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The Great Penny Experiment

Lesson Teaches Scientific Method

When I started out as a teacher working with developmental lessons, I felt that the children were missing out on some learning. I teach in a school that has a large minority population. Many of these children have just arrived in the United States and do not always understand our concepts and ways of doing things. These children were falling through the cracks and were becoming lost in the system. When I gave announced tests on information taught to them in previous lessons, most would receive a passing grade because they studied the night before the exam. However, I found that when I asked questions relating to the previously taught material in the weeks following the exam, few children had integrated the information and could still give an accurate answer. By close observation of classroom activities, I came to the conclusion that most children could study to pass an exam, but few retain or integrate information unless they learn by doing. Therefore, I concluded that Hands-on Inquiry Based Instruction (HIBI) was the way to proceed.

I began to re-write board of education curricula by converting stand-up developmental lessons into hands-on science experiments. The challenge now was to teach the children *how* to perform an experiment. Through weeks of trial and error, I explored many different instructional concepts and designed an inclusive, hands-on science unit that would have the children incorporating experimentation, observation, data collection, and presentation with oral presentation techniques as a total learning unit.

The experiment unit in simple terminology is titled, "How Many Drops of Water Can Fit on a Penny's Surface Before the Water Spills Over?" Children explore the steps of scientific investigation with the use of simple objects: a penny, a dropper, and a cup of water. Through steps of the scientific method, written into this unit, the children learn to predict, test, and come up with conclusions about their predictions.

Ask your students to guess (predict) how many drops of water will fit on a penny, and then take a vote. Talk about the United States as being a democratic nation in which we vote on things. Have your students realize that voting in a science experiment is wrong, and that the only way to find out the real answer to this particular question would be to do an experiment.

Through a series of activities, your students will learn to compute averages and will create graphs to represent those data. The children will test different variables and will determine why it is sometimes necessary to control variables in their experiments. Using scientific method format that includes such sections for writing down information such as a problem (question to be answered), a hypothesis (a guess based on the previous knowledge), materials (what they need to use), procedure (step-by-step instructions), results (what happens in their experiment), conclusions (why things happen), and variables (things that you messed up), you may wish to have your students keep a journal, log, or lab notebook documenting their work.

Four activities are based on the initial question of how much water will fit on a penny's surface. A penny is made of a non-absorbent material, but it has hills and valleys on its surface, which can hold water. Water can fill the spaces on a penny but will not be absorbed into it. Fill cups with water and give children their droppers. Now you can begin.

In the first activity, ask your students if the distance between the dropper of water and the penny will have an effect on how much water a penny will hold. Drop a rock into a small basin or pan of water. Talk to your students about splashing. Ask them where the splash came from and why it occurred. Your students should be able to carry the rock/basin experiment over to their own experiment with the pennies. They should hypothesize and, after testing, conclude that as they increase the distance between the dropper and penny, splashing will begin to mess up their results. Allow your students to work on this first penny experiment. Talk with your students about why doctors and scientists test experiments more than once. After allowing your students time (about two class periods) to test their results from various dropper heights, work with your students on computing averages for their test results, and then work with them on graph techniques for sharing their results with others.

Does the age of a penny have an effect on how much water you can fit on it? In the second activity, discuss with your students the possibility of having a new penny that looks old or an old penny that looks new. Could someone have taken a new penny and made it look older that it should look? Could someone have put pennies away years ago so that when you look at them now, they look brand new. Explain that when pennies tarnish, some of the space that could be filled with water is now filled with a different material. This will cause the penny to hold less water. After allowing your students to work on the second penny experiment (about two class periods will be necessary for the trials, averages, and graphs to be made), they should realize that the age of a penny has

no effect on how much water it will hold. Instead, it is the condition of the penny that makes a difference. They should also realize that using the cleanest, most un-scratched penny they can find will give the best results.

All through these exercises, you will hear your students complain about someone bumping into their table and messing the experiments up. The third activity will focus on the theory that shaking the table will have an effect on how much water a penny will hold. Question your students as to why their results will be affected if the table is bumped or banged. Have your students work in small groups so that one child can drop water while others shake the table and document information. Ask your students how a pan of water will be affected if you pull sharply on the side of the pan. Using Newton's Law that a body at rest tends to stay at rest, demonstrate that as you pull on the pan, the water wants to stay in its original position. The pan, however, is no longer in that position, so the water falls or spills onto the table. When students shake the table, the water will move back and forth on the penny until it spills over the sides. After allowing your students time to work on the third penny experiment (two class periods), your students should also come to realize that besides the water spilling off the penny, it is not easy to drop water onto a moving target or, in this case, a moving penny.

The fourth activity challenges students to discover which side of the penny will hold the most water. Begin by questioning your students as to why pennies will hold water at all. Because they have worked with pennies for at least six class periods already, the students should be able to tell you that a penny is like a small pool. The coin has a ridge around it, a ridge that raises up the side of the penny higher than the center of it. This allows water to fit on the penny's surface. Therefore, a raised surface in the center of the penny will fill space that could potentially be filled with water. The students, after making careful observations, should predict which side will hold the most water determined by the idea that one side of the penny has more raised surfaces taking up space. Allow two class periods for your students to test several times the heads

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and tails sides of the penny. Have the children average their results and make a graph based on their findings.

After completing these experiments, your students should know how to use the scientific method as a tool to solve problems. They also should have learned how to control a variable; in this case, they should understand that to get the greatest number of drops they should hold the dropper close to the clean, non-scratched penny on the tails side, and they should do this experiment on a table that cannot be shaken.

Many of my colleagues have tried these same experiments in their classrooms. They have found that the children learn many concepts and retain more information through these hands-on exercises. Because these experiments require only a few, inexpensive materials, this unit can be implemented in almost any school or classroom. If sinks and running water are unavailable to the teacher, water can even be transported into classrooms in recycled three-liter soda bottles. Therefore, many obstacles are overcome because expensive equipment, special facilities, cost of consumable workbooks, and a specialized science background are not needed.

The children loved doing the experiments, and when tested, I found that they retained more information and could integrate it with newer material months later. Former students, who have returned years later, still remember many of the hands-on experiments that we performed together.

Each year, I write new material and revise old lessons. Teachers need to review the experimenting process to see what works and what doesn't. Revision and updating are two of the most important steps a teacher can take to ensure that his or her students are on task. Additionally, writing new material keeps the teacher's mind keen and prevents lessons from becoming stale.

Keep in mind that hands-on science lessons are noisy and require a great deal of time and effort to prepare. I had to rethink my ideas on classroom management, but I found the time and effort were worthwhile. ❦

Heads or Tails

Problem: Which side of a penny will hold more water, heads or tails?

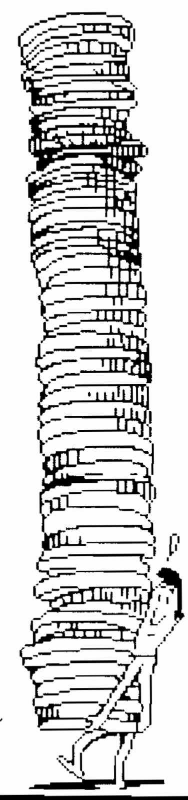
Development:

Q – Which side of the penny has a more raised surface (things sticking up like edges, faces, etc)?

Q – How might this affect the amount of water that side will hold?

Q – How can you tell for sure which side will hold more water?

Q – Why should you test each side more than once?



Table

Graph these results on a separate sheet.

* Do not average in your guess.

Side	Guess	Trial 1	Trial 2	Trial 3	Average
Heads					
Tails					

Conclusion:

Q Which side of the penny holds more water drops? Why?

Q Variables (like side of penny, shaking the table) mess you up. How can you avoid these things?