

ETP Title: “Pharmaceutical Web Quest”

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This Educational Transfer Plan consists of a lesson titled *Pharmaceutical Web Quest*. In this lesson students will use the internet to research the structure and medicinal characteristics of one specific pharmaceutical compound. The idea for this lesson was immediately apparent because of the close overlap of what I teach (chemistry) and the work of my sponsor company (pharmaceutical discovery and development). Amgen uses the main principle of medicinal chemistry – that chemical structure determines medicinal activity. This lesson plan aims to help students better understand molecular structure and to see that a molecule’s structure determines its value as a medicine. This lesson will also highlight for students the great importance of chemistry to human health and the treatment of diseases.

I. Learning Goals:

Students will learn...

1. the molecular formula and chemical structure of a specific drug.
2. the disease(s) for which the specific drug is used.
3. the symptoms and harmful outcomes of the disease.
4. the cause of the disease.
5. how the specific drug combats the disease.
6. that molecular structure determines medicinal activity.
7. that medicinal molecules are active when they bind to a receptor site on a protein.
8. that a drug can only bind to a receptor if it can travel to the location of the receptor.

II. ETP alignment with California State Standards:

This ETP contributes to students learning chemistry standards 10 a-f (Organic Chemistry and Biochemistry):

10. The bonding characteristics of carbon allow the formation of many different organic molecules of varied sizes, shapes, and chemical properties and provide the biochemical basis of life. As a basis for understanding this concept:

- a. *Students know* large molecules (polymers), such as proteins, nucleic acids, and starch, are formed by repetitive combinations of simple subunits.
- b. *Students know* the bonding characteristics of carbon that result in the formation of a large variety of structures ranging from simple hydrocarbons to complex polymers and biological molecules.
- c. *Students know* amino acids are the building blocks of proteins.
- d.* *Students know* the system for naming the ten simplest linear hydrocarbons and isomers that contain single bonds, simple hydrocarbons with double and triple bonds, and simple molecules that contain a benzene ring.
- e.* *Students know* how to identify the functional groups that form the basis of alcohols, ketones, ethers, amines, esters, aldehydes, and organic acids.
- f.* *Students know* the R-group structure of amino acids and know how they combine to form the polypeptide backbone structure of proteins.

Prerequisite Knowledge: students must first study in this order chapters 1-19, 25, 26, and 27 in their textbook, “chemistry, Connections to Our changing World”, Prentice Hall. These chapters cover in this order:

1. Energy and Matter
2. Atomic structure and electron configurations
3. The periodic table and element groups
4. Chemical formulas and bonding
5. Molecular shape
6. Chemical reactions and equations
7. The mole and stoichiometry
8. States of matter
9. Solutions, Solubility and chemical equilibrium
10. Acids and Bases
11. Carbon and its compounds
12. Classes of Organic compounds (functional groups)
13. Biological compounds (proteins, lipids, carbohydrates, nucleic acids)

Students will begin their Pharmaceutical Web Quest after completing the study of item 13, biological compounds.

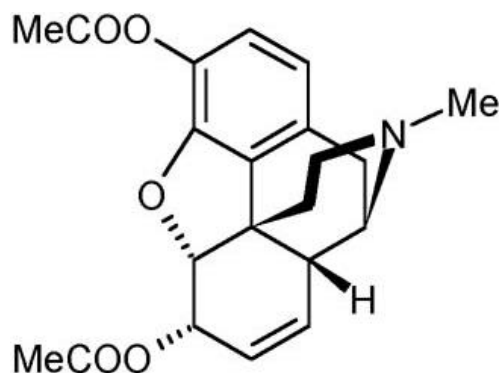
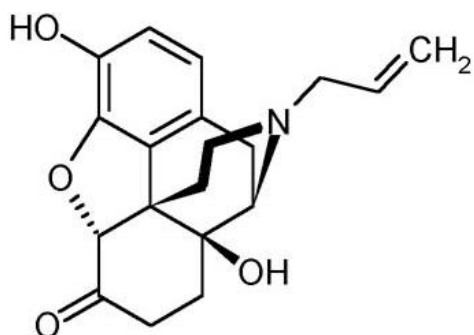
III. Lesson Introduction (Attention Getter): Teacher and student will talk about two related molecules, morphine and heroin:

Teacher's opening questions:

What is morphine? What is it used for?

What is heroin? What do you know about it?

Teacher writes these drug names and molecular formulas on board, then shows their structures using molecular models.



Morphine

Heroin

Questions:

What do they have in common?

What functional groups?

Teacher then explains short history of these two drugs. Use the following references:

Morphine, see <http://en.wikipedia.org/wiki/Morphine>

Heroin, see <http://en.wikipedia.org/wiki/Heroin>

IV. Instructions for Students:

1. You will randomly select a drug to investigate (pick name out of a hat). You may instead choose a drug that a family member uses for treatment of a disease.
2. Use the internet or library resources to gather information about the drug.

3. Present the information on a display board, about 2 x 3 feet in size, made of heavy paper or cardboard.
4. Include these topics about the drug:
 - Drug name
 - Molecular formula and structure
 - Identify the functional groups in the structure
 - Date of the drug's invention or discovery
 - Name of Inventor or discoverer
 - What disease(s) is the drug used for?
 - Symptoms and harmful outcomes of disease
 - How the drug works against the disease (what is the receptor protein?)
 - Where does the drug work (location of the receptor site?)
5. Make the display board visually interesting. Include pictures, graphs or diagrams in the display board. Use multiple colors and large fonts.
6. Refer to the rubric as you work on this project.
7. Time for completion: 3 weeks.

V. Student Resources:

Information sources: students will primarily use internet search engines like Google and Yahoo. The Wikipedia free online encyclopedia is particularly useful and will be recommended.

Display Board: Students will be required to supply the board and all other materials used to make the board.

VI. Assessment and Evaluation:

At the end of the lesson the teacher will hold a poster session during which all the display boards will be shown. A pair of students will assess two boards done by other students. They will use the rubric shown below (they will see this rubric at the start of the assignment also). The teacher will roam the classroom to assess the work and to discuss with the students the merits of each board. This peer assessment will enable students to learn about other medicines.

The teacher will assign final grades primarily on the peer assessments, with some modifications as needed to ensure that grading is reasonable.

The teacher will evaluate the effectiveness of the lesson based on grade statistics and on the attitudes, comments, and behavior of students. The rubric will be used to probe for the strong areas and weak areas of student performance.

Rubric:

Missing = 0, Poor = 1, Fair = 2, Good = 3, Very Good = 4, Great! = 5

Name of drug	0 1 2 3 4 5
Molecular formula of drug	0 1 2 3 4 5
Structure of drug	0 1 2 3 4 5
Functional groups labeled on structure	0 1 2 3 4 5
Date of the drug's invention or discovery	0 1 2 3 4 5
Name of Inventor or discoverer	0 1 2 3 4 5
What disease(s) is the drug used for?	0 1 2 3 4 5
Symptoms and harmful outcomes of disease	0 1 2 3 4 5
Where does the drug act in the body?	0 1 2 3 4 5
What does the drug bind to? (receptor protein)	0 1 2 3 4 5
Is the Display well organized?	0 1 2 3 4 5
Is the Information Clear, easy to understand?	0 1 2 3 4 5
Is the board visually appealing?	0 1 2 3 4 5
Is bibliography provided?	0 1 2 3 4 5
Total (70 points possible)	

VI. List of Medicinal Compounds. The teacher will write the names of these drugs on separate pieces of paper. At the start of the lesson, students will blindly select their compound to research by drawing the names from a hat.

Digitalis	Colchicine	Acetaminophen
Quinine	Tetracycline	Aspirin
Ephedrine	Estradiol	Cisplatin
Codeine	Progesterone	Methadone
Scopolamine	Cortisone	Pilocarpine
Penicillin	Prozac	Doxorubicin
Sulfanilamide	Nitroglycerin	Doxepin
Ibuprofen	Valium	Nifedipine
L-DOPA	Lisinopril	Lovastatin