Scientific Method: Demo Ideas

THE FUN OF SCIENTIFIC INVESTIGATIONS

MATERIALS:

* Two eggs per pair of students, one raw, one hard-boiled, plus a couple extras for eggs broken extra early
* Permanent markers--about 5

METHOD:

1. Query the Egg: You have just been given two eggs. One of your eggs is fresh and one is hard-boiled. Choose one of the eggs and put a mark on it. Do you think the marked egg is (Circle one) Raw Hard-boiled
2. Now, do a scientific investigation and discover all the ways your two eggs differ that could be used to tell any hard-boiled egg from any raw one. (That means that size, shape, color, specks, etc.,. can't be listed, as, if you write that the small one is hard-boiled, it means that all small eggs are hard-boiled.) It might help if you pretend that your dad is going to make cookies and that your little brother mixed up the hard-boiled eggs in the refrigerator and you need to find all the hard-boiled eggs and all the raw ones. (No, you may not break the eggs to find out, and yes, please do keep your eggs over the desk because if the eggs drop on the floor the raw egg, at least, is going to be a real mess to clean up!)
3. Make a list the ways you have found to tell all hard-boiled eggs from all raw eggs:
4. Would you like to change your original hypotheses? If so, now is your chance The marked egg is (circle one) Raw Hard-boiled Why do you think this?
5. Now, how are you going to prove it? That's right, but you only get one chance. Go up to your teacher and break your egg over the bowl, and, if you are right, you'll get salt and/or pepper and be able to eat it. If not, you get to clean up the mess, so be careful!

Submitted by

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AN AUTUMN DEMO FOR EXPLAINING RATE OF REACTION

GRADES: 7-12

This can be used in explaining rate of reaction in chemistry classes, but because of the effect I liked to use it near Halloween. It involves making 3 solutions which might require a well-stocked chemistry lab. When the colorless solutions are mixed in the proper order, they will suddenly turn bright orange, then just as suddenly turn blue-black. The effect is called the "Old Nassau Reaction" because it was the colors of the Princeton Tigers. The University of California sometimes used to use it as they sang of their colors, gold and blue.

MATERIALS:

* Solution A consists of 15 g of KIO3 dissolved in a liter of water

* Solution B is made by dissolving 4 g of soluble starch in 500 ml of boiling water
* Solution C requires 3 g of HgCl2 dissolved in a liter of water
* large beakers or flasks for mixing, and 50 ml to 250 ml beakers for the demo

METHOD:

1. The solutions must be freshly made the week of the demo, and should be tried before showing to a class. This makes enough for many demonstrations. CAUTION: POISON. Do not allow any one to drink the solutions! KIO3 is potassium iodate, while HgCl2 is mercury II chloride.
2. Mix equal volumes of B + C + A in that order. I just use beakers large enough so that the volumes used are less than one third of the volume of the beaker. For example, if I use 250 ml beakers, I fill each beaker with 50 ml of solution. It is easier to be sure of the order if the beakers are labeled A, B, and C.
3. Pour B into C, then both back into B. Now pour B into A, then back into B (pouring back and forth does the mixing.) Now hold the beaker with all three solutions up for the class to see. Very soon the colorless liquid will turn bright orange, then suddenly turn black.

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OBSERVATION PRACTICE: DEMONSTRATING THE COLLAPSING CAN

This experiment is the old stand-by, collapsing can. In this version, I use it to teach how to write a complete observation, and one set of procedures for scientific problem-solving.
MATERIALS:

* empty, undented soda can
* bowl of cold
* method of heating
* dark colored background (i.e. cardboard)

METHOD:

1. Before I begin, I tell the students the names of tools I am using and also that the bowl contains cold water.
2. I direct them to watch the demonstration carefully, and then write down everything they observed. They must try to remember everything.
3. I then proceed to do the demonstration in silence, modeling listening for the sounds of boiling water. I put up a dark colored background so that they can see the presence of steam when the water boils.

4. I make a show of emptying the soda can of water, then putting back in only one tablespoon of water. They watch me light the burner, placing the can over the burner, and wait for the water in the soda can to boil. I then take the can carefully with tongs, and invert it into the bowl of cold water. The can's collapse is dramatic and instantaneous!

OBSERVATIONS:

After they write what they have observed, I ask them to voice the one big question they have!
USING SCIENTIFIC PROCEDURES:

1. What is the QUESTION you have now?
2. What is your guess or HYPOTHESIS about why the can collapsed? (I solicit several guesses, then select one to work with for part 3. If there is time, we may do more than one. Students suggest many things, and help each other explain.)
3. Let's TEST your hypothesis: Describe how we would test your idea to see if it is right or not. (Together, the students and I design a test. Usually the hypotheses involve temperature changes, weakness of aluminum cans, and other suggestions which can be tested by varying where the hot water is, if the can is inverted or not, or whether or not the can needs to have boiling water in it to collapse. Then we try out their ideas. They are told to use complete sentences in all reporting, and to include drawings.)

CONCLUSION: What happened in your test? Were you right? What if you were not right -- how would you change your hypothesis? Write another explanation for why the can collapsed. (Answer all the questions, please!)

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OBSERVATION SKILLS PRACTICE: UNKNOWN POWDERS

In this experiment we will see if you are able to observe 3 powders very carefully.
MATERIALS:

* piece of aluminum foil
* ruler
* scissors
* medicine dropper
* wooden stirring rod
* small container of water.
* sugar (unlabeled to all but the teacher)
* Plaster of Paris (unlabeled to all but the teacher)
* baking powder (unlabeled to all but the teacher)

METHOD:

1. Cut out 3 squares of aluminum foil. Make them 5 cm on each side.
2. Bend the edges of the foil to make a shallow dish. Make 3 of them. Label them A, B, & C.
3. Get a level spoonful of powder A. Put it in dish A. Add 15 drops of water. Stir it.
4. Observe carefully. Write your observations.
5. Get a level spoonful of powder B. Put it in dish B. Add 15 drops of water. Stir it.
6. Observe carefully. Write your observations.
7. Get a level spoonful of powder C. But it in dish C. Add 15 drops of water. Stir it.
8. Observe carefully. Write your observations.
9. One powder was sugar. How could you tell which one it was?
10. One powder was Plaster Of Paris. Which one?
11. One powder was Baking Powder. It made bubbles. Which one was it?

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OBSERVING A CANDLE

Observation practice is one of the most important activities in a science classroom. Here is one that gives the students practice, while dealing with an ordinary, but often ignored, daily object.
MATERIALS:

* candles
* matches
* plastic stand (or some other type of holder)You can copy these questions directly onto a student worksheet

METHOD:

MOST PEOPLE HAVE USED CANDLES. VERY FEW PEOPLE HAVE TAKEN THE TIME TO OBSERVE A CANDLE CAREFULLY. THAT IS WHAT YOU WILL DO NOW. ANSWER QUESTIONS 1-8 BEFORE YOU LIGHT YOUR CANDLE.

1. Draw the candle.
2. What is the color of the string at the top of the candle?
3. Describe what the candle feels like.
4. Can you see any marks, or spots, inside the candle?
5. Look at the bottom of the candle. Is the string the same color as at the top?
6. Describe how hard the candle is. Tell if it is hard in some places, and soft in others.
7. Say something about the candle.

LIGHT YOUR CANDLE. TAKE IT TO YOUR DESK. STAND IT UP ON YOUR PLASTIC SQUARE. BE CAREFUL!
ANSWER THESE QUESTIONS AFTER YOU LIGHT YOUR CANDLE.

1. How much of the exposed string (1/2, 1/3, etc.) is surrounded with flame?
2. What colors are in the flame?
3. The greatest part of the flame is what color?
4. Draw the flame. Be sure to show the string.
5. Is there any smoke?
6. What must you do to make smoke?
7. What color is the smoke?
8. Where is the flame dark?
9. Does the flame come to a sharp point?
10. What can you do to change the shape of the flame?
11. Draw a line to show how far into the candle the light goes.
12. Does the top of the candle have a little cup of melted wax?
13. Is the cup the same on all sides?
14. Is wax dripping down the side of the candle?
15. Draw the wax that is dripping down the side of the candle.
16. Let ONE DROP of melted wax fall onto your hand. How hot is it?
17. For how long a time does the drop of melted wax stay hot?
18. Does the candle make any noise as it burns?
19. Can you read the page by the light of your candle?
20. Does the burning candle produce an odor?

EXTRA CREDIT! What other things can you observe about your candle?

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Consumer Science

Those whiners who constantly mewl "why do I need to learn this?" can be in charge of this lesson - let them brainstorm ways to use the scientific method in testing consumer products. The following are just samples; have your kids come up with other products to test, and devise ways to test them.
Project Ideas:

* Popcorn: which pops better, fluffier or tastes better? (One brand may not be best in all categories.)
* TV: Which channels have fewer commercials? Which shows have the most interesting commercials?

* Weights & Measures: Devise a way to test accuracy of scales, then have each student check their bathroom scales at home.
* Laundry Soap: test on stains soaking in jars of solutions.
* Dog Food: Students can bring in pieces of dog food from home. Make a blind taste test to send home to try on their pets, giving the pets a choice between different brands, to see which food they eat first.
* Paper Towels: measure how much water will be soaked up for a given size of towel. Also, how accurate are the sizes given on the paper towel packaging?
* Soft Drinks: use a graduated cylinder to measure soft drink volumes from 3 or 4 different brands.