Modeling STEM activities into classroom practice

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Abstract:

Students understand concepts better when they have had a chance to work hands on with relevant material. Examples will be presented from my classroom where difficult concepts have been modeled into simple experiments with considerable success in enhancing student understanding. Special focus will be given to selected topics that students seem to have the most difficulty grasping. The objective is to enable students to transfer their understanding to solve complex problems with considerable ease and apply their understanding to real world scenarios on assessments. Suggestions will also be provided for implementation of various concepts into the high school classroom.

Most of us try to incorporate STEM into our classroom practice. However sometimes it may be necessary to create specific activities to get students to understand difficult concepts. From my experience, students learn better by doing. So today we will rotate through different stations and get a feel for what some of these activities might look like. There will be time at the end for discussion.

1. **Diffusion Station**
   This experiment uses paper chromatography to separate the components of a mixture depending upon their solubility in the solvent, and how far they travel along the chromatography paper.

   Materials needed:
   Coffee filter paper
   Food coloring dyes
   Clear plastic cups
   water

   Procedure:
   Coffee filters are cut into narrow strips for this experiment. This will be the stationary phase of the experiment. Draw a line with pencil about 2 cm from the bottom and spot 2-3 food coloring dyes on the line. Place the strip in a clear plastic cup with tap water (the mobile phase) and let the chromatography run for about 20 min. When the solvent front line reaches 1 cm from the top, remove strip and let it dry.

   To make the procedure more scientific, a retention value or Rf value can be calculated. Every compound has a specific Rf value and we can use these known Rf values to compare with an unknown solution whose Rf value is unknown.

   The Rf value is defined as the ratio of the distance moved by the solute (the dye or pigment under test) and the distance moved by the solvent (known as the Solvent front) along the paper, where both distances are measured from the common Origin or Application Baseline, that is the point where the sample is initially spotted on the paper.

2. **Osmosis Station**
   This experiment involves the use of dialysis tubing to demonstrate the concept of osmosis.

   Materials needed:
   Dialysis tubing
   Lugol's iodine
   0.5% starch solution
   500 ml Beaker
   string

   Procedure:
   Cut about 4 inches of dialysis tubing, and fill it with Lugol's iodine solution. Tie both ends with a string and place in a beaker of 0.1% starch solution. Leave for a few hours. The starch will move into the dialysis bag coloring it blue. The experiment can be made more scientific by using different concentrations of starch solution.

3. **Heart Model Station**
   In my Physiology class, I have students make life sized human heart models to demonstrate their understanding of the working of the heart. Students first submit a proposal with measurements to me, which I approve and then they label the parts and get the heart working. Students also demonstrate their handiwork in class. Some photos of these models are posted at this station.

4. **Environmental pollution station with Daphnia magna**
   Daphnia magna are cultivated for this experiment.

   Materials needed:
   Daphnia magna
   Dissecting microscope
   Solutions of 0.1%, 0.05% and 0.01% ammonium sulphate
   Well plates
   Counters
   Disposable pipettes

   Procedure:
   To simulate environmental pollution from ammonium sulphate in pesticides, Daphnia magnia will be placed in solutions of 0.1%, 0.05% and 0.01% ammonium sulphate for about 1 minute Heart rates of Daphnia will be measured before and after they are placed in the solutions using a dissecting microscope.