

Bringing Definitions Alive in Chemistry

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The author describes a 35 minute presentation which introduces the student to acids/bases and pH. This presentation includes a lecture which is integrated with demonstrations. The demonstrations allow students to use four out of five of their senses to see acids/bases and pH come to life.

It has been my experience that a lecture becomes more meaningful when students use as many of their five senses as possible. A lecture-demonstration session requires about 35 minutes and is a good way to introduce the acid/bases and pH topic in freshman chemistry.

The presentation starts off with a couple of transparencies listing the characteristics of acids. The students quickly realize that one of the characteristics of an acid is that it tastes sour or tart. Two bags of candy are then distributed to the class. The first bag of candy is Hershey's Kisses which contains no citric acid while the second bag is Gummi Savors which does contain citric acid. A transparency listing the ingredients of each type of candy is shown to the class while the candy is being passed around. The students are encouraged to read the ingredients while they taste both types of candy. The conclusion that the students are expected to reach is that the Gummi Savors taste tart because citric acid has been added; essentially, students taste one of the characteristics of an acid.

After the candy taste test, the characteristics of bases are discussed. At this point, an acid is placed into a test tube and students are asked to touch the bottom of the test tube and afterwards, a base is added to the test tube and once again students touch the test tube. The students will feel that the test tube is getting warm—evidence of a chemical reaction. Once again students witness the characteristics of acids and bases

with one of their senses. (One of the characteristics of a base is that it reacts with an acid to produce a salt and water.)

A qualitative diagram of the pH scale is presented to the class which ties in pH with the previous discussion of acids/bases and the candy taste test. The tart or sour taste of acids is once again emphasized and the class is asked to rank the following juices in terms of how sour they are: orange, grapefruit, lime and lemon. Once again students are given the opportunity to use their sense of taste by tasting the orange and grapefruit juice. While students are tasting the juices, the instructor measures the pH of the four juices and lists them on a transparency. Students then realize that the more sour lemon and lime juices have a lower pH than the less sour orange juice.

As a final part of this presentation, buffer solutions are introduced. A transparency showing the main characteristic of a buffer solution (which is that the buffer solution resists changes in pH when an acid or base is added) is shown to the class. Students are then asked to gather around the pH meter with pencil and paper in hand. The instructor then measures the pH of 30.0 mL of distilled water (the pH may be around 4.5 to 5.0) and then one drop of a 3.0 molar hydrochloric acid is added to the water and the pH is remeasured. A drop of 1-2 pH units should occur. The instructor must emphasize that the water is not a buffer solution; therefore it experienced a huge drop in pH when the acid was added. This experiment is then repeated with buffer solution (the pH of the buffer solution should be as close to the pH of the pure water as possible.). A drop of 0.1 pH units should occur. Once again the main characteristic of a chemical definition is brought alive. One bonus to this procedure is that students can learn how to use a pH meter. •