Sample Curriculum

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Sample Curriculum

First: Identify the direction an object will move when it is pushed or pulled; draw conclusions based on observed evidence.

Second: Describe metric readings from graduate cylinders; compare and order a set of objects according to a measurement, and make predictions before measuring.

Third: Predict the direction an object will move when it is pulled or pushed; distinguish between gravity, magnetism, and friction as kinds of forces; distinguish between mass and weight.

Fourth: Measure the mass and weight of objects using the appropriate metric measuring instruments, and record data.

Fifth: Measure length, mass, weight, and volume and record data.

Materials Needed for Mechanics Experiments

Momentum, gravity, and balance experiments

Matter Has Volume: graduated cylinder, dice, cylindrical shaped object, rocks.
Missing Volume Experiment: metric ruler, cube, graduated cylinder, alcohol, water.
Heavy Versus Light: play dough, sheets of paper of equal size, different sized balls.
The Parachute Race: a 100 gram mass of play dough, one piece of typing paper, 12 inches of tape, and two feet of string.
Where is the Mass of the Meter Stick: meter stick, play dough, dowel stick.
Dough Boy Balance: wooden tongue depressor, play dough, stiff but bendable wire.
Board Stiff Center: flat piece of irregularly shaped wood or metal, string with weight on the end, pencil.
The Uphill Roller: a three-pound coffee can, 200 grams of play dough, short board, some books.
Inertia Card Flip: some playing cards, 10 pennies, and a wide-mouthed bottle.
Homemade Fulcrum Balance: ruler, string or wire, paper cups, nail, wooden support for fulcrum, things to weigh (M&M’s, jelly beans, paper clips, thumb tacks), pennies, nickels.

Pressure and Volume of Air, Water, and Solids

The Water Glass Mystery: drinking glass, jar or bottle, large pan, plastic tube or straws.
Air Volume and the Collapsing Box: Fruit juice box, jar with wide mouth, small balloon, and a zip-lock bag.
Water Exerts Pressure: Two liter soda bottle, hot nail, water.
Air, Water, Density, and the Cartesian Diver: eye dropper, 2 liter soda bottle, water, food coloring.
Bernoulli’s Principle: paper, ping-pong ball, 3x5 card, thread spool, pin, funnel, tape, balloons, thread, soda cans, straws.
Matter Has Volume

Scientific Concept Involved:

Volume is the amount of space occupied by matter. The amount of space is easily determined for matter having common geometric shapes but less easily determined for irregularly shaped objects like rocks or a king’s crown. Archimedes discovered that no two objects could occupy the same space at the same time. Therefore, if we were to place a rock in a graduated cylinder containing water, we would expect to see the water level rise an amount equal to the volume of the rock.

Equipment Needed: A graduated cylinder, dice, cylindrical object, and rocks.

Procedure:

Fill the graduated cylinder about half full of water. Record this volume exactly. Before dropping the die into the water, determine its volume by measuring one of its sides in centimeters and then use the following equation to determine its volume: volume = side cubed. Now drop the die into the cylinder and record the new volume. If you subtract the first reading from the second, you should get the volume of the cube. Remember that one cubic centimeter is equal to one milliliter.

Repeat the above using a cylinder. The volume of a cylinder can be determined by using the equation volume = πr²h.

Next drop a rock into the graduated cylinder and determine its volume.

Vocabulary Development:
volume, Archimedes, graduated cylinder, pi

Data Collected:

<table>
<thead>
<tr>
<th>object</th>
<th>initial reading</th>
<th>final reading</th>
<th>volume</th>
<th>calculated volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>one cube</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>two cubes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cylinder</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>rock</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Questions:

1. Was the calculated volume of the cube the same as the displaced volume?

2. Would you expect the volume of the rock as determined by this experiment to be accurate?

3. Would you fill the bathtub at home completely full of water before getting into the tub? Why or why not?

Conclusions and Comments:

Further Investigations:

What would be the problem of measuring the volume of the king’s crown with this method?

Application to Everyday Life and Other Disciplines:

Pitfalls to Avoid When Doing the Experiment:

Best Grade Level:

Show-Me Standards:
The Missing Volume Experiment

Scientific Concept Involved:

Matter is anything in the universe that has mass and volume. Mass is a measure of a body’s inertia, and volume is the amount of space an object occupies. The volume of a solid can easily be measured by using a ruler if the object has a rectangular shape. The volume occupied by a liquid can be measured by pouring it into a graduated cylinder and measuring its volume in liters or milliliters.

Equipment Needed: Metric ruler, cube, graduated cylinder, alcohol, water.

Procedure:

First measure the volume of the cube in cubic centimeters, using the formula:

\[
\text{volume} = \text{length} \times \text{width} \times \text{height}.
\]

Place one of the cubes on the table. Now place the other cube exactly where the first cube is located. What must you do with the first cube?

Now measure exactly 50 ml of water with one of your graduated cylinders. Pour this water into the other graduated cylinder and record its volume. With the now empty graduated cylinder, measure exactly 50 ml of water and pour it into the graduated cylinder containing the water. Record the volume of the mixture.

Empty and dry both graduated cylinders. Again, put 50 ml of water in one and pour the water into the other cylinder. Now put 50 ml of alcohol in the second cylinder pour it into the cylinder containing water. Record your results.

Vocabulary Development:

volume, centimeter, millimeter, cubic, impenetrability

Data Collected:
Questions:

1. Why did the first block move out of position when you moved in the second block?

2. What was the sum of the two liquid volumes before they were mixed together? What was the sum of the mixture?

3. Can you design a model of what the molecules might look like which will account for the difference in their volume?

4. Why did I have you put 50 ml of water in one cylinder and then pour it into the other when measuring the volume of 50 ml + 50 ml? Why the “extra” pouring step?

Conclusions and Comments:

Further Investigations:

1. What do you think might happen if we mixed two volumes of air together?

2. Do you think a cup of marbles and a cup of BB’s would equal two cups? Prove your answer by doing an experiment.

Application to Everyday Life and Other Disciplines:

Pitfalls to Avoid When Doing the Experiment:

Best Grade Level:

Show-Me Standards:
Heavy Versus Light

Scientific Concept Involved:

Weight and mass are different; so different, in fact, that they have different units. The table below will help you see the difference in their units:

<table>
<thead>
<tr>
<th>Unit</th>
<th>English System</th>
<th>Metric System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass</td>
<td>slug</td>
<td>gram or kilogram</td>
</tr>
<tr>
<td>Weight</td>
<td>ounce or pound</td>
<td>newton or dyne</td>
</tr>
</tbody>
</table>

Weight is a measure of the planet’s gravitational attraction for an object and varies as the planet’s gravitational attraction varies. The planet’s gravitational attraction depends on the size of the planet and the distance of the object from the center of the planet.

Mass is independent of the planet’s gravity. It depends on the object’s desire to remain at rest or in straight line motion. Big masses have a strong desire to remain unchanged.

**Equipment Needed:** Play dough, sheets of paper of equal size, different sized balls.

**Procedure:**

1. Have members of your group measure a 25 g, a 50 g, a 75 g, and a 100 g mass of play dough. Roll each of these masses into a sphere and then drop each from the same height at the same time. Record your results.

2. You might try this with different mass but identical size spheres, such as a golf ball and a practice golf ball.

3. You might also try this with different size and mass spheres, such as a baseball and a softball.

4. Now take two identical pieces of paper, wad one and then drop both from the same height. Again record your results.

**Vocabulary Development:**
mass, weight, gravity, and terminal velocity

**Data Collected:**
Questions:

1. What did you find out about the time it took for the different mass pieces of play dough to drop the same distance?

2. How did the times compare when you dropped objects having different masses but the same volume?

3. How did the time compare when you dropped the identical pieces of paper the same distance?

Conclusions and Comments:

Further Investigations:

How do you think the time would compare if you were to drop two objects having very different masses and volumes (such as a feather and a hammer) in a vacuum?

Application to Everyday Life and Other Disciplines:

Pitfalls to Avoid When Doing the Experiment:

Best Grade Level:

Show-Me Standards:
The Parachute Race

Scientific Concept Involved:

All objects falling in air will reach a terminal velocity. The terminal velocity is the highest speed reached by the falling object and the speed which is maintained for the rest of the object’s fall. The rate of the descent of an object falling through the air depends on the shape of the object. For example, a parachutist has the same mass if his chute is open or closed. If his chute is closed, he may fall at a rate of between 120 miles per hour and 270 miles per hour. If his chute is open, however, he may fall at approximately 18 miles per hour.

Equipment Needed: A 100 gram mass of play dough, a piece of typing paper, 12 inches of scotch tape, and two feet of string.

Procedure:

1. Four students will work together and brainstorm the best methods to achieve the following results:
   (a) Using the above-mentioned materials, design an object which will drop very rapidly.
   (b) Using the above-mentioned materials, design an object which will drop very slowly.

2. Each team of four will compete against all other teams until a winner in each category is determined. Judges must be neutral.

3. Each team must use all of the above-mentioned materials for their fast drop. They must again use all of the above-mentioned materials for their slow drop.

Vocabulary Development:

terminal velocity, streamlining, honesty, fairness

Data Collected:
Questions:

1. What was the basic difference between your designs for the fast-moving and slow-moving masses?

2. Did your design wobble as it fell? Is there something you could have done to prevent this wobble?

Conclusions and Comments:

Further Investigations:

What kinds of things have we done to cars and airplanes in order to reduce their wind resistance and thereby make them more energy efficient?

What kinds of things have we done to the automobile in order to create friction between the car and the road?

Application to Everyday Life and Other Disciplines:

Pitfalls to Avoid When Doing the Experiment:

Best Grade Level:

Show-Me Standards:
Where is the Mass of the Meter Stick?

Scientific Concept Involved:

All matter possesses a single point where all of its mass seems to be located. This point is called the object’s center of gravity. If one can find the center of gravity of a body of matter, one can place an upward force at this point and balance the mass of the entire object.

Friction between two surfaces is dependent on the force each surface exerts on the other, as well as the nature of the surfaces of the matter rubbing together. If the force at the surface, called the “normal” force, is great, the friction between the objects may be great.

Equipment Needed: Meter stick, play dough, dowel stick.

Procedure:

1. Place the meter stick on the two dowel sticks and place the two dowel sticks at either end of the meter stick so that it is level with the floor. Now move the dowel sticks together at the same rate of speed until they are next to each other. Record the measurement on the meter stick located between the two dowel sticks. This point is the center of gravity.

2. Repeat the above procedure a number of times but have the initial placement of the two dowel sticks differ each time. Record your results.

3. Place a blob of play dough somewhere near one end of the meter stick. This time predict where you think the two dowel sticks will come to rest. Were you correct?

4. Place two or more blobs of play dough on the meter stick at various positions and predict the location of the center of gravity.

Vocabulary Development:
center of gravity, friction, normal force

Data Collected:
Questions:

1. Define center of gravity.

2. Why did only one dowel stick move at a time?

3. In which direction did the center of gravity shift when you placed on the meter stick the one piece of play dough?

Conclusions and Comments:

Further Investigations:

If you were an aeronautical engineer, do you think that knowing where the center of gravity is in a plane would be important? Why?

Application to Everyday Life and Other Disciplines:

Pitfalls to Avoid When Doing the Experiment:

Best Grade Level:

Show-Me Standards:
Dough Boy Balance

Scientific Concept Involved:

The point where all the mass of a body of matter seems to be located is called the center of mass. This point usually lies within the system, but sometimes it can be located outside the system. If it lies outside the system, one must imagine a plumb bob line running this point, through the center of the earth and through the object. Then if one places an upward force where this line touches the object, one can balance the object.

Equipment Needed: Wooden tongue depressor, play dough, stiff but bendable wire.

Procedure:

Insert one end of the wire through a small hole in the tongue depressor. Attach a blob of play dough to the other end of the wire. Bend the wire so that it is curved and is bending back toward the back end of the tongue depressor. Now place the back end of the tongue depressor on the edge of the table and try to balance the object. If you cannot balance the object so that it is horizontal, bend the wire until you have success at balancing the object. Draw a picture of the apparatus.

Now balance the apparatus with the tongue depressor’s front end pointing upward. Draw a picture of the apparatus.

Once again balance the apparatus, but this time have the front end of the tongue depressor pointing downward. Draw a picture of the apparatus.

Vocabulary Development:
center of mass, balance point, horizontal

Data Collected:
Questions:
1. What is the major difference between your three drawings? Explain why this happened.

Conclusions and Comments:

Further Investigations:

What happens to the stability of a stepladder as one climbs to the top? Could you design a more stable stepladder?

Obtain from your teacher the balancing belt rig and explain why it works.

Application to Everyday Life and Other Disciplines:

Pitfalls to Avoid When Doing the Experiment:

Best Grade Level:

Show-Me Standards:
Board Stiff Center

Scientific Concept Involved:

One can find the center of mass of an irregularly shaped object made of rigid material by using a plumb bob. A plumb bob is a string with a weight on one end. It is used to find a vertical line which runs through the center of the earth. Many times a carpenter will use a plumb bob to see if a wall is vertical. We will use a plumb bob to determine the location of the center of mass of an irregularly shaped object.

Equipment Needed: A flat piece of irregularly shaped wood or metal, a string with a weight on the end, a pencil.

Procedure:

Place a nail through one of the three or four holes in your board. Next tie the string plumb bob on the nail and while you are holding the assembly next to a wall, draw a pencil line next to the string line. Place the nail in another hole and draw another line. Do this one more time. Place a small circle around the point where all three lines come together (they do meet at a point, don’t they?). This is the center of mass of the board, and if you place your finger below this point, you will be able to balance the board.

Vocabulary Development: Plumb bob, center of mass, vertical.

Data Collected:
Questions:

1. Does a plumb bob help you find a vertical or horizontal line.

2. While you are supporting the board with your finger below the center of mass of the board, what do you think is the downward force at all other points on the board.

Conclusions and Comments:

Further Investigations:

Do you think it is important to know the location of the center of mass when designing drinking glasses for tots?

Design a drinking glass you think would be stable for a tot.

Application to Everyday Life and Other Disciplines:

Pitfalls to Avoid When Doing the Experiment:

Best Grade Level:

Show-Me Standards:
The Uphill Roller

Scientific Concept Involved:

Did you ever knock over a glass of milk at the dinner table and wonder why a glass which could never tipped over had not been invented? The concept behind the stable drinking glass is the location of the center of gravity. Stability of an object depends on having a low center of gravity and always having the center of gravity plumb bob line fall within the baseline of the object. Because of this, the most stable position a lineman on a football team could have would be flat on his stomach.

Equipment Needed:
A three pound coffee can, 200 grams of play dough, a short board, and some books.

Procedure:

We will form teams composed of two to four students. Each team will try to get their coffee can to roll the greatest distance up the inclined board and then over the edge of the board. The winner will be determined only if the can rolls over the edge of the incline. If the can goes over the edge of the inclined board and has the longest uphill run, that team will be declared the winner.

You must use the same amount of play dough; however, where and how you position the dough is up to you.

Vocabulary Development:
stability, center of gravity, baseline

Data Collected:
Questions:

1. While the can was moving up the incline, was the center of mass moving to a higher or lower position?

2. What kind of ideas would you use to design a stable drinking glass?

Conclusions and Comments:

Further Investigations:

What would be your design for a stable flower bud vase?

Application to Everyday Life and Other Disciplines:

Pitfalls to Avoid When Doing the Experiment:

Best Grade Level:

Show-Me Standards:
Inertia Card Flip

**Scientific Concept Involved:**

Inertia is a property that all bodies of matter possess. Inertia is the desire for a body of matter to resist any change in its motion. If a car is traveling too fast around a sharp turn, it will try to straighten out the curve by continuing on in the direction it was originally traveling. On the other hand, if you are sitting still in a car and all of a sudden the car is pushed forward, you will find yourself plastered to the back of the seat because of your body’s desire to remain exactly where it was before the car was pushed forward.

**Equipment Needed:** Some playing cards, 10 pennies, and a wide mouthed bottle.

**Procedure:**

This is a contest to see who can get the 10 pennies in the jar first. You will work as a team and each team will be given some time to establish their strategy.

The rules of the game are quite simple:

1. A penny can be placed in the jar only by having it fall off the edge of a playing card, which must maintain its horizontal flat position with the table on which the jar sits.
2. You can not touch the penny but you can move the card, keeping in mind the above mentioned position of the card.
3. If a penny drops to the floor, you may pick it up and try again.
4. The game is over when all of your pennies are in the jar.

**Vocabulary Development:**
inertia, horizontal flat plane, quickly

**Data Collected:**
Questions:

1. What proof do you have that bodies of matter wish to remain at rest forever, unless acted upon by an outside force?

Conclusions and Comments:

Further Investigations:

1. How do men in India survive the blow to their chest with a sledge hammer when they are supporting a concrete slab full of nails?

2. How does an astronaut go to the bathroom in space when there is no gravity to pull things down?

Application to Everyday Life and Other Disciplines:

Pitfalls to Avoid When Doing the Experiment:

Best Grade Level:

Show-Me Standards:
Homemade Fulcrum Balance

Scientific Concept Involved:

The fulcrum balance is just like a see saw at the play ground. It has a point around which all rotation occurs and two masses at each end. In our case we will know the mass at one end, but the mass at the other end will be our unknown. Our balance must be perfectly level. We will accomplish this by adding or subtracting mass from one end rather than by changing the length of the two cups from the fulcrum.

Equipment Needed: Ruler, string or wire, paper cups, nail, and wooden support for fulcrum. Things to weigh: M&M’s, paper clips, jelly beans, thumb tacks.

Procedure:

Making your balance:

1. Make your scale pans by punching three holes equally spaced apart around the rim of each cup. Using approximately 40 centimeters of string for each cup, thread the string through the three holes and make a hanger for your cup. The string from the cup should connect to the paper clip so that when you hold the paper clip, the cup hangs vertically.

2. Next, place two paper clips through the end holes of your ruler. These will be used to attach your cup’s paper clip to, so bend your clips so that they can be easily removed.

3. Now comes the really important part. Place the fulcrum nail in one of the two holes located at the center of your ruler and place the nail on the fulcrum support arm. Attach your scale cup pans and see if your system is balanced. That means perfectly level! If it is not, glue some small items to one or the other cup until your system is perfectly balanced.

Calibrating your balance:

1. Place in one cup a known mass of 5, 10, or 20 grams. In the second cup add 1984 or later pennies until your balance is level. What can you conclude about the mass of a penny?

2. Do the same thing again, but this time use nickels. What can you conclude about the mass of a nickel?

Vocabulary Development:
fulcrum, balance, center of gravity, pennies, nickels, known metric mass

Data Collected:
Questions:

1. Which has the greater mass: an M&M or a paper clip? You may wish to mass more than one for more accurate results.

2. Which has the greater mass: a thumb tack or a paper clip? Again, you may wish to mass more than one.

3. Can you predict how many M&M’s will equal the mass of 10 paper clips? Check your answer for correctness!

4. What is the mass of your pencil in penny masses?

5. What is the mass of your pencil in nickel masses?

6. How many penny masses equals one nickel mass?

Conclusions and Comments:

Further Investigations:

Conversion factors are a way of life for the scientist. Can you find in reference books any other conversion factors used by scientists?

Application to Everyday Life and Other Disciplines:

Pitfalls to Avoid When Doing the Experiment:

Best Grade Level:

Show-Me Standards:
The Water Glass Mystery

Scientific Concept Involved:

Pressure is defined as the amount of force an object exerts on a given area. Since all matter has both mass and volume, all matter, including fluids (both liquids and gasses) exerts a pressure on the surface below it. You would think that the pressure air exerts would be very small, but you must remember that air pressure is due to all the air directly above, and that is miles of air. Water is much more dense than air; therefore, it takes a shorter column of water to exert the same pressure that air exerts. **Fact: all the air above a one inch square surface at sea level exerts a pressure equal to a column of fresh water 34 feet high.** Also remember that all matter has volume (this includes fluids), and because of matter’s volume, no two objects can occupy the same space at the same time.

Equipment Needed: Drinking glass, jar or bottle, large pan, and a flexible soda straw.

Procedure:

Fill a large pan or basin with fresh water. Now submerge a glass into the basin, open end down, and tilt it so that water runs into the glass until it is completely full of water. Next tilt the glass until it is vertical, with the open end down. Now lift the glass straight up, but do not let the glass break the surface of the water. Record your observations.

Remove the glass. Again submerge the glass, this time tilting it so that it fills only half way with water. Again tilt the glass so that the open end is down and lift the glass as before, without breaking the surface of the water. Now have your partner bend the straw and insert it into the air pocket in the glass. Have your partner blow on the other end of the straw. Record your observations. Now suck on the straw (careful—not too much!). Again record your observations. Last take your mouth from the straw and record your observations.

Last of all, place your finger over one end of a straw and push the other end into the pan of water. Now lift the straw out of the water with your finger still over the end. Remove your finger and record your observations. Again submerge the straw, but this time with your finger not over the other end. When the straw is submerged, place your finger over the upper end and remove the straw from the water. Record your observations.

Vocabulary Development:

air pressure, density, volume

Data Collected:
Questions:

1. What happened to the air in the first glass when you tilted it to the side? Why?

2. What happened to the water level in the glass when you blew into the straw? Why?

3. What happened to the water level in the glass when you sucked some of the air out of the glass? Why?

4. What was in the straw when you removed it from the water? Why?

Conclusions and Comments:

Further Investigations:

Do you think the height of a mercury column that could be supported by air pressure would be more or less than 34 feet?

Application to Everyday Life and Other Disciplines:

Pitfalls to Avoid When Doing the Experiment:

Best Grade Level:

Show-Me Standards:
Air Volume and the Collapsing Box

Scientific Concept Involved:

Air, like all matter, has mass and volume. The volume that air occupies varies with temperature and pressure, but if these variables are kept constant, then the volume occupied by a given amount of air will be constant. However, if we add more air molecules to a container, its volume will increase, and if we subtract air molecules, the container’s volume will decrease.

Equipment Needed: One fruit juice box, one student with lots of hot air, one jar with wide mouth, one small balloon, and a zip-lock bag.

Procedure:

Have a student withdraw air from the box by sucking on the straw. Record your observations.

Now have the student blow air into the box. Record your observations.

We will now make a human lung by putting a partly filled balloon into a large-mouthed bottle. The partially inflated balloon should have its end tied so that air cannot get in or out. Next, cut the sides of the zip-lock bag so that we have a flat piece of plastic and place it over the mouth of the jar. We may wish to place a rubber band around the neck of the bottle so that the air inside the bottle is trapped. Push in on the top piece of plastic and notice what happens to the partly-inflated balloon. Record your observations. Now pinch the top piece of plastic and pull up. Record your observations.

Vocabulary Development:
suction, vacuum, pressure, volume

Data Collected:
Questions:

1. What happened to the volume of the box as you removed air molecules? Why?

2. What happened to the volume of the box as you added air molecules? Why?

3. What happened to the inner balloon as you pushed down on the top plastic seal? Why?

Conclusions and Comments:

Further Investigations:
When we breathe, air comes into our lungs and goes out of our lungs. How do you think air enters our lungs when we inhale.

Application to Everyday Life and Other Disciplines:

Pitfalls to Avoid When Doing the Experiment:

Best Grade Level:

Show-Me Standards:
Water Exerts Pressure

Scientific Concept Involved:

If you have ever carried a bucket of water out to the barn to water your horse, you know that water has weight. In fact, a cubic foot of fresh water weighs about 64 pounds. We know that in the metric system water has a density of 1 gram per milliliter (one gram per cubic centimeter) or one kilogram per liter. This is considerably more dense than air, which has a density of 1.29 grams per liter (I rounded that off to 1.3 in my cubic meter of air experiment.)

When you stand beneath the entire ocean of air above you, you don’t pay much attention to the pressure exerted on you, but if you stand at the bottom of an ocean of water, your body would not be able to withstand the pressure of water exerted on you. The pressure of water changes as you go down.

Equipment Needed: A one or two liter soda bottle, hot nail, and some water.

Procedure:

1. Heat up a nail with a butane torch and then press the hot nail to the side of the soda bottle at points A, B, and C. Alternatively, use a large needle or pushpins to make the holes. The pushpin might work the best because you can leave them in place!

2. Next, get a partner and the two of you hold your fingers over the three holes while you fill the bottle with water.

3. Now release all fingers at the same time while you hold the bottle over a pan to catch the water. Alternatively, pull the pushpins out one at a time, starting from the top.

Vocabulary Development:
pressure, density

Data Collected:
Questions:

1. At which point in the bottle do you feel the water pressure was the greatest? Why?

2. Do you think putting your thumb over the bottle top would make a difference in the water flow? Explain.

Conclusions and Comments:

Further Investigations:

1. Find out the pressure per square inch of surface at an ocean depth of 5 miles.

2. You might wish to read about the construction of the Ead’s Bridge in St. Louis. It was during the construction of this bridge that we learned about the effects of water depth.

Application to Everyday Life and Other Disciplines:

Pitfalls to Avoid When Doing the Experiment:

Best Grade Level:

Show-Me Standards:
Air, Water, Density, and the Cartesian Diver

Scientific Concept Involved:

When a skin diver dons his suit and tank and heads into the water, he faces a number of new problems, all based on his density relative to the density of water. First, he has added equipment, some of which is more dense than water. His tank, for example, will cause him to sink. He also has on his diving suit, which adds to his volume but which has little density and causes him to float. In order to equalize his density with that of the surrounding water, he has on another piece of equipment called a buoyancy vest which allows him to add or delete air as needed so that he can maintain a neutral density with the surrounding water.

Equipment Needed: Eye dropper (glass works best), two liter soda bottle, water, food coloring.

Procedure:

First fill the soda bottle with water to the very top. Then draw some colored water into your eye dropper and drop it into a jar filled with water deeper than the eyedropper. If the eyedropper sinks, squeeze out some of the water and try again. Fill or empty the dropper until it just barely floats. When you have the dropper so it just barely floats, place it in the soda bottle. The soda bottle should be nearly fill. Cap the bottle and squeeze the side of the bottle. Observe what happens.

Vocabulary Development:
Density, cartesian diver, pressure, volume.

Data Collected:
Questions:

1. What happens to the volume of air in the eye dropper as you squeeze the bottle? Why?
2. What do you think happens to the density of the eye dropper as you squeeze the bottle? Why?
3. Why did the eye dropper descend when you squeezed the bottle?

Conclusions and Comments:

Further Investigations:

What do you think will happen to the volume of a diver’s wet suit when he goes down as he dives in the ocean?

What problems do you think this might cause the diver?

Application to Everyday Life and Other Disciplines:

Pitfalls to Avoid When Doing the Experiment:

Best Grade Level:

Show-Me Standards:
Bernoulli’s Principle

Scientific Concept Involved:

Bernoulli discovered that when the velocity of a fluid is high, the pressure exerted by the fluid is low, and when the velocity of a fluid is low, the pressure it exerted is high. This discovery has many applications in today’s society. It is the reason behind the lift of a propeller plain airfoil and the updraft of your fireplace on a windy day.

Equipment Needed: Paper, pong-pong ball, 3x5 card, thread spool, pin, funnel, tape.

Procedure:

1. Cut a piece of paper 20 centimeters long and 8 centimeters wide. Bend the paper as shown, having each side 5 centimeters high. Place the paper on a flat table and blow under the bridge. Record your observations.

2. Cut a piece of paper 5x15 cm and bend it in the shape of an airplane wing. Tape the ends together. Place a straw through the side end and let the paper hang vertically down. Now blow over the top of the structure and record your results.

3. Place a ping-pong ball in a funnel and try to blow it out. While you are blowing, turn the funnel in other directions. Record your observations.

4. Cut a perfect square out of a 3x5 card using the side as one side of the square. Place a pin through the very center of the card and insert the pin into the hole of the spool. Hold the card to the spool and begin to blow through the other end of the spool. While continuing to blow, remove your hand from the card and see what happens.

5. Cut a soda straw in half with scissors. Place one half of the straw in a glass of water and use the other half to blow across the top opening of the straw in the water. Record your observations.

6. Stand two empty soda cans about a half inch apart on about 10 straws. Blow between the soda cans. Record your observations.

7. Hang two balloons by string from the table, with the balloons about an inch apart. Blow between the balloons. Record your observations.

Vocabulary Development:
Bernoulli, centimeter, airfoil, fluid, pressure

Data Collected:
Questions:

1. Why did the bridge go down?

2. Why did the airfoil go up?

3. If we had an airplane wing with a surface area of 10 square feet and the pressure on top of the wing was 1.5 pounds per square inch less than on the bottom, what would be the lift of the wing?

Conclusions and Comments:

Further Investigations:
Light a candle and blow on either side of the candle flame. In which direction do you think the flame will move. Make a prediction before actually doing the experiment.

Application to Everyday Life and Other Disciplines:

Pitfalls to Avoid When Doing the Experiment:

Best Grade Level:

Show-Me Standards: