Keep Your Bubbles Up

<u>Grade Levels Targeted:</u> 5 – 8

<u>Writers:</u> Stephanie EauClaire, www.seauclaire@wcpss.net
Jamie Hall, www.jdhall@wcpss.net
Kevin McDermott, www.kmcdermott.wcpss.net
Barbara Pearman, www.bpearman@wcpss.net
Amy Simon, www.asimon@wcpss.net

<u>Educational Standards:</u>

NCOS Goals:

Grade 5 Goal 4: Learner will conduct investigations and use appropriate technologies to build an understanding of motion in technological design.

Grade 6 Goal 1: Learner will design and conduct investigations to demonstrate an understanding of scientific inquiry.
Goal 2: Learner will demonstrate an understanding of technological design.

Grade 7 Goal 1: Learner will design and conduct investigations to demonstrate an understanding of scientific inquiry.
Goal 2: Learner will demonstrate an understanding of technological design.
Goal 3: Learner will conduct investigations and utilize appropriate technologies and information systems to build an understanding of the atmosphere.

Grade 8 Goal 1: Learner will design and conduct investigations to demonstrate an understanding of scientific inquiry.
Goal 2: Learner will demonstrate an understanding of technological design.

National Science Standards B, D, E, F & G

<u>Objective:</u>

Students will determine the best method for keeping bubbles aloft without touching them with their hand of other objects. In doing so, they will develop an understanding of the Bernoulli Principle.

<u>Materials:</u> For each group: 1 gallon bucket or basin, measuring cup, dishwashing detergent (Dawn works well) 1 eyedropper, 50-60 drops of glycerin, straws, index cards, and bubble wands

<u>Engineering Connection:</u> Aeronautical Engineering

<u>Setting up the Activity (for facilitator):</u>

Divide students into groups of 2-4.

Provide for each group are 1 gallon bucket or basin, measuring cup, dishwashing detergent, 1 eyedropper, 50-60 drops of glycerin, straws, index cards, paper towels, and bubble wands.

Place paper towel under basins and provide extra paper towels to each group. Take time to impress upon the students that they need to be very careful with the bubble mixture, making sure they hold the bubble wands over the basin when blowing bubbles.

If possible, perform the experiments in a carpeted area because the bubble mixture is very slippery when spilled on tile or linoleum.

Introduction (for youth):

Bubbles are delicate, beautiful, and fascinating, and their movement unpredictable. What makes them rise and fall and change directions? Do you think there is a way you could control their movement? How? What do you think might be the best method to keep bubbles from hitting the ground without touching them with your hands or anything else?

What to do:

1. Mix a bubble solution using 1 gallon of water, 8 ounces of detergent, 50-60 drops of glycerin.
2. Using wands, blow bubbles and experiment with trying to control the movement of the bubbles.

***Teachers note: Make it clear from the beginning that no one bursts anyone else's bubble**.

3. Have students put their bubble blowers down and share the methods they tried and how successful those methods were.
4. Draw a diagram of an airplane wing on a chart or board and explain the Bernoulli Principle to the students (**see background information**.)
5. Distribute straws and index cards and have students try to change the pressure above or below the bubble by waving the index card back and forth or by blowing air on it through the straw.

Finishing it up (for facilitator):

After 5 to 10 minutes, lead a discussion about the methods used and the success of the methods tried.

Talking It Over:

a. Share What You Did:

1. **What did you discover when you waved the index card over the bubble or under the bubble?** (Answers will vary, but increasing the air over the bubble should decrease the pressure and the bubble should rise. The opposite would be true if waving the index card under the bubble.)
2. **Did you see a difference if you waved the card faster or slower? If so, why do you think that was?** (By increasing the speed, the pressure should be reduced on that side, increasing the pressure on the opposite side.)
3. **What happened when you blew air over the top of the bubble? Under the bubble? Along the side of the bubble?** (The pressure on the side you were blowing on would reduce while pressure on the other side would increase, moving the bubble toward the side you are blowing on)

b. Process What's Important;

4. **What did you find to be the most successful method of controlling the bubble?** (Answers will vary.)
5. **How long were you able to keep it aloft?** (Answers will vary.)
6. **How do you think your method changed the pressure on the bubble and kept it in the air?** (Answers will vary.)

c. Generalize to Your Life:

7. **Looking back at the airplane wing, how do you think raising the flaps up or down on the wing helps the pilot change the movement of the airplane?** (Raising the wing would cause the air traveling over it to travel farther, thus reducing the pressure. The pressure under the wing would then cause the wing to rise.)
8. **Where in nature do we see this principle used to control movement?** (Answers will vary, but some examples are birds, flying insects.)

d. Apply What You Learned:

9. **How do you think Bernoulli's discovery counteracts the force of gravity?** (Gravity is pulling the object downward, but by controlling the way the air travels around it, increasing the pressure under an object overcomes the force of gravity.)

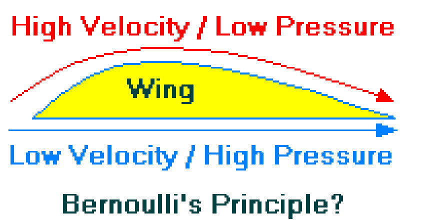
10. **How do you think the Bernoulli Principle might affect the design of automobile?** (By controlling the way air is moved around an object, car designers are able to reduce the friction, or drag, that would slow the automobile down.)
11. **Do you think the movement of cars would be affected if they were designed with bodies that were more box shaped? How?** (Yes, see above explanation.)
12. **What other inventions can you think of that use this principle in their design?** (Answers vary, but could include helicopters, kites, and gliders.)

More Challenges:

1. Using the knowledge they have acquired, challenge students to manipulate a balloon from one place to another using straws or index cards, requiring it to travel over and under obstacles and around corners.
2. Ask students to research and report how birds use this principle to change directions when they fly.

Background Information (for facilitator):

The Bernoulli Principle:



Daniel Bernoulli was a scientist during the 18th century who studied the way that air travels around an object. He discovered that the faster air flows, the less pressure it exerts. As air hits the airplane wing, some of it will travel up and over the wing and some will travel under it. Even though the air traveling over the top of the wing has farther to travel, it will arrive at the back of the wing at the same time as the air traveling the shorter distance under the wing. Therefore, the air above the wing must travel faster, thus exerting less pressure. Since there is then more pressure under the wing, the wing will lift. This is called "Dynamic Lift." In order to keep an object aloft, you can either increase the pressure under it or decrease the pressure above it.

Resources: http://www.mste.uiuc.edu/davea/aviation/bernoulliPrinciple.html
http://www.lsc.org/lscyouth/programs/psd2003/humanflight/bernouliprinciple.html
http://www.nap.edu/readingroom/books/rtmss/1.48.html