponge	$110.50
Egg Carton	$55.75

Happy Designing!

ACTIVITY LOG: Eggbert

1. Sketch and label the parts of your team's design.

2. How well did your design work?

- ☐ **Survival** ***(no damage)***
- ☐ **Living…with cracked skull** ***(shell cracked)***
- ☐ **Unconscious with brain damage** ***(yolk broke)***
- ☐ **Totally scrambled** ***(everything is broken)***

3. How could your group modify your design to make it better?

_____

_____

_____

_____

4. How did your group work as a team? What was the most difficult part?

_____

_____

_____

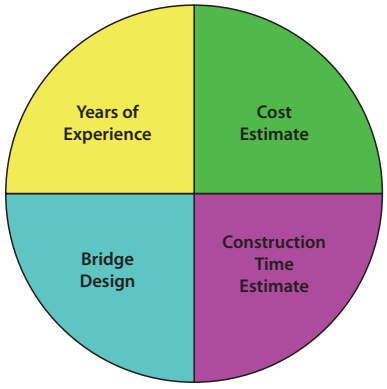
_____

Figure That!

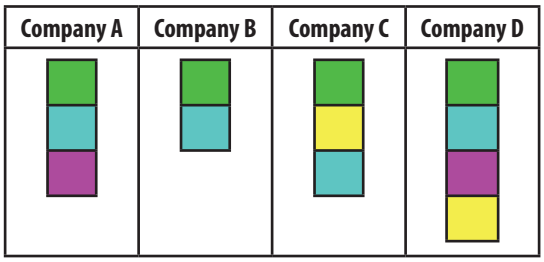
Activity Log

PROBLEM 1: WHICH COMPANY'S PROPOSAL BEST MEETS THE CRITERIA?

Each company's proposal must include these four criteria (requirements).



Listed below are the criteria (requirements) each company's proposal actually included:



1. ***Quantify*** **the data by showing each company's proposal information as a fraction, decimal, and percent.**

Company	Fraction	Percent	Decimal Equivalent
A			
B			
C			
D			

2. **In a fraction, is the total number of criteria represented by the *numerator* or *denominator*?** _____

3. **Company B's proposal includes only 2 out of 4 criteria, or** $\frac{2}{4}$ **.**

   Write this as a reduced fraction. _____

4. **What fraction of the companies submitted proposals include at least 75% of the required proposal criteria?** _____ **Write this fraction as a decimal.** _____

5. **What percentage of companies that submitted proposals meet all the criteria?** _____

6. **Which company's proposal would you choose based on the data?** _____

   Why? _____

PROBLEM 2: WHICH TYPE OF BRIDGE IS BEST?

	Criteria for Bridge *(Requirements that must be met)*			
Bridge Type	**Span** (200 meters)	**Load** (Light Loads)	**Construction Time** (Quick)	**Can it be temporary?**
Beam	☐	☐	☐ (Can be, but not always.)	☐ (Can be, but not always.)
Suspension	☐	☐	☐	☐
Arch	☐	☐	☐	☐
Floating	☐	☐	☐	☐

	Quantify the Data *What fraction, percent, and decimal equivalent of the criteria are met by each type of bridge?*		
Bridge Type	**Fraction**	**Percent**	**Decimal Equivalent**
Beam			
Suspension			
Arch			
Floating			

Figure That!

Activity Log

1. **If one bridge meets $\frac{2}{4}$ of the criteria and another bridge meets $\frac{1}{2}$ of the criteria, can you make a decision on which bridge is <u>best</u> based on this information?**

Yes or NO

Why? _____

2. **If you were eliminating the bridge types that meet only 50% or less of the criteria, what fraction of the bridge types would you eliminate?**

3. **If you wanted a temporary bridge with quick construction time, which bridge would you choose based on the data provided?** _____

Why? _____

_____

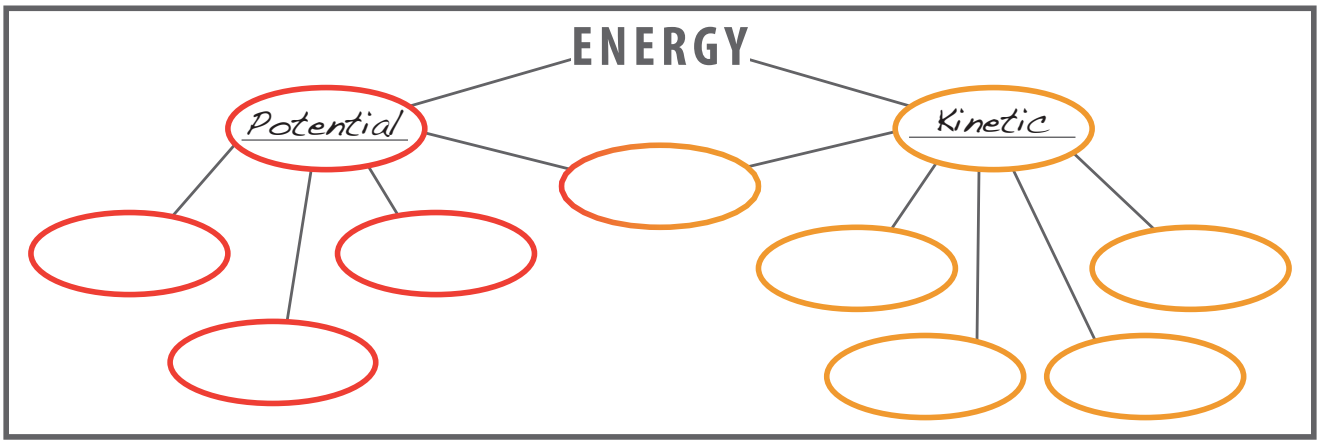
4. **Describe how using fractions, decimals, and percents help in solving problems.**

_____

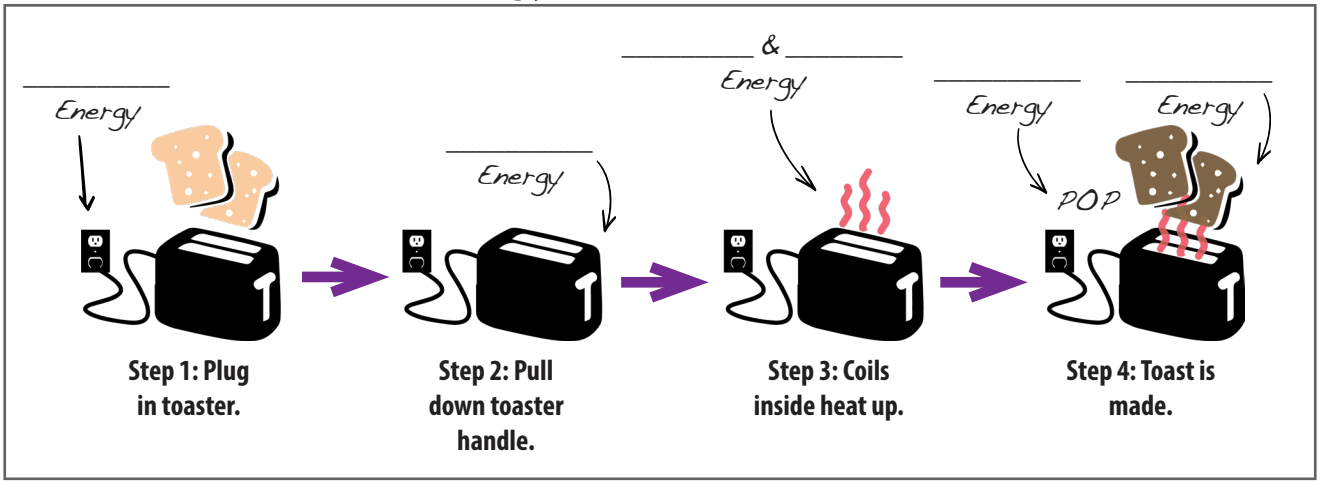
_____

ACTIVITY LOG: Energy Explorations

Energy Diagram: Fill in the missing energy types in your chart below.



Law of Conservation of Energy: Fill in the missing energy types in the series below.



Witnessing Energy Activities: As you complete each activity, mark which types of energy you witness!

ACTIVITY	Chemical	Electrical	Mechanical	Gravitational	Radiant/Light	Sound	Thermal
A. Magic Balloon							
B. Solar Fountain							
C. Go, Go Gears							
D. Turn on the Lights							
E. Color It Hot or Cold							
F. Food Lights Me Up							
G. Spouting Bowl							
H. Tune & Hammer							
I. Energy of the Future							

NEWTON'S LAWS of MOTION

First Law

An object at rest stays at rest and an object in motion stays in motion, unless acted upon by an unbalanced force. Isaac Newton realized that an object in motion would continue to move in a straight line until a force interfered and caused a change in the motion. He also determined that an object that was not moving would remain motionless until an outside force acted upon it. He called this resistance to change "inertia" [ih - nur - shuh].

Second Law

F=ma or Force is equal to the product of the mass times the acceleration. Newton's second law explains that the more quickly you want something to speed up or slow down or to accelerate, the more force you'll need. It also explains that the more mass you're trying to move, the more force you'll need to apply.

Third Law

For every action, there is an equal and opposite reaction. Whenever two objects interact, there is a **pair of forces** acting between them. The size of the force acting on the first object is equal to the size of the force acting on the second object. Likewise, the direction of the force acting on the first object is opposite to the direction of the force on the second object.

Rocketry

According to ***Newton's 1st Law, an object at rest will stay at rest unless acted upon by an outside force.***

The engines of a rocket create the force of ***thrust*** which makes the rocket go upward or forward. Before thrust is applied to our rocket, it is an object at _____. Once a force (thrust) is applied, the rocket becomes an object in _____.

Newton also explained that ***an object in motion will continue in motion unless acted upon by an outside force.***

What outside force slows a rocket down? _____

What outside force helps bring a rocket down to the surface of the Earth? _____

Newton's 2nd Law states that F=ma. If you ***increased*** the ***mass*** of the rocket, what would happen to the acceleration if the force remains the same?

_____

_____

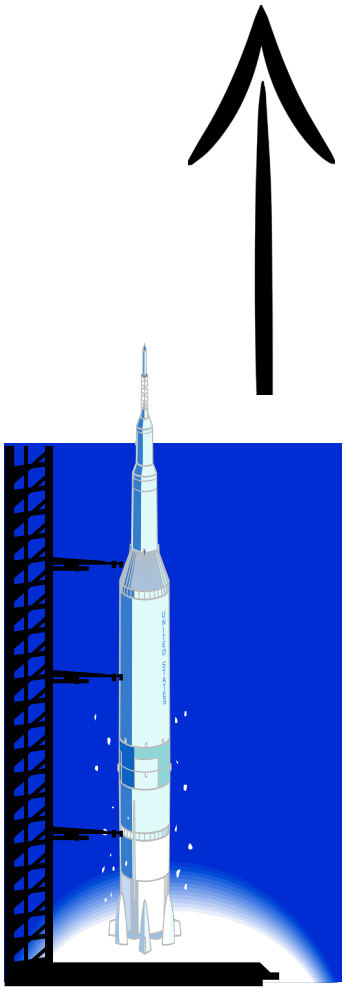
What would you need to do if you wanted to ***increase*** the amount of ***acceleration*** of your rocket? To increase the acceleration you could _____ of the rocket or you could _____.

Newton's 3rd Law explains that for every action, there is an equal and opposite reaction.

Applying this law to launching your rocket,

the ***action*** is _____

and the ***reaction*** is _____.



Launch: Mass as Variable

Predict

1. As I ***increase*** the amount of ***mass*** on the rocket but keep the applied force the same, the rocket will

   ☐ travel a longer distance ☐ travel a shorter distance

	Mass of Rocket	Force Applied	Launch Angle	Distance Traveled
Launch 1				
Launch 2				
Launch 3 (optional)				

Launch: Force as Variable

Predict

1. As I ***increase*** the amount of ***force*** on the rocket but keep the mass the same, the rocket will

   ☐ travel a longer distance ☐ travel a shorter distance

	Mass of Rocket	Force Applied	Launch Angle	Distance Traveled
Launch 1				
Launch 2				
Launch 3 (optional)				

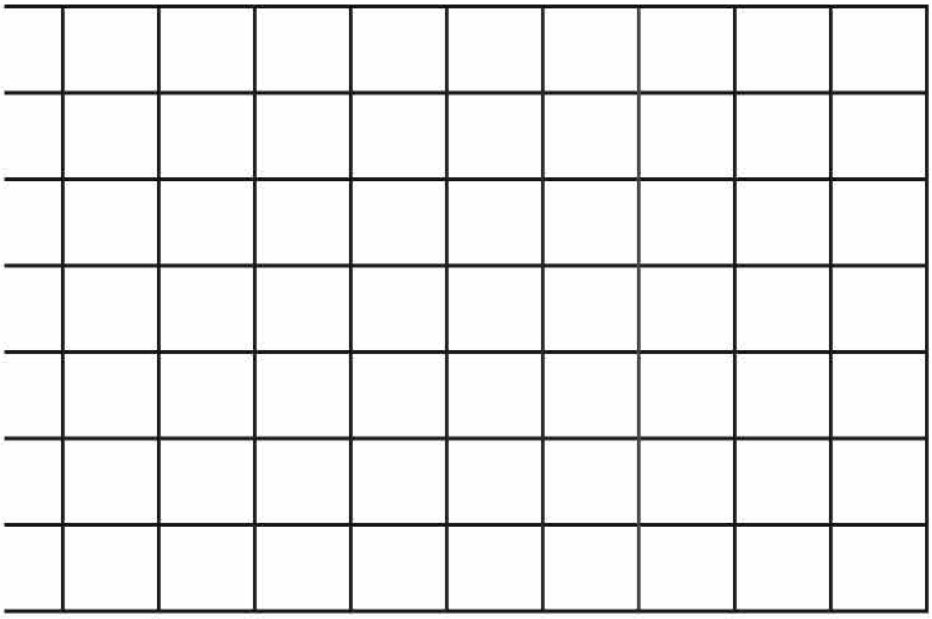
Distance of Rocket Launch: Mass as Independent Variable

Type of rocket launched: _____

Constant:_____

Dependent Variable:_____

Y-axis: _____ (unit of measurement: _____)



X-axis: _____

(unit of measurement: _____)

Data Analysis

When applying an equal amount of force, the rocket with greater mass will travel a distance

☐ further than ☐ less than

the rocket with less mass.

Transfer of Energy

Fill in the blanks with the appropriate word from the bank below.

Physical changes require a transfer of energy either through a transfer of _____ or applying a _____.

Chemical changes occur as energy is transferred when molecules _____, _____, or _____to form one or more new substances.

Word Bank:

bond *break* *force* *heat* *rearrange*

Identify the pictures as examples of **Physical (P)** or **Chemical (C)** changes.

 **P or C**	 **P or C**
 **P or C**	 **P or C**
 **P or C**	 **P or C**

Unknown Substance Analysis

You must determine which substance changes chemically and which changes physically. We have placed a small amount of an unknown substance into the blue and red balloons. Substance A = Blue, Substance B = Red. ***Put on your safety goggles.***

Determine who will be person 1, 2, 3 and 4 in your group and follow directions very carefully.

Person 1

Fill up **flask A** with 100 mL of water. Carefully put the mouth of the **blue** balloon over the opening of the flask. Don't flip the balloon over; just let it hang on the side of the flask.

Person 2

Flip the balloon over so the substance inside the balloon falls into the flask. Gently swirl the flask to mix the water and substance.

STOP
Observe

What happens to the balloon as the water and substance mix? **TOUCH** the bottom of the flask. What do you notice about the temperature? **RECORD** your observations in your **activity log**.

Person 3

Fill up **flask B** with 100 mL of water. Carefully put the mouth of the **red** balloon over the opening of the flask. Don't flip the balloon over; just let it hang on the side of the flask.

Person 4

Flip the balloon over so the substance inside the balloon falls into the flask. Gently swirl the flask to mix the water and substance.

STOP
Observe

What happens to the balloon as the water and substance mix? **TOUCH** the bottom of the flask. What do you notice about the temperature? **RECORD** your observations in your **activity log**.

ANSWER

Questions 1-4 in your **activity log**.

Observations:

Substance	What does the balloon do?	Temperature (hot or cold)
A - Blue Balloon		
B - Red Balloon		

Research/Information about Substance A and Substance B:

*When **Substance A** and water mix, it fizzes. This is because a **chemical change** occurs; the new matter is different from the old matter. One of the ways you know that a **chemical change** has occurred is when the reaction gives off a gas.*

***Substance B** is soluble in water. Even though we may not be able to see it anymore, it is still there, only going through a **physical change** from a solid to a liquid.*

*An **EXOTHERMIC REACTION** is one that gives off heat and becomes hotter.*

*An **ENDOTHERMIC REACTION** is one that takes in heat and becomes cooler*

Determine the change of the substance:

1. Substance A is a _____ change because _____

   _____.

2. Substance B is a _____ change because _____

   _____.

Determine the type of reaction:

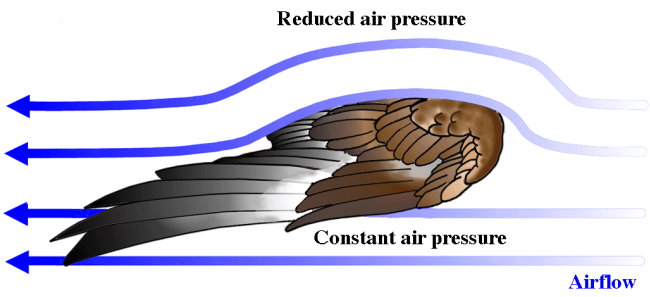
3. Substance A is **COLD** which means it is an _____ reaction.

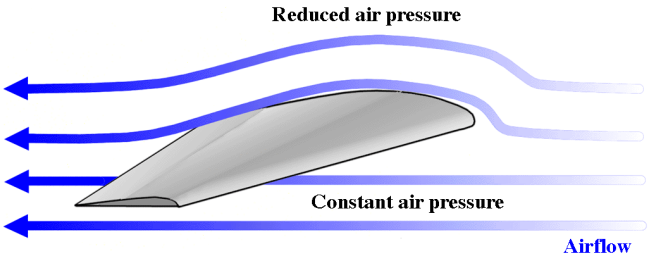
4. Substance B is **HOT** which means it is an _____ reaction.

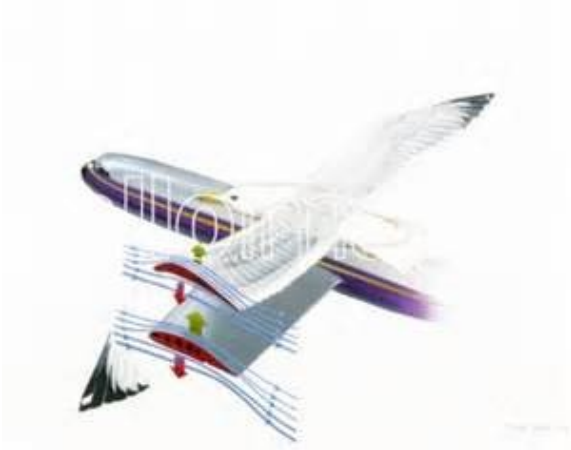
Bernoulli's Principle

Daniel Bernoulli, a Swiss mathematician, expanded on Newton's ideas and further explored the motion of fluids. Bernoulli's equation describes the basic principle of airflow pressure.

Bernoulli's principle, simply stated, says, "as the velocity of a fluid (air) increases, its internal pressure decreases." Bernoulli's principle is derived from Newton's second law of motion which states the requirement of an unbalanced force (in this case, pressure) to produce an acceleration (velocity change).

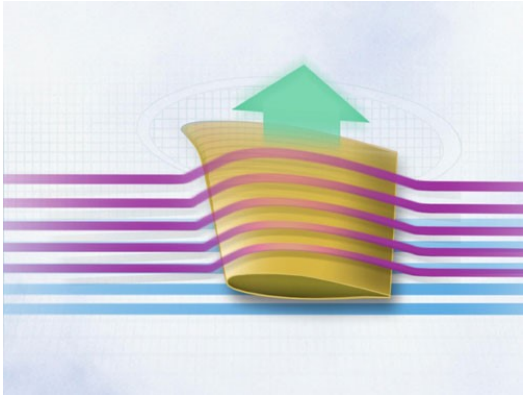






How an Airfoil Works

These pictures of bird wings and airplane wings moving through the air show how its shape, or airfoil, affects the airflow. The airflow passing over the wing's curved upper surface is *faster* than the airflow passing over the lower surface. This causes a difference in pressure, which **lifts** or sucks the wing upwards.



Fast air Always exerts _____ pressure!

Activity A: Lift

	Blower Off	Blower Slow Speed	Blower High Speed
Digital Scale Reading			

1. How did the scale reading change as you increased the blower speed?

_____

2. Explain your observations.

_____

_____

3. Were you surprised by the changes you observed? Explain.

_____

Activity F: Paper Tent

1. What do you expect to happen?

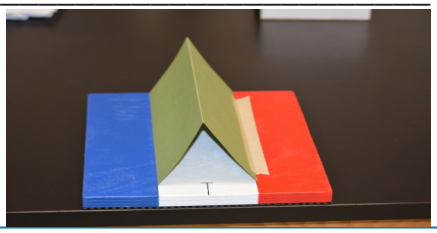
_____

2. What happens when you blow air under the tent?

_____

3. Why do you think the tent moved the way it did?

_____



Activity D: Ping and Pong

1. Predict what will happen when you blow a steady stream of air between the two ping pong balls.

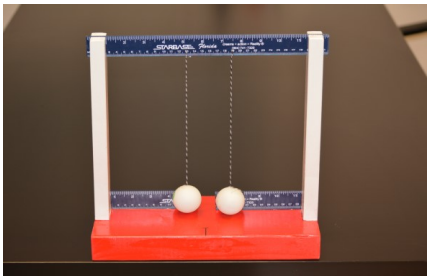
_____

2. What actually happened?

_____

3. Why do you think the ping pong balls moved the way they did?

_____



Activity E: Paper Bridge

1. Predict what will happen when you blow a steady stream of fast air underneath the paper bridge.

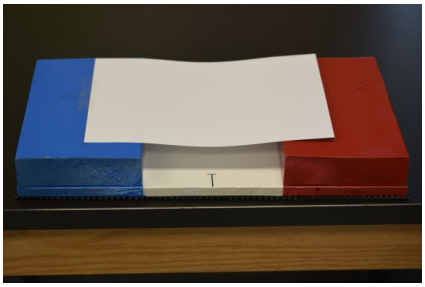
_____

2. What actually happened?

_____

3. Why do you think the paper reacted that way?

_____



Chromatography C.S.I.

Activity Log

Someone used a black marker to write a mean message on the bathroom wall, criticizing the cafeteria food. It has to be one person from a group of four students who left the cafeteria early. Each of the four students has a different brand of black marker. Discover which marker was used to write the message.

You will use the analytical chemistry process called chromatography. Using chromatography, you will investigate each marker's solubility, or how easily it dissolves.

1. Water is the substance, or _____, you use to make the ink dissolve.

2. The ink is the substance, or _____, you will dissolve.

3. The filter paper is the _____ that holds the substance.

Student Identifier	Marker Brand	Matching Chromatogram
1		
2		
3		
4		

4. The chromatogram of the marker used to write the message was _____

5. Which student's marker matched that chromatogram? ☐ #1 ☐ #2 ☐ #3 ☐ #4

6. Is this conclusive evidence that the student who owned the marker was the one who wrote the message? ☐ Yes ☐ No

7. Why or why not? _____

_____

8. Of the pigments mixed to create the black ink in the marker, which pigment do you think is the most soluble? _____ Why? _____

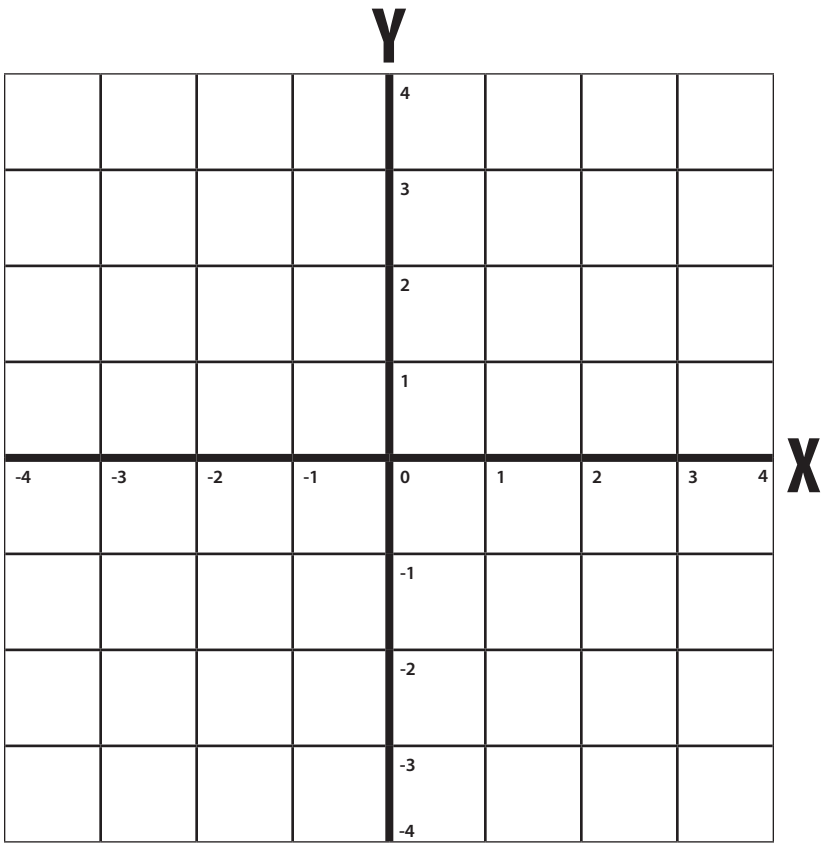
_____

9. Which do you think is the least soluble? _____Why?_____

_____

FIND THE AIRPLANES!

Try to locate the STARBASE airplane fleet!



STARBASE GRID (Keep track of your team's guesses here!)

DIRECTIONS

STARBASE will place 5 airplanes on their grid:

- ✓ **G-5 (5 points long)**
- ✓ **Space Shuttle (4 points long)**
- ✓ **F-16 (3 points long)**
- ✓ **Cessna (2 points long)**
- ✓ **Paper Airplane (1 point long)**

Each student gets to guess one set of (X,Y) coordinates, in turn.

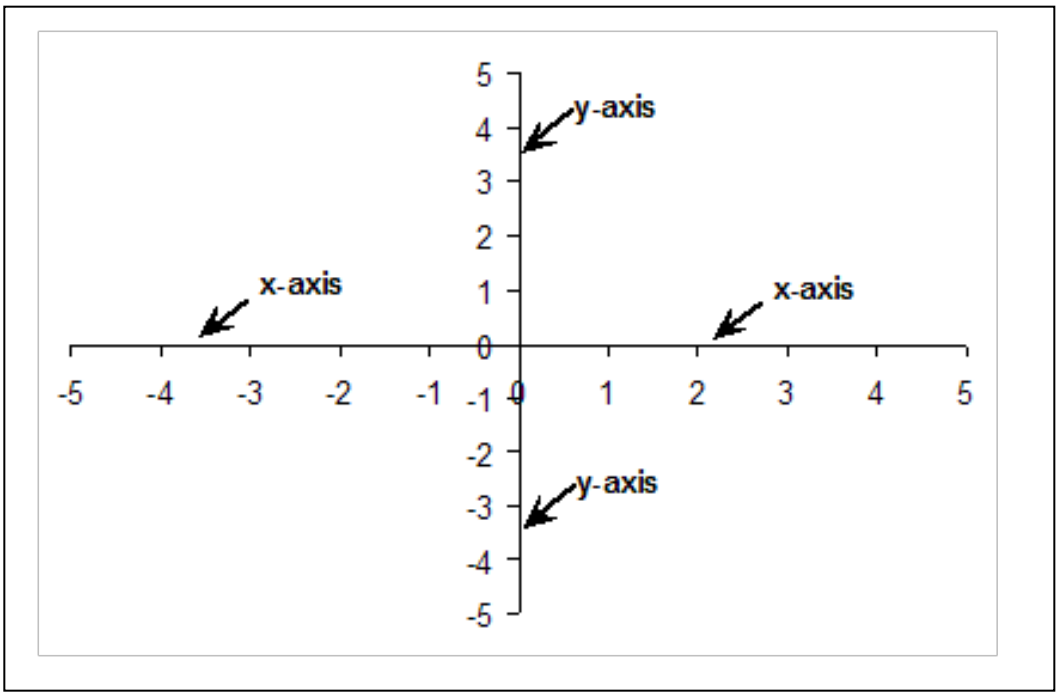
The instructor will tell you whether or not you found a part of an airplane.

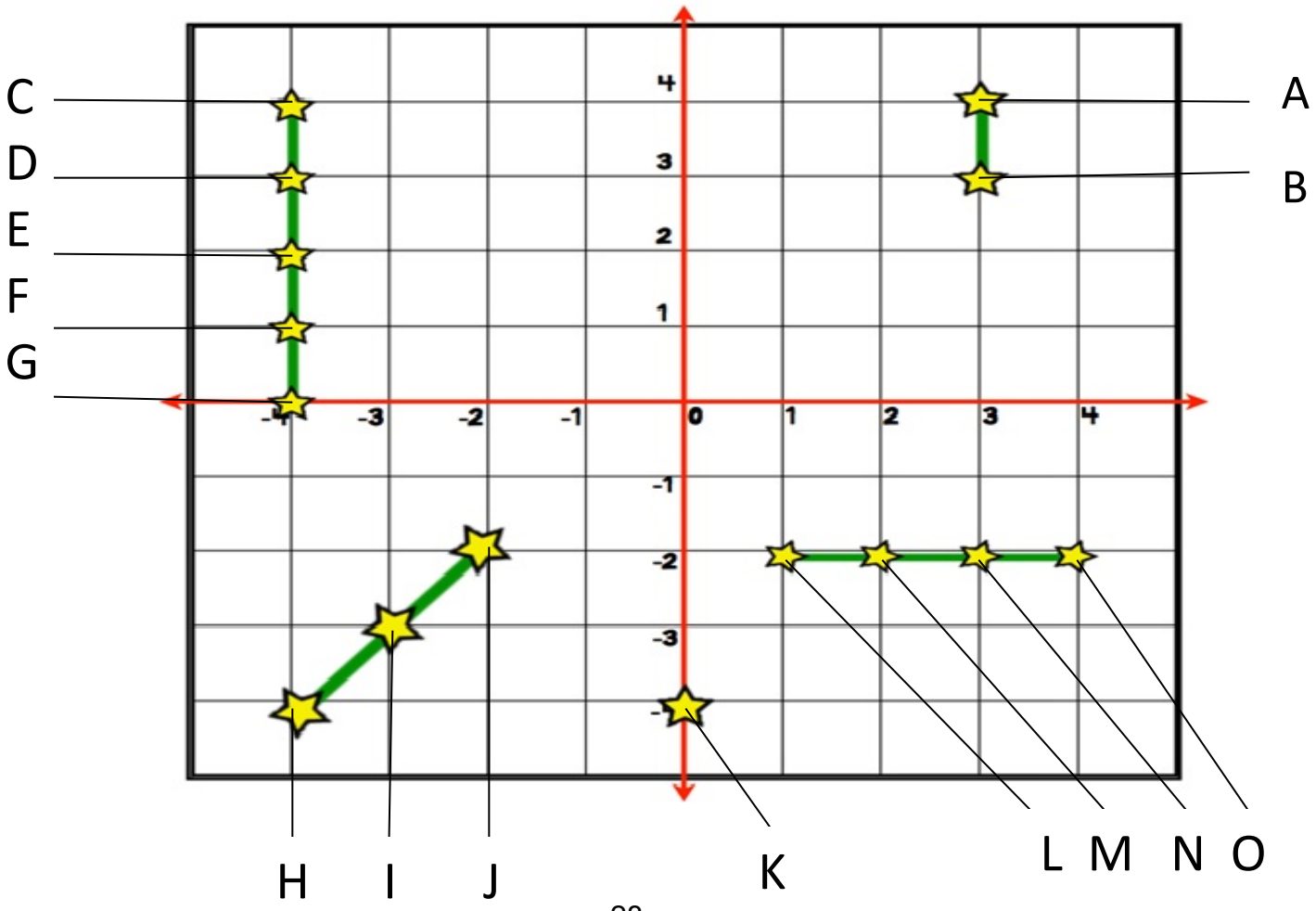
- ✓ **Mark ● on the grid for misses**
- ✓ **Mark × on the grid for correct guesses**

If you find all five airplanes, you win! If you don't, STARBASE wins!

Fly on the Ceiling

Activity Log





Exploring Fluid Mechanics

Based on your observations, what is true about all fluids?

1. _____

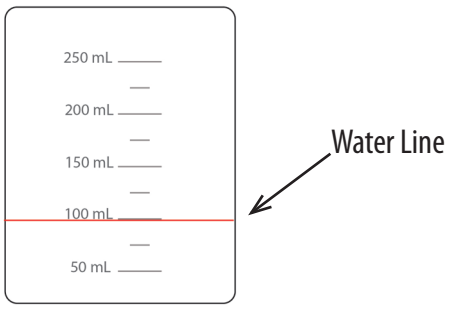
2. _____

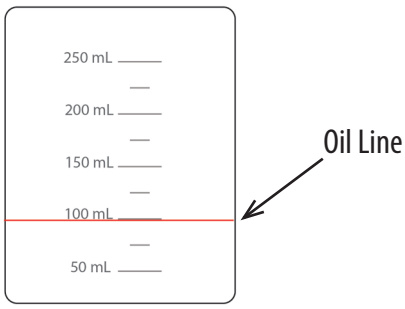
3. _____

Fluid Stations

Station 1 - Density

WATER	OIL
1. Pour 100 mL of water into the beaker labeled "water." 2. Carefully drop 2 plastic cubes into the water. 3. **Record observations** – Draw a picture of the location of the plastic cubes.	1. Pour 100 mL of oil into the beaker labeled "oil." 2. Carefully drop 2 plastic cubes into the oil. 3. **Record observations** – Draw a picture of the location of the plastic cubes.





What is different about water and oil that caused differences in the location of the plastic cubes?

Fluid Characteristics

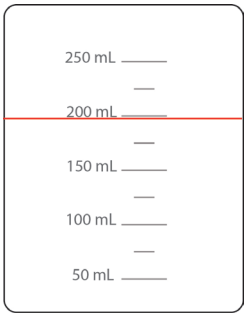
Predict: What will happen to the cubes if you pour the oil into the water? *(Discuss with your team.)*

1. *CAREFULLY* pour the oil into the water.
2. Add 1 drop of food coloring and stir, gently.
3. **Record observations** – Draw a picture of the location of the plastic cubes.

Why are the cubes located where they are? _____

_____

_____



Station 2 - Viscosity

1. Dip a plastic spoon into the cup of corn syrup.
2. Pull out the spoon and allow the corn syrup to drip back into the cup.
3. Pour water into the empty cup.
4. Dip a different plastic spoon into the water.
5. Pull out the spoon and allow the water to drip back into the cup.
6. Repeat with both corn syrup and water and make observations to compare the drops.
7. Draw a picture of your observations.

Corn Syrup Water

Corn syrup has high viscosity and water has low viscosity. Based on your observations, what does viscosity mean?

Viscosity means_____

_____

_____

Fluid Characteristics

You are testing properties of fluids using liquids.

How do these properties apply to gases?

Station 3 - Surface Tension

1. Each person needs 1 plastic disc, 1 paper towel, and one pipette.
2. Place the plastic disc on the paper towel.
3. Fill the pipette with water.
4. Gently place 25 drops of water on the disc.
5. Make observations and draw the shape of the water on the disc to the right.
6. Continue to add drops of water until it "breaks."

How many drops were you able to place on the disc?

_____ drops

Station 4 - Compressibility

1. Place the marshmallow inside the bell jar.
2. Insert the tube into the bell jar, and attach the syringe to the tube.
3. Pull back on the syringe to draw the air out of the jar.
4. Make observations about the marshmallow and bell jar.
5. Predict what will happen when you let the air to flow back in.
6. Twist the connector on the top to return the air into the bell jar.

When air is taken OUT of the jar, the marshmallow _____.

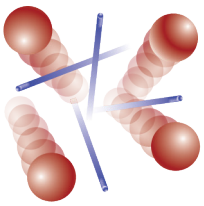
When air is put back IN the jar, the marshmallow _____.

States of Matter Experiments

Activity Log

Label each phase:

KINETIC ENERGY



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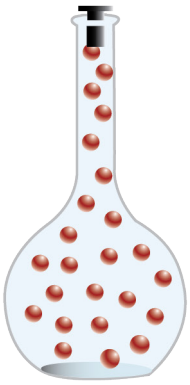

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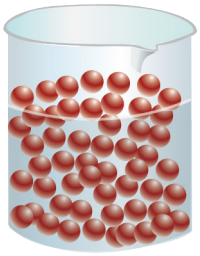

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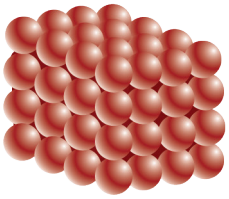

_____

Phases of Matter

The phase of matter can be changed by increasing or decreasing the amount of _____.

Greater heat energy causes greater _____ energy, or energy of motion.

Kinetic Energy and States of Matter

Record your observations as you move the jar of molecules in each box. How do the molecules in the jar change as the size of the movement box increases?

Circle 1 

1. _____

State of Matter

Circle 2 

2. _____

State of Matter

Circle 3 

3. _____

State of Matter

How can matter change from one state to another? _____

_____

_____

Which state of matter emits light? _____

Science, Technology, Engineering & Math (STEM) Careers

Circle the career ideas that bring a smile to your face.

Accountant
Aerospace Engineer & Tech
Agricultural – Engineer, Teacher, & Technician
Armed Forces Service Member (Air Force, Army, Navy, Marines, Coast Guard)
Architecture – Engineer, Architect, Drafter
Astronaut
Astronomer
Atmospheric and Space – Scientist and Teacher
Author
Automotive – Engineer, Mechanic, Tech, & Teacher
Biochemistry – Engineer, Chemist, Physicist & Teacher
Biologists & Biology Teacher
Biomedical Engineer
Biostatistician
Botanist
Carpenter
Chemist & Chemistry Teacher
Chemical Engineer
Clinical Psychologist
Computers – Programmer, Technician, Engineer, Network Support & Security, Analyst
Construction Manager
Counseling Psychologists
Designer
Dietician & Nutritionist
Diver
Doctor
Electrical Engineering – Engineers & Technicians
Electro-mechanical Engineering
Electronics Engineering – Engineers & Technicians
Engineering Teachers
Environmental Engineers
Environmental Restoration Planners
Environmental Science
Epidemiologist
Farm and Ranch Manager
Fire Prevention & Protection
Fish & Game Wardens
Fishers & Related Workers
Flight Engineer
Food Science
Forest & Conservation Techs
Foresters
Geneticist
Geologist
Graphic Designers
Human Factors Engineers & Ergonomist
Industrial Engineers
Information Security Analyst
Inventor
Manufacturing Engineer
Marine Architect
Marine Biologist
Marine Engineer
Materials -- Engineer & Scientist
Mathematician
Mechanical Engineer
Medical Scientist
Meteorologist
Microbiologist
Microsystems Engineer
Mining & Geological Engineer
Molecular and Cellular Biologist
Nano-systems Engineer
Neuropsychologist & Clinical Neuropsychologist
Nuclear Engineer
Nurse
Nursery & Greenhouse Manager
Nutritionist
Optometrist
Paleontologist
Park Naturalist
Pediatrician
Petroleum Specialist
Pharmacist
Photonics Engineer
Pilot
Product Safety Engineer
Physicist
Psychologist
Radiologist
Seismologist
Scientist
Software Developer
Soil & Plant Scientist
Soil & Water Conservationist
Statistician
Surgeon
Teacher
Telecommunications Engineering
Transportation Engineers & Planners
Video Game Designers
Water/Wastewater Engineer
Wind Turbine Service Tech
X-ray Technician
Zoologist & Wildlife Biologist

Setting Goals For Your STEM Career