EXTRACTION OF CAFFEINE FROM TEA/PRE-LAB ACTIVITIES

Time for pre-lab discussion: Two class periods

Purpose: To extract caffeine from tea

Concept preparation and relevance: Discuss the following with class two days before the laboratory experience.

1. Why are extraction processes useful?
   Taxol from Pacific Yew
   Quinine and other drugs/useful products from plants
2. We do an extraction process every time we make tea/coffee,
   here we will try to isolate one compound from tea.
3. Procedure makes use of several processes:
   a. Solvent Extraction: define it, demo it
      Demo 1:
      a. Iodine in water in test tube; stopper and shake
      b. Iodine in Trichloro-trifluoroethane (TTE); stopper and shake
      c. Add TTE to (a) above; stopper and shake
      Discuss: polar/nonpolar solvent interactions
      Relate to lab through aqueous solution of tea and added 1,1, 1-
      Trichlороethane (1,1,1-TCE)
      Caffeine is more soluble in 1,1,1-TCE than in water, although it is soluble
      in both; tannins are more soluble in water.
      Demo 2: Extend concepts in Demo 1 to include ionic compounds and their
      interactions with polar/nonpolar solvents
      Pose Q: How might sodium sulfate and sodium carbonate (used in lab)
      interact with aqueous/non-aqueous layers?
      Use Conductivity apparatus:
      a. Sodium sulfate in water
      b. Sodium sulfate in 1,1,1-TCE or TTE
      Pose Q: If given a choice, where would sodium sulfate be? (Relate to salt
      water)
      Teacher can refer to results of this demo when asking students how they
      know that the white powder extracted in the experiment is not the sodium
      sulfate which they added earlier; can also give data on melting point of the
      solid. Discuss how properties determine choice of separation method.

B. Centrifugation-define its purpose
   Demo it by video
   Relate to shaking Italian salad dressing; observe that it takes a while for the
   two immiscible liquids to separate; centrifuging speeds up the process of
   layer separation.

C. Sublimation: define it; discuss why it is being used in this experiment, relating
choice of method to properties of compounds involved. Demo it using iodine in a beaker; evaporating dish with ice cube in it on top of beaker. Heat beaker and observe.

Day Two of pre-lab discussion:
Students will have read the lab and should be prepared to discuss safety considerations as well as specifics regarding the laboratory procedures.

LABORATORY PROCEDURES:
Refer to student lab handout for the numbered procedures.

Before discussing the laboratory procedure for the extraction of caffeine from tea, indicate to the students that several general procedures will be used in the lab. Videotaped presentations of how to use these specific pieces of equipment or the meaning of the terms will be presented. Students should be able to perform the procedure and explain why it is used.

SHOW VIDEOS ON THESE LAB PROCEDURES
Emphasize safety/care of equipment
1. Use of the pipette pump
discuss why it is needed and in what context in this lab
2. Analytical balance
discuss advantages/disadvantages/special considerations as an alternative to the triple beam balance.
3. Pasteur pipet use
relate to its purpose in the lab
4. Decanting

DISCUSSION OF LABORATORY PROCEDURE FOR THE LAB:

Emphasize that the procedure is not designed to maximize yield, but rather to obtain a small amount of very pure product. While quantitative measurements are made of the amount of tea used and the amount of caffeine produced, students should be aware that the amounts are very small.

Lab step #2: different types of tea can be used to compare

#3: pipette pump used to dispense 10 mL of sodium carbonate solution; take care not to poke hole in tea bag with stirring rod; adjust heat setting of hot plate when boiling begins. Note liquid level in beaker before heating to estimate volume of 10 mL of sodium carbonate + bag. Al foil can be removed after boiling begins. Handle hot beaker with beaker tongs.

#4: Be sure to squeeze bag carefully.

#5: Demonstration: proper gentle shaking of centrifuge tube and relieving of pressure.
Pose Q: How do we know that the layer of interest is the bottom one? Property to be investigated to determine this?

#6: Not to worry if sample is contaminated with some of the dark aqueous layer on the
third separation. The procedure with the sodium sulfate will remove aqueous droplets.

#8: Note location of waste container. Stop here at end of Day #1 of lab procedures.
#9: It may be necessary to add quite a bit of sodium sulfate. Recall the old style paperweights with “snow” in them. If you observe this when you swirl the vial, you have added enough.

#11: Discuss the reason for the sand bath rather than simply heating the beaker with a burner. Note the caution.

#13: Sublimation should be done using a hot plate rather than a sand bath for better viewing of the process. Some crystals may condense on the inside of the larger beaker. These may be scraped off with a microspatula and added to the pile on the bottom of the small beaker.

General suggestions:

Look ahead to the next procedures and be prepared to maximize efficiency in lab.
Goggles and Aprons should be worn at all times. Extreme care should be in evidence especially when TOPS equipment is being used.

Lab report requirements:

Pre-lab report should include (this is due on 1st day of lab)
  Title
  Purpose
  procedure outline including diagrams of setups
  data tables prepared
  space prepared to record observations as you proceed on both days.

After completing the lab:

Finish the data sheet and answer the questions.

Due Date ____________