

Bromothymol Blue and “Doing Science” (Btb) Demonstration

Overview and Rational: This demo is done on the first 2 days of school so the students can jump right into the science. The demo allows for observations, then discerning the difference between observations (facts) and inferences. After observing the phenomenon, students ask questions and come up with their initial ideas to explain what they saw. Next, we test the ideas with the equipment we have on hand and derive at an explanation. This demo follows the steps that a scientist can take when faced with a new phenomenon. We are not following the scientific method; thus students experience a different way to “do” science.

Equipment

- Bromothymol Blue (dilute stock solution 1:10 w. distilled H₂O then further dilute 2 parts tap H₂O: 1 part Btb.)
- Erlenmeyer flask
- Straw
- Hot plate
- CO₂ Water
- Tap water

Demo:

Day 1

Have a student volunteer blow through a straw into the flask of Btb while the class observes. Once the Btb has changed from blue to green to yellow, ask the class what they have observed, focusing on data only. Students may say “the liquid went from blue to green to yellow,” “bubbles were blown into the liquid,” “it changed color after the bubbles were blown in the flask.” Some student’s may jump to the idea that the O₂ in the breath changed the Btb. At this point remind the students that as scientists we are first just observing and collecting facts, not inferences at this time. This is a good place for a discussion about facts verses inferences.

Hopefully, their curiosity has peaked and a student has asked “What did change the Btb from blue to yellow?” This is your driving question. If no one asked you can ask the students, “what are you curious about, or what do you want to know?”

Once the class has discussed the facts and you have a question, the conversation can move to the inferences. Based on prior knowledge and the facts, what ideas do they have about the phenomenon they observed? Students may suggest that the bubbles caused the change, or that it was the O₂ in the student’s breath, or the CO₂, or the heat or the water. Ask the students what the next move is. We have all these ideas, but we do not have data to support them, so how do we know what actually changed the Btb? We must run tests.

I explain that we have limited equipment, but can be creative with what we have. How can we test for heat, water, O₂ and CO₂? We come up with putting the Flask of Btb on a hot plate and heat it up, add water, add carbonated water (after testing the plain water idea), and because pure oxygen is dangerous we don't have any in the lab will rule it out / or as a possibility in a process of elimination.

Note: Though these tests are not completely conclusive, they head us in the right direction of understanding what will change the Btb from blue to yellow. Later in the year when we work with Btb again the students can either do some research or read text that explains that Btb is a pH indicator and often used for the measuring the presence of carbonic acid.

Day 2

Testing our ideas. The equipment is all set up when the students come in. First have the students predict what will change the Btb. We first add some water, and nothing happens, then we put the flask of Btb on the hot plate, and we heat it up, but nothing happens. We then add carbonated water and a dramatic change from blue to yellow occurs. We rule out oxygen.

We discuss that we did not actually follow the scientific method, yet we "did science" in a systematic way. We are not done, we still do not know if oxygen plays a role, we have further work to do, but for now we can eliminate the idea that water and heat changed the Btb and that carbon dioxide does.