

RET POLYMER ACTIVITY  
SUMMER 2007--AMY RUTLAND

BACKGROUND:

Have you ever had a headache and taken a pain reliever? Why do some pain relievers begin to dissolve in your mouth and others go down as a whole pill?

Polymer scientists have developed specialized coatings used in pharmaceuticals to assist in the delivery of drugs to the body in the proper place and at the proper time, often eliminating bad tastes, and acid stomachs that are often caused by drugs. Some coatings may be natural polymers such as keratins, as simple as shellacs, or much more complicated man-made coatings.

These drug coatings are often comprised of chemical substances that will react at varying pH's based on the location in the body the absorption needs to occur. For instance, mouths are usually close to neutral (slightly basic or acidic depending on your dietary intake), stomachs are strongly acidic, and the intestinal tract is more alkaline/basic. If a drug is targeted for release or absorption in the mouth, it would need to be able to be dissolved in the mouth at a more neutral pH or have a carbohydrate based coating that the amylase (the salivary enzyme that digest complex carbohydrates) can dissolve. If the drug were to be released in the stomach, it would need to be able to be digested by pepsin (a protein digesting enzyme) or HCl (the acid in gastric juice). If the drug were to be released and absorbed in the intestinal tract, it would need to be able to be dissolved in a more alkaline (basic) pH, by bile salts, or pancreatic juices (lipases, proteases, etc.).

PURPOSE: In this activity, you will determine the most likely location in which different versions of a popular pain reliever are targeted dissolve.

MATERIALS:

- Medication samples – Tylenol® Rapid Release Gels , Tylenol® tablet, Tylenol® Meltaways ,Tylenol® 8 hour, Tylenol® Go Tabs, Tylenol® EZ tabs, Tylenol® caplets, and at least one generic acetaminophen sample
- Small clear cups (such as pill cups)
- Pipettes or graduated cylinder capable of measuring 4 ml
- Distilled water (control), Dilute HCl and pepsin solution (gastric juice), Amylase and Distilled water solution , Dilute NaOH (or other dilute base)
- Sharpie® marker

## PROCEDURE:

1. Label 5 cups for each medicine sample provided with the pill type and one of the 5 solution types using the Sharpie® marker.
2. Place one tablet/capsule in each of the labeled cups.
3. Measure 4 mL of the appropriate test solution into each of the 5 individually marked test tubes or vials for each medication sample.
4. Note the times the medicine samples were covered with the liquid and check each cup every 30 seconds for the first five minutes and again every minute for the next 10 minutes (the total time is 15 minutes since most coatings should dissolve completely in this amount of time). Determine the amount of time it takes for each pill to dissolve and record this information in the chart provided.
5. If some tablets or capsules have still not completely dissolved in any of the solutions, place the undissolved samples to the side and continue to check at 5 minute intervals. Record the amount of additional time it took for each of those pills to dissolve in the column provided.
6. Empty all samples in the designated waste container and wash and sample cups, etc.
7. Answer the questions for discussion provided.

DATA:

**Time required for tablet to dissolve in minutes**

Sample Name	Solution Type >	Water (Control)	Amylase and water (Mouth)	Gastric juice or HCL and Pepsin (Stomach)	Dilute Base (Intestine)
Regular strength tablet					
Rapid Release Gel					
8 hour					
Caplet					
EZ tab					
Go tab					
Meltaway					
Generic					

QUESTIONS FOR DISCUSSION:

1. Which tablets most likely will dissolve in the mouth?
2. Which tablets will be more likely to dissolve in the stomach?
3. Which coatings were most likely designed to be absorbed in the small intestine?
4. Based on the data above, which of the pain relievers would you want to take if you were experiencing a terrible headache?
5. How could you apply this information to a study of other medications?

Teacher Notes:

1. Use store brands of each pill. They are considerably cheaper and there is very little difference in time it takes coating to dissolve.
2. Adjust volumes of solutions added according to the pill sample and container; covering the pill with test solution is usually sufficient.
3. Avoid test tubes for round pills. Gels in particular get stuck and it is difficult to remove them from the test tubes.
4. Amylase and gastric juice can be ordered from most scientific supply companies.