

Biology II
Unit 1: Scientific Inquiry
Lab Safety: How Hot is Hot?
Background Information

(Modified from Laboratory Investigation 14: "The Spice of Life", Exercise C: How Hot is that Jalapeno?)



Figure 1: An eye injury caused by a pepper burn

One of the most important contributions from the Western Hemisphere to the world's spice racks are the capsicum peppers. These chili peppers are fruits of plants in the genus *Capsicum*. These peppers are unrelated to black pepper (*Piper nigrum*). Among the varieties of capsicum are the mild bell peppers to the extremely spicy habanero and ghost chili.

The fiery taste of chilies is due to the presence of a group of alkaloids known as capsaicinoids. The most important of these is **capsaicin**. The capsaicin content of bell peppers is extremely low, but it is quite high in jalapenos, cayenne, and habaneros. In 1912 Wilbur Scoville came up with a method of measuring the biting taste of these peppers. This method uses a panel of five tasters who sample extracts of the peppers diluted in sugar water. The units used are **Scoville Heat Units**. The greatest dilution, which can still be detected by 3 of the 5 tasters, is considered the heat level. For example, if capsaicin is tasted at the 1:10,000 dilution, then the Scoville Units for the pepper will be 10,000. These range from 0 for bell peppers to 1,000-5,000 for jalapenos to 100,000-300,000 for the hottest habaneros. In modern commerce, the Scoville Heat Units are measured more precisely with the HPLC (high pressure liquid chromatography). For this exercise, we will use a modification of Scoville's taste test to measure the "heat" of several capsicum peppers.

Lab Safety

As a general rule, one must never eat in a science lab. This is one of the rare exceptions where eating is the lab. It is important that all other standard laboratory techniques are followed. Eye goggles and gloves **MUST** be worn. If capsaicin were to come into contact with your eyes or skin serious damage can occur. **DO NOT** get capsaicin on your skin or in your eyes. Serious burns may occur. If you get any capsaicin on your skin, tell your instructor immediately and then wash with large quantities of soap and water.

Peppers provide a unique range of flavors to a variety of dishes, but why are peppers spicy?

Materials Needed

6 disposable dropping pipets
6 test tubes with lids
45 mL of 5% sugar water
1 test tube rack
Chili peppers
Mortar and pestle
Vinyl gloves
Goggles

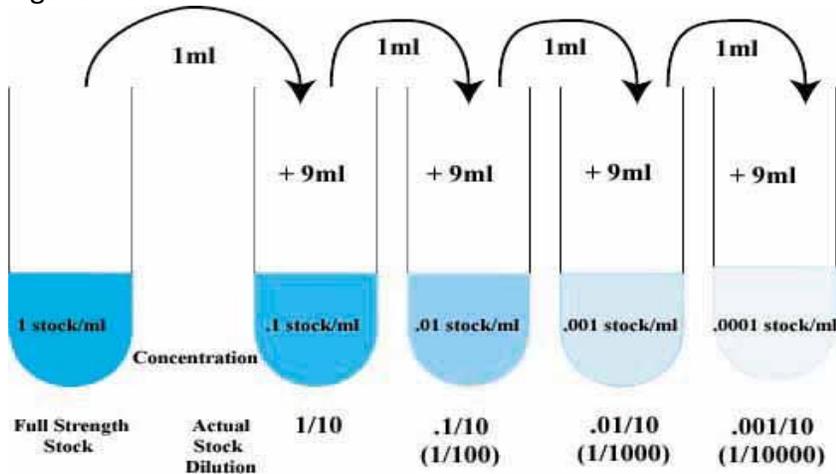
Jobs

Materials Acquisition
Dilution Preparation
Grinder
Clean-Up
**if your group has three people, the materials person will also help with clean-up*
**if your group has five people, there will be two clean-up people*

Procedures

1. Obtain 6 test tubes. Label them "stock", "1:10", "1:100", "1:1,000", "1:10,000", and "1:100,000". Place them in a test tube rack, and fill every tube (except the stock tube) with 9 ml of the 5% sugar solution.
2. Using gloves, cut off and weigh 5g of the pepper your group has been assigned. Place it in a mortar and add 5mL of distilled water. Using the pestle, grind for 3-4 minutes, then transfer as much liquid as possible (10mL if possible) to the tube marked "stock." Using a pipet, transfer 1 ml of the solution into the tube marked 1:10, then place the used pipet back into the stock tube. Cover the 1/10 tube and shake well. Repeat with the remaining tubes, using a new pipet every time. This is a **dilution series**. The solutions in the tube now vary in concentration from 1:1 to 1:100,000 (Figure 2).

Figure 2. Serial dilution



3. Place a new pipet into the 1/100,000 tube (the other tubes should already have pipets in them from the last step).
4. While the clean-up person thoroughly washes the mortar and pestle, everyone else should be washing their hands.

You will now be testing each group's prepared dilutions.

5. Place one drop of each at the end of your index finger, without touching the pipet to your finger. Beginning with the 1:100,000 solution, taste the drop. Is the capsaicin distinguishable? Repeat with the 1:10,000 solution, etc. and record results in the data table. Once you can taste the capsaicin, you can stop. **Remember, you are looking for the "hotness" of the pepper, not the "taste" of the pepper. If you can taste the pepper, but can't taste the spiciness, then you should keep going.**
6. You now need to drink some milk or water, eat an unsalted cracker, and rinse your mouth before proceeding to the taste test for the next pepper. You should also wash your hands to remove any traces of the previous pepper.

Name _____

Hour _____

Biology II

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Pre-Lab

(Background) Brainstorm at least 5 reasons why you think some plants have evolved to contain capsaicin.

(Determination of hypothesis, IV, & DV) Not only do peppers vary based on Scoville units, but they also vary based on size, shape, color, etc. Choose one of these variables, and use the results from our lab to determine if there is a correlation between it and the Scoville rating for the pepper. This does not have to be the same for your entire group.

IV: _____

DV: _____

Hypothesis: _____

Rationale: _____

Data Table (Scoville Heat Units = SHU)

| Pepper | A | B | C | D | E | F | G |
|----------------------|---|---|---|---|---|---|---|
| My IV: | | | | | | | |
| My Data (SHU) | | | | | | | |
| Class Data (Avg SHU) | | | | | | | |

Based on your results, rank the peppers from least to most spicy.

Post-Lab

Based on your data, do you accept or reject your hypothesis? Give evidence to support your conclusion (saying “because that’s what my data shows” is not an appropriate answer).

What errors may have occurred that could have skewed your results? (Remember: determining possible errors is part of good science and is not an indication that you messed up)

Based on your results, describe a follow-up experiment that you could perform (complete with testable question, IV, DV, hypothesis, and rationale).

What safety procedures were in place to ensure subjects involved in the experiment were free from harm?

If you had switched the order in which you tasted the peppers, how could that have altered your results?

Why did you have to determine a class average for Scoville rating, instead of just using your own data?