Introduction to Pharmacology

Course
Practicum in Health Science

Unit I
Preparation for Practicum

Essential Question
What is pharmacology?

TEKS
130.205 (c)

Prior Student Learning
Students should be able to be familiar with drug information on medicine bottles.

Estimated time
1 to 2 hours

Rationale
Pharmacology is the science that deals with the study of therapeutic agents. Knowledge of the properties of therapeutic agents is vital in providing quality health care. It is an ever changing, growing body of information that continually demands greater amounts of time and education from health care workers.

Objectives
Upon completion of this lesson, the student will be able to:
- Define pharmacology and its major subdivisions
- Define a drug
- Explain the differences between therapeutic effect, side effect, and toxic effect
- Identify a drug receptor
- Trace the interactions between agonists and antagonists with the receptors
- Explain the relationship between drug dosage, drug response, and time
- Explain drug safety and therapeutic index
- Describe three names by which drugs are known
- List two common drug reference books

Engage
Ask students how they think physicians keep track of the medicine that exists from year to year. Show students a Physician’s Desk Reference so they can see how many pharmaceuticals are available and what each agent is used for.

Key Points
I. Major areas of pharmacology
   A. Pharmacodynamics -- study of the action of drugs on living tissue
   B. Pharmacokinetics -- study of the process of drug absorption, distribution, metabolism, and excretion
   C. Pharmacotherapeutics -- study of the use of drugs in the treatment of disease
   D. Pharmacy -- science of preparing and dispensing medication
   E. Posology -- study of the amount of drug required to produce therapeutic effects
   F. Toxicology -- study of the harmful effects of drugs on living tissue

II. Drug
   A. General definition -- any substance that can cause a change in function when administered to a living organism
   B. Pharmacologically -- any medication that is used in treating a disease or
disorder
C. Drug sources -- natural sources, plants, etc.

III. Drug effects
A. Therapeutic effect – intended
B. Side effects – not necessarily harmful
   1. secondary indication for use
   2. undesired side effects
C. Adverse effects
   1. may be harmful
   2. with prolonged use may effect function of vital organs, e.g., liver and kidneys
   3. reduction of dosage or switching to other drug may minimize harmful consequences
D. Toxic effects – all drugs will act as poison when taken in excess
   1. implies drug poisoning
   2. can be extremely harmful, sometimes even life threatening
   3. drug must be stopped
   4. supportive treatment and administration of antidotes may be required

IV. Concepts applicable to any drug
A. Site of action – unknown for some drugs but determined for most
B. Mechanism of Action – how the drug produces effects
C. Lower receptor site – specific location on certain cells; similar to a lock and key concept
D. Agonists and antagonists
   1. chemical: substance that can alter a drug’s action
      a. facilitate
      b. interfere with
E. Dose -- the exact amount of a drug administered in order to produce a specific effect
F. Response -- the effect of the drug on the site of action
   1. response proportional to amount of drug given
   2. maximal response attained – ceiling effect
   3. doses above those required for ceiling effect likely to produce toxic effects (overdose)
G. Dose-Response Curve
   1. response effect of the drug on the site of administration
   2. response proportional to amount of drug given
   3. dose-response curve -- the plotting of relationship between dose and response
   4. potency – a measure of strength or concentration of a drug to produce a specific effect
   5. dose that produces ½ the maximal response, referred to as ED50 (effective dose 50)
   6. ED50 can be used to compare potency of drugs that produce the same
H. Time-Response Curve
1. relationship of drug response and duration of action
2. duration of action -- length of time a drug continues its effect
3. time-response curve -- plotting results
4. onset of action -- time from drug administration to first observable effect
5. response will continue as long as effective concentration of drug remains at site of action
6. time-response curves used for predicting frequency with which the drug must be administered to maintain effective drug response

V. Drug Safety
A. Food and Drug Administration (FDA) has established guidelines that govern approval of all drugs
1. prior to approval each drug must fulfill two requirements
   a. efficacy -- proof of effectiveness
   b. safety -- specific criteria as determined by extensive animal testing and controlled human testing
2. one of the first tests performed is the lethal dose LD50
   a. LD50 is the dose that will kill 50% of the animals tested
   b. results used to predict safety of the drug

B. Therapeutic Index (TI)
1. ratio of the LD50 and the ED50 of a drug
2. gives an estimate or relative safety of a drug equation expressed as TI = LD50/ED50
3. TI only used in animal studies to establish dosage levels for other testing procedures
4. goal of drug therapy to achieve therapeutic effects in all individuals without producing harmful effects

C. Adverse effects
1. most adverse effects are dose dependent: the higher the dose the greater the chance for producing adverse effects; certain tissues more frequently affected than others
2. drugs can cause
   a. nausea
   b. vomiting
   c. diarrhea
3. organs and systems most often adversely affected due to high concentration exposure
   a. liver
   b. kidneys
   c. brain
   d. cardiovascular system
4. drugs that produce birth defects -- teratogens
5. drugs that promote growth of cancerous tumors -- carcinogens
6. some adverse effects not dependent on dose
7. individual differences may cause variations in response to drugs
8. changes in drug metabolism can lead to unusual responses to a particular drug
9. drug allergy -- occurs when an individual becomes sensitized to a particular drug and produces antibodies (antigens)
   a. subsequent administration of drug leads to antigen-antibody reaction
   b. causes release of histamine from most cells
   c. histamine produces characteristic symptoms of allergy
      i. rashes
      ii. hives
      iii. itching
      iv. nasal secretion and congestion
      v. hypotension
      vi. bronchoconstriction
      vii. edema
      viii. dyspnea
   d. anaphylaxis -- potentially fatal

VI. Drug Nomenclature
A. Drug names
   1. chemical name -- (usually) long and complicated chemical name
   2. nonproprietary name
      a. usually contraction of chemical name
      b. also referred to as generic name
   3. trade name
      a. also known as brand name or proprietary name
      b. given by manufacturer
      c. a drug can have as many brand names as there are manufacturers producing it
B. Prescription Drugs
   1. prescription drugs -- require written, digital or phone order
   2. prescription can only be issued under direction of individual licensed to prescribe. For example
      a. physician
      b. veterinarian
      c. dentist
   3. to limited extent, depending on state law, physician assistants and nurse practitioners, opticians, and others
C. The Prescription
   1. a legal document
   2. contains instructions for pharmacist to dispense drug
D. Nonprescription drugs
   1. over the counter (OTC)
   2. may be purchased anywhere
   3. does not require services of a licensed health care professional
4. still carries certain risks

VII. Drug References

A. United States Pharmacopoeia/National Formulary (USP/NF)
   1. official drug list recognized by U.S. government
   2. provides information concerning physical and chemical properties of drugs
   3. revised every 5 years
   4. used primarily by drug manufacturers to ensure drug production according to government standards

B. Physicians’ Desk Reference (PDR)
   1. reference most widely used by physicians, pharmacists, and nurses
   2. updated yearly
   3. provides information on indications for use, dosage and administration, contraindications, and adverse reactions

C. Drugs Facts and Comparisons
   1. available in bound format and, most frequently used, loose leaf form
   2. index and drug information service subscribed to by most medical libraries
   3. updated monthly
   4. provides most current drug information on a regular basis

D. United States Pharmacopoeia Dispensing Information (USP DI)
   1. United States Pharmacopoeia Convention, Inc. publishes series of volumes under general title
   2. updated yearly
      a. Volume I: Drug Information for the Health Care Professional -- provides in-depth information about prescription and OTC medications and nutritional supplements
      b. Volume II: Advice for the Patient -- provides drug information for the patient, e.g., how to take, signs to watch out for, etc.

E. Drug Information – American Hospital Formulary Service
   1. provides detailed drug information
   2. drugs organized according to therapeutic use
   3. updated yearly

F. Drug Monograph -- An instrument that provides information about prescription, over-the-counter (OTC), investigational, nutritional and herbal products. Provides the important data about the drug. All manufacturers’ monographs provide essentially the same items of information about each drug:
   1. description
   2. action
   3. indications
   4. usage in pregnancy
   5. adverse reactions
   6. dosages (and administration)
   7. packaging availability
Activity
I. Locate and interpret a package insert and identify the critical components.

II. Complete the monograph abbreviated review forms.
   Teacher’s Note: obtain a number of monographs from a local pharmacy or online.

III. Complete the PDR Scavenger Hunt.
   Teacher’s Note: recommend this activity be used as a homework assignment to be completed at the public library to increase awareness of consumer accessibility.

Assessment
Quiz INTRODUCTION TO PHARMACOLOGY
Successful completion of Monographs
Successful completion of the PDR Scavenger Hunt

Materials
Key: Unit Quiz INTRODUCTION TO PHARMACOLOGY
Graphs listing drug effects (therapeutic, side effect, adverse effect, etc.)
Drug references (PDR, etc.)
PDR Scavenger Hunt Key

Accommodations for Learning Differences
For reinforcement the student will design flash cards with critical components for therapeutic agents of their choice.

For enrichment the student will investigate a drug of choice and design an educational pamphlet informing the consumer about the benefits and risks of the drugs, referencing the sources. Present a pamphlet to a professional review committee.

National and State Education Standards
National Health Science Cluster Standards
Healthcare professionals will understand the roles and responsibilities of individual members as part of the healthcare team, including their ability to promote the delivery of quality healthcare. They will interact effectively and sensitively with all members of the healthcare team.

8.1 Healthcare Teams
8.11 Understand roles and responsibilities of team members.

TEKS
130.205(c)(1)(A) interpret data from various sources in formulating conclusions;
130.205(c)(3)(A) demonstrate proficiency in medical terminology and skills related to the health care of an individual;
130.205(c)(6)(A) integrate regulatory standards such as standard precautions and safe patient handling;
Texas College and Career Readiness Standards
English/language art
B.1 Identify new words and concepts acquired through study of their relationships to other words and concepts.
B3. Use reference guides to confirm the meanings of new words or concepts.
Cross-Disciplinary standards-Foundational Skills
A2. Use a variety of strategies to understand the meanings of new words.
Quiz: INTRODUCTION TO PHARMACOLOGY

1. Define the following terms by matching the appropriate definition with the correct term (not all choices apply):

   _____ 1. Study of the action of drugs on living tissue A. Pharmacological definition of a drug
   _____ 2. Study of the process of drug absorption, distribution, metabolism B. Posology
   _____ 3. Study of the use of drugs in the treatment of disease C. Toxicology and excretion
   _____ 4. Science of preparing and dispensing medication D. Pharmacodynamics
   _____ 5. Study of the amount of drug required to produce therapeutic effects E. Pharmacy
   _____ 6. Study of the harmful effects of drugs on living tissues F. General definition of a drug
   _____ 7. Any substance that can cause a change in function when administered to a living organism G. Pharmacokinetics
   _____ 8. Any medication that is used in treating a disease and / or disorder H. Pharmacometrics
   _____ 9. I. Pharmacokinesiology
   _____ 10. J. Pharmacotherapeutics

2. Define and contrast therapeutic, adverse, and toxic effects in a short essay, using complete, well structured sentences.
3. T/F The site of action for any drug has been determined.

4. T/F The potency of a drug is a measure of duration of the drug to produce a specific effect.

5. T/F The relationship of a drug response and the duration of action is expressed in the Dose-Response-Curve.

6. T/F Time-Response-Curves are used to predict the frequency with which a drug must be administered to maintain effective drug response.

7. T/F The TI is the ratio of LD50/ED50 and gives an estimate of a drug's safety.

8. T/F Changes in drug metabolism lead to the usual responses to a particular drug.

9. T/F Idiosyncrasy is an individual, predictable response to a drug.

10. T/F Anaphylaxis is an immediate, potentially fatal reaction.

11. T/F A prescription is a legal document that contains instructions for the patient on how to take a medication.

12. T/F Drug allergies occur without the individual ever having been exposed and sensitized to a certain drug.

13. List three official drug references by their complete name.

   __________________________________________  
   __________________________________________  
   __________________________________________  

Answer Key to Quiz

INTRODUCTION TO PHARMACOLOGY

1. 1 D
2 G
3 J
4 E
5 B
6 C
7 F
8 A

2. Look for key words

Therapeutic effect: intended effect, primary reason for administering drug

Adverse effect: may be harmful; with prolonged use may damage vital organs, e.g., liver and kidneys; reduction of dose or switching to other drug may minimize harmful consequences

Toxic effect: all drugs will act as poison when taken in excess; implies drug poisoning; can be extremely harmful, sometimes life threatening; supportive treatment and administration of antidote may be required function

3. F
4. F
5. F
6. T
7. T
8. F
9. F
10. T
11. F
12. F

   Physician’s Drug Reference (PDR)
   (any three) Drugs Facts and Comparison
   United States Pharmacopoeia Dispensing Information (USP DI)
   Drug Information – American Hospital Formulary Service
The Drug Monograph

This is an instrument that will help you sort through thousands of pages of data, providing you with only the data important for you to know. There are a number of formats available and knowing what to review will save you a lot of precious time. All manufacturers’ monographs provide essentially the same items of information about each drug:

- Description
- Action
- Indications
- Usage in pregnancy
- Adverse reactions
- Dosages (and administration)
- Packaging availability

In addition the following information may be available, if applicable:

- Microbiology
- Warnings
- Precautions
- Laboratory interference
- Drug abuse and dependency
- Overdosage
- Pharmacology (and toxicology)
- Drug interactions

The information you need to know about each drug in order to perform your job properly can be reduced to a realistic workable knowledge of drugs. Consistency is very important in order to retain as much information as possible. The following format is a tool that allows you to extract important information:

1. Generic drug name
2. Representative drug name(s)
3. Other identification (e.g. nicknames, acronyms, etc.)
4. Primary drug class
5. Intended indications for use (primary use)
6. Other indications for use (secondary, etc.)
7. Dosage limits
8. Potential drug and/or food interactions
9. Potential unwanted drug effects
10. Potential drug effect on existing disorders
11. Potential drug interference with laboratory tests
12. Other noteworthy facts
| **DRUG MONOGRAPH**  
<table>
<thead>
<tr>
<th><em>(Abbreviated Review Form)</em></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Drug, generic name:</strong></td>
</tr>
<tr>
<td><strong>Trade name(s):</strong></td>
</tr>
<tr>
<td><strong>Other Identification:</strong></td>
</tr>
<tr>
<td><strong>Primary Drug Class:</strong></td>
</tr>
<tr>
<td><strong>Intended Indications for Use:</strong></td>
</tr>
<tr>
<td><strong>Other Indications for Use:</strong></td>
</tr>
<tr>
<td><strong>Action:</strong></td>
</tr>
<tr>
<td><strong>Contraindication(s):</strong></td>
</tr>
<tr>
<td><strong>Adverse Reaction (ADR):</strong></td>
</tr>
<tr>
<td><strong>Side Effects:</strong></td>
</tr>
<tr>
<td><strong>Dosage Limits:</strong></td>
</tr>
<tr>
<td><strong>Drug Interactions:</strong></td>
</tr>
<tr>
<td><strong>Warnings:</strong></td>
</tr>
<tr>
<td><strong>Noteworthy Facts:</strong></td>
</tr>
</tbody>
</table>
PDR Scavenger Hunt

Use the PDR to locate the following information. Record answers in the space provided.

1. Find the address for ORTHO-MCNEIL Pharmaceutical.

2. The following two drugs are brand names. Find the following information required for each of these drugs.

   *Tylenol Nighttime Flu Gelcaps*
   - What are active ingredients?
   - What drug interaction precaution is given in bold print?
   - How is it supplied?

   *LANOXIN Pediatric Elixir*
   - What organ is it used for?
   - When is it contraindicated to give?
   - What is the generic name for LANOXIN?

3. Give me the name of an ANTIMALARIAL that starts with L.

4. What are the sub-group titles that fall under CONTRACEPTIVES?

5. What is the message given under WEIGHT CONTROL PREPARATIONS?
Key

PDR Scavenger Hunt

Use the PDR to locate the following information. Record answers in the space provided.

1. Find the address for ORTHO-MCNEIL Pharmaceutical.
   1000 Rt202
   PO Box 300
   Raritan, NJ 08869-0602

2. The following two drugs are brand names. Find the following information required for each of these drugs.

   **Tylenol Nighttime Flu Gelcaps**
   - What are active ingredients?
     - Acetaminophen 500 mg, Pseudoephedramine hydrochloride 30 mg, and diphenhydramine hydrochloride 25 mg
   - What drug interaction precaution is given in bold print?
     - MAOI-monoamine oxidase inhibitor.
   - How is it supplied?
     - Colored blue and white in blister packets of 10 or 20

   **LANOXIN Pediatric Elixir**
   - What organ is it used for?
     - Heart -- to increase cardiac output
   - When is it contraindicated to give?
     - Ventricular fib
   - What is the generic name for LANOXIN?
     - Digoxin

3. Give me the name of an ANTIMALARIAL that starts with L.
   Lariam Tablets

4. What are the sub-group titles that fall under CONTRACEPTIVES?
   Devices, Implants, Injectables, and Oral

5. What is the message given under WEIGHT CONTROL PREPARATIONS?
   See Appetite Suppressant/ Nutritionals