Young Scholars of Utica
http://www.utica.edu/academic/yslpp/

Workshop January 8, 2011

Hosts: Professor Myriam Cotten, Lydia Rono, and Akritee Shrestha

“Is There a Chemist in You?”
Schedule

Morning

- Why do you think that “chemistry is fun”?
- What are the things that chemists do?
- Lab tour
- Blue Bottle Demonstration
- Description of afternoon project
  - “The Plot”
  - Separation and analysis of analgesics
- Molecular models to visualize shapes and polar groups

Lunch
Sandwiches from Subway
Liquid Nitrogen Ice Cream

Afternoon (hands on)

- Identification of compounds in analgesics
  - Thin layer chromatography
    - Principles
    - Demonstration of spotting and developing plates
    - Individual identification
  - Infra-red spectroscopy
    - Fingerprint of chemicals based on their unique structures and groups

- Debriefing and questionnaire
Help LeBron James!

Analyze analgesics for him

Goals
You need Lebron James. He travels a lot for basketball and contracted a cold during a flight on Monday after the Christmas holiday. Since he had a headache on Tuesday morning, he took a medicine to relieve the pain but it made him feel very drowsy. On Wednesday, he turned to another medicine and had a much better experience. He felt energized for several hours. Your goal is to 1) identify which medicine he took on Monday and which one he took on Tuesday; 2) Explain to LeBron why the two medicines had very different effects.

Background
To assess the chemical content of the medicines, you will use two complementary techniques:
1) With thin layer chromatography (TLC), you will physically separate compounds in the medicines on the basis of chemical properties such as polarity.
2) Using Infra-Red spectroscopy, you will obtain a fingerprint of the medicines and compare it to reference samples.

Thin layer chromatography (TLC)

- The main new technique that you will be using is thin layer chromatography (TLC). This technique is used every day in the industry. It is often used by chemists to determine the number of components in a mixture, identify substances in a mixture, and follow the progress of chemical reactions.

- Chromatographic separations rely on the possibility that compounds can partition between two phases, a mobile and a stationary phase, based on their physicochemical properties. In TLC, the mobile phase is a liquid (eluent) while the stationary phase is a material such as silica or alumina coated on a solid backing (e.g. glass or plastic or aluminum).

- The mixture of interest is applied near the bottom of the so-called developing plate, which is placed upright in a sealed tank containing a small amount of eluent at the bottom. The mobile phase will rise on the TLC plate due to capillary action. Once the plate has been developed in the tank, it is removed from the tank and allowed to dry until the solvent(s) has evaporated. The spots are usually visualized using ultra-violet (UV) light.
Since the TLC plate you will be using is coated with a polar material, substances that are very polar will spend more time adsorbed to the stationary phase and move more slowly than substances that are less polar since these latter ones will spend more time dissolved in the mobile phase. Therefore, separation is obtained based on the different polarities of the various substances in the mixture.

**Procedures**

*Thin Layer Chromatography*

1. Obtain a sample of the two unknown medicines.
2. Obtain a TLC plate. Use forceps to handle the plate so that contamination is avoided. Use a pencil to draw a line about 1 cm from one end of the plate.
3. Use capillaries to spot the unknown medicine samples and known medicines on the plate after listening to the instructions regarding spotting technique. Make the first spot ~ 1 cm from the left edge and make the other spot at a 1-cm interval to the right of the first spot. Repeat the spotting for each medicine twice. To keep track of your work, sketch a drawing of your plate on a piece of paper.
4. Pour a small amount of eluent in a beaker to a level less than 1 cm. The height of the eluent in the beaker is important since you do not want the liquid to immerse the spots on your TLC plate.
5. Line the beaker with a piece of filter paper that extends almost completely around the inside of the beaker. Leave a small opening so that you can observe the plate once it is inserted in the beaker. The filter paper will be saturated with the eluent, thereby creating an atmosphere saturated with solvent vapors inside the beaker, which is ideal for the development of the plate.
6. Place the TLC plate in the chamber so that it does not touch the filter paper. Develop the TLC plate in the beaker with a watch glass at the top to seal the chamber.
7. **Watch carefully** the eluent rise on the plate. Capillary action can act very quickly for some of the eluents. When the eluent has advanced to within 1 cm of the top of the plate, use the forceps to remove the plate from the beaker.
8. Let the plate dry, preferentially under the hood. Use a handheld UV lamp to visualize spots. Mark the contour of the spots with a pencil. Sketch the plate in your lab notebook including the distances traveled by the spots and eluent.

*Infra-Red Spectroscopy*

Bring your unknown samples with you and we will show you how to obtain a fingerprint.

**Conclusion**

1. What are the chemicals in each medicine?
2. Can you tell whether the medicines you investigated was taken by LeBron on Tuesday and Wednesday?
3. Can you explain why?
Structures

ASPIRIN

CAFFEINE

ACETAMINOPHEN
Questionnaire

Thank you for visiting the Department of Chemistry at Hamilton College. We were very honored to be your hosts. We would be very happy if you could fill out the following questionnaire.

In the chemistry lab today, I learned how to…

The most exciting moment today was ………

Would you be interested in coming back for another workshop (yes, maybe, not sure)?

Would you be interested in coming back for a paid summer research position (yes, maybe, not sure)?

If yes, please provide your email address and/or phone number.

THANK YOU!