

## Teacher Guide: Wanna Buy Some Drugs?

### ACTIVITY OVERVIEW

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**Abstract:**

An engaging introductory activity to the Pharmacogenomics module on the Genetic Science Learning Center website (<http://gslc.genetics.utah.edu/units/pharma>). Students complete a short reading and briefly research medicines to learn that many commonly-used medications can have adverse side effects. A short teacher-led discussion follows to introduce students to pharmacogenomics, a new application of genetics that might help prevent these adverse reactions and improve the efficacy of medications.

**Module:**

Pharmacogenomics: Drugs Designed for You

**Key Concepts:**

Prescription and over-the-counter drugs can have adverse side effects; pharmacogenomics aims to reduce adverse drug reactions

**Prior Knowledge Needed:**

None

**Materials:**

Student handouts, computers with Internet access, prescription drug advertisements (optional), pharmacist fact sheets (optional), labels from over-the-counter medications (optional)

**Appropriate For:**

Ages: 12 - 20  
USA grades: 7 - 14

**Prep Time:**

Varies depending on method of research used

**Class Time:**

45 minutes

**Activity Overview Web Address:**

<http://gslc.genetics.utah.edu/teachers/tindex/overview.cfm?id=191>

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Other activities in the *Pharmacogenomics* module can be found at:  
<http://gslc.genetics.utah.edu/teachers/tindex/>

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### I. PEDAGOGY

#### A. Learning Objectives

- Students will learn that prescription and over-the-counter drugs have side effects.
- Students will interpret a drug fact sheet.
- Students will learn that pharmacogenomics aims to figure out how people's genetic variations correlate with their responses to a specific medication.

#### B. Background Information

Each year 106,000 Americans die from adverse drug reactions and 2.2 million suffer serious side effects. The same medications that cause these problems greatly benefit many people, but have little to no effect in others. Simply put, individuals respond differently to any particular medication. Scientists, clinicians and pharmaceutical companies think that variation in response to drugs may be correlated to genetic variation. Two emerging fields, *pharmacogenomics* and *pharmacogenetics*, aim to figure out how genetic variation leads to variation in drug response, and use this information to: reduce adverse drug reactions, increase efficacy of medications, and improve the drug development process.

*Pharmacogenetics* – The study of how genetic variations among individuals are associated with variations in the responses to specific drugs. The ultimate goal of this field is to one day tailor drug therapies to individual patients.

*Pharmacogenomics* – The study of how drugs interact with genes and their protein products. The goal of this field is to use genetic data from large groups to improve the drug development process.

Because they are closely related, both fields often fall under the umbrella term of *Pharmacogenomics*.

#### C. Teaching Strategies

##### 1. Timeline

- One week before activity:
  - Reserve computer lab for research – 20-30 minutes should suffice

**Note:** Students may use drug fact sheets, drug advertisements from magazines, and/or labels from over-the-counter medications as an alternative to computer lab research. You may also wish to print a number of drug fact sheets from the Internet (see **Additional Resources** for

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sources). If you choose to use paper resources, you may want to collect these materials 2-3 weeks prior to the activity.

- One day before activity:
  - Copy student handouts, one per student
- Day of activity:
  - Students read a brief article about adverse drug reactions (Page S-1)
  - Students choose a drug from a list to research (in the computer lab or using resources you have collected), fill out a brief report form (Page S-3) and share what they learned with the class
  - Introduce and define “pharmacogenomics” and discuss how it may help avoid adverse side effects to medications (see Background Information, page 1 and Classroom Implementation, pages 2-3, or Additional Resources, pages 3-4)

### 2. Classroom Implementation

- Ask students to read *Antidepressants Linked to Teen Suicide* (page S-1).
- Discuss:
  - How many of you have had, or know someone who has had an adverse reaction to a medication?
  - Do medications always work as intended?
- Have each student pick out a drug to research from the *Commonly Used Medications* list (page S-2). Students may also research a medication that is not on the list.
- Allow students time in the computer lab to research the drug they have chosen and to fill out the *Drug Report Form*, page S-3. See the list of suggested websites in **Additional Resources**.

**Note:** Students may use drug fact sheets, printed drug advertisements from magazines and labels from over-the-counter medications as an alternative to computer lab research.

- Ask each student to share the information on their *Drug Report Form* with the rest of the class.
- Share with students the following information:
  - Each year 106,000 Americans die from adverse drug reactions and 2.2 million suffer serious side effects.
  - For others, drugs have no effect, good or bad.

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- Researchers think that each person's response to a drug may be influenced by genetics.
- Scientists, physicians and pharmaceutical companies are creating a new field called "pharmacogenomics" that aims to figure out how people's genetic variations correlate with their responses to a specific medication.
- The ultimate goals of pharmacogenomics are to: (a) tailor medical treatments to the individual, increasing efficacy and reducing adverse reactions and (b) use genetics to inform the drug development process.

### 3. Extensions

- Explore the *Pharmacogenomics* module on the Genetic Science Learning Center website (see **Additional Resources**) for more detailed online and print activities about pharmacogenomics.
- As students share the information on their *Drug Report Form* (page S-3), create a list of possible side effects. Discuss whether some types of side effects are more common than others. Compare and contrast the side effects of drugs designed for similar purposes.
- Have students research the FDA's regulations concerning the advertisement of medications.
- Have students analyze drug advertisements, noting the target audience, when and where the advertisements are more prevalent, and visual clues about the medical conditions for which the drug is prescribed.
- Have students research current drug controversies and/or drugs that have been pulled off the market.
- Have students research the FDA's drug approval process.
- Have students create their own advertisement for the drug they research.

### 4. Adaptations

- Students may work in pairs or groups to research their medication of choice.
- To assign medications for research: Before class, prepare 3" x 5" cards with one medication from the *Commonly Used Medications* list (page S-2) on each card. Have students select a card, or hand a card to each student or group.
- Skip reading the *Antidepressants and Teen Suicide* article (page S-1) short article.
- Read the *Antidepressants and Teen Suicide* (page S-1) but do not research individual drugs.

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### 5. Common Misconceptions

- All prescription medications are safe for everyone.
- All over-the-counter medications are safe for everyone.

## II. ADDITIONAL RESOURCES

### A. Activity Resources linked from the online Activity Overview at:

<http://gslc.genetics.utah.edu/teachers/tindex/overview.cfm?id=191>

- Website: *Pharmacogenomics: Drugs Designed for You* - Students learn about a new field in genetics that aims to tailor medication to the individual and inform the drug development process.
- Websites: Each contains a searchable data base with information on the uses and side effects of a number of prescription and over-the-counter medications. Searchable by brand name.

*Medline Plus* (from the U.S. National Library of Medicine and the National Institutes of Health)

*PDRHealth* (consumer information from the Physicians Desk Reference)

*Drugs.com*

*RxList*

*Health Square*

## III. MATERIALS

### A. Detailed Materials List

- Student handouts, pages S-1 to S-3
- Computers with Internet access
- Printed drug fact sheets from the Internet (optional - see Additional Resources for sources)
- Drug advertisements from magazines (optional)
- Drug fact sheets from the pharmacist (optional)
- Labels or fact sheets from over-the-counter medications (optional)

## IV. STANDARDS

### A. U.S. National Science Education Standards

Grades 5-8:

- Content Standard C: Life Science - Reproduction and Heredity; the characteristics of an organism can be described in terms of a combination of traits. Some traits are inherited and others result from interaction with the environment.

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### Grades 9-12:

- Content Standard C: Life Science - Molecular Basis of Heredity; in all organisms, the instructions for specifying the characteristics of an organism are carried in DNA.
- Content Standard F: Science in Personal and Social Perspectives - Personal and Community Health; many diseases can be prevented, controlled or cured.

### **B. AAAS Benchmarks for Science Literacy**

#### Grades 9-12:

- The Human Organism: Physical Health - new medical techniques, efficient health care delivery systems, improved sanitation, and a fuller understanding of the nature of disease give today's human beings a better chance of staying healthy than their forebears had.
- The Designed World: Health Technology - knowledge of genetics is opening whole new fields of health care.

### **C. Utah Secondary Science Core Curriculum**

#### *Intended Learning Outcomes for Seventh and Eighth Grade Integrated Science*

Students will be able to:

5. Demonstrate Awareness of the Social and Historical Aspects of Science
  - a. Cite examples of how science affects life.

#### *Intended Learning Outcomes for Biology*

Students will be able to:

5. Demonstrate Awareness of the Social and Historical Aspects of Science
  - a. Cite examples of how science affects human life.

#### Biology (9-12)

Standard 4: Students will understand that genetic information coded in DNA is passed from parents to offspring by sexual and asexual reproduction. The basic structure of DNA is the same in all living things. Changes in DNA may alter genetic expression.

Objective 3: Explain how the structure and replication of DNA are essential to heredity and protein synthesis

- f. Research, report, and debate genetic technologies that may improve the quality of life (e.g., genetic engineering, cloning, gene splicing).

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### V. CREDITS

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## Teen Suicide and Antidepressant Use

In September 2004, the U.S. Food and Drug Administration announced that use of antidepressants may increase suicidality (suicidal thoughts and actions) in children. An independent panel at Columbia University, assembled at the FDA's request, reviewed 25 studies that included 4,000 patients and eight commonly prescribed antidepressant medications. The panel found a consistent link between increased suicidal tendencies in children and teens who were using the medications. In fact, the panel concluded that children who were taking antidepressants were 1.8 times more likely to show suicidal thoughts or behaviors than patients who were taking placebos. The FDA now believes that antidepressant medication may cause two to three percent of children to have suicidal thoughts or actions when they otherwise wouldn't.

The FDA has been advised to include a warning label on antidepressants and educate patients, and the parents of patients, about this potential side effect. Health professionals and researchers are quick to point out the vast benefits of these medications however, cautioning against a ban of pediatric use of antidepressants.

### Sources

<http://www.cbsnews.com/stories/2004/09/13/health/main643099.shtml>

<http://www.fda.gov/bbs/topics/ANSWERS/2004/ANS01306.html>

<http://www.fda.gov/bbs/topics/news/2004/NEW01116.html>



## Wanna Buy Some Drugs?: Drug List

Accutane

AcipHex

Actifed

Advair

Advil

Allegra

Ampicillin

Aricept 

Azelex

Celebrex

Clarinet

Concerta

Cortisone

Coumadin

Differin

Dimetapp 

Effexor

Erythromycin

Glucophage

Imitrex

Interferon

Lipitor

Meridia

Nexium

Paxil

Pertussin

Prednisone

Pravachol 

Prevacid

Prozac

Retin-A

Ritalin

Singulair 

Topamax

Ultram

Valium

Vicodin

Wellbutrin 

Xanax

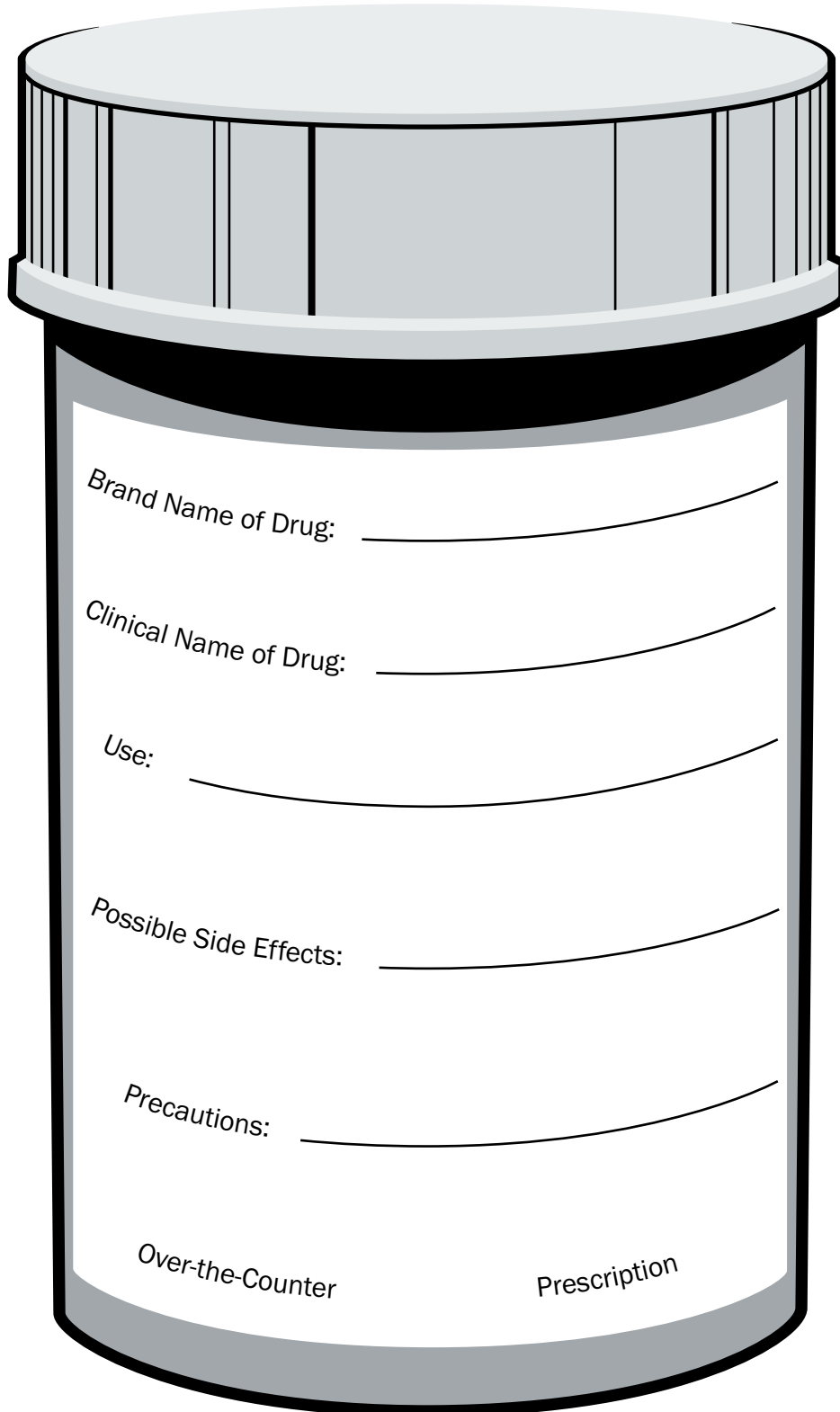
Xenical 

Zoloft

Zyrtec



## Drug Report Form



Brand Name of Drug: \_\_\_\_\_

Clinical Name of Drug: \_\_\_\_\_

Use: \_\_\_\_\_

Possible Side Effects: \_\_\_\_\_

Precautions: \_\_\_\_\_

Over-the-Counter       Prescription