

Chapter 13 Topics

- Muscles and Joints
- Muscle Relaxants
- Inflammation and Swelling
- Arthritis and Related Disorders

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Learning Objectives

- Define muscle relaxants.
- Identify muscle relaxants and their various mechanisms of action.
- Identify the nonnarcotic analgesics and describe their uses and mechanisms.
- Understand an autoimmune disease.

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Learning Objectives

- Identify agents used to treat arthritis, rheumatoid arthritis, and gout, and discuss their usage and side effects.

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Muscles and Joints

- Bones of the skeletal system provide framework of the body
 - Are connected at joints
- Joint: place of union or junction between 2 or more bones
- Skeletal muscles: contractile tissues that provide movement at joints

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Anatomy of a Joint

The diagram illustrates the anatomy of a joint. It shows two bones connected by articular cartilage. The joint is enclosed by a fibrous capsule, which is lined by a synovial membrane. The space between the bones is the joint cavity, which contains synovial fluid. Labels include: bone, joint cavity, articular cartilage, bone, fibrous capsule, synovial fluid, and synovial membrane. A bracket on the right side groups the fibrous capsule and synovial membrane as the joint capsule.

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Joints and Ligaments

- Wide variety of joints in human body
- Ligaments: noncontractile connective tissue that ties one bone to another bone
 - Maintain bones in alignment
 - Form fibrous capsule that encloses moving parts

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Classification of Joints By Structure

- Cartilaginous: articulating bone surfaces covered with cartilage
- Fibrous: articulating bone surfaces attached by fibrous connective tissue
- Synovial: articulating bone surfaces covered by a fluid-filled, fibrous sac

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Classification of Joints By Movement

- Permit no movement
- Permit slight degree of movement
- Permit variety of movement

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Examples of Joints and Their Functions

Joint Type	Function
Shoulder joint	Ball-and-socket
Humeroulnar joint	Hinge
Superior radioulnar joint of elbow	Pivot
Intervertebral joint	Gliding

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Examples of Joints and Their Functions

Joint Type	Function
Hip joint	Multiaxial ball-and-socket
Carpometacarpal joint of thumb	Saddle
Wrist joint	Condyloid
Knee joint	Uniaxial hinge
Ankle joint	

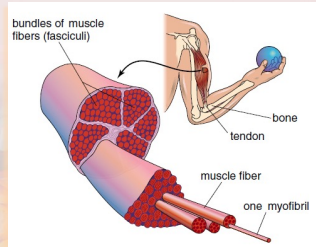
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Muscle

- An organ that produces movement by contracting (shortening itself)
- Connected to bones by tendons, tough cordlike tissue

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Bones, Muscles, and Tendon for Movement at Elbow Joint



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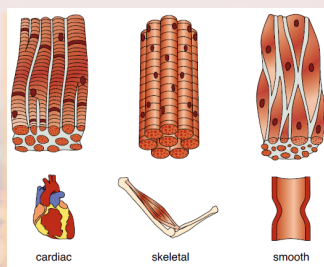
Three Muscle Groups

- **Skeletal:** voluntary contraction, locomotion and posture
- **Smooth:** involuntary contraction, lining of organs such as stomach, esophagus, uterus, bladder
- **Cardiac:** involuntary, heart muscle, striated texture

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Three Types of Muscle



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Muscle Relaxants

- Skeletal muscle contractions voluntarily controlled (CNS)
- Neurotransmitter acetylcholine (ACh) is released, binds with receptors on muscle cell membrane, calcium is released, causing a contraction
- Relaxation occurs when ACh is broken down by acetylcholinesterase

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Muscle Relaxants

- Agent to reduce muscle tension, acts on motor neurons or at neuromuscular junction
- Block normal muscle function by
 - Blocking release of ACh
 - Preventing destruction of ACh
 - Preventing ACh from reaching receptors

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Discussion

Most muscle relaxants are not controlled substances, so why are they highly abused?

They are abused due to the relaxing feeling that patients have from taking them.

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Inflammation and Swelling

- Analgesics used to relieve pain
- Nonnarcotic analgesic used for mild-to-moderate pain, inflammation, and fever
- Two types of pain
 - **Somatic:** dull, throbbing pain from skin, muscle, or bone
 - **Visceral:** sharp, stabbing pain from organs

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Fever

- Response to body's temperature-regulating center (the hypothalamus) to endogenous pyrogens
 - Substance produced due to bacterial or viral infections
- Brain then releases prostaglandins (PGs) which cause the body thermostat to reset at higher temperature

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Inflammation

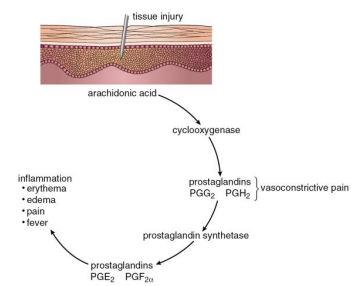
- Pain pathway in tissue injury
- PGs can cause inflammation, tissue damage, and fever
- Nonnarcotic analgesics interrupt pathway, inhibiting enzyme to synthesize PGs
 - Relieves inflammation and pain
 - Reduces fever

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Pain Pathway in Tissue Injury

FIGURE 13.5
Pain Pathway in
Tissue Injury



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Side Effects of Nonnarcotic Analgesics

- Increase risk of stomach ulcers
- Elevate serum concentrations of hepatic enzymes
- Promote water and electrolyte retention
- Can cause renal insufficiency

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NSAIDs

- Properties of nonsteroidal anti-inflammatory drugs (NSAIDs)
 - Analgesic (pain relieving)
 - Anti-inflammatory
 - Antipyretic (fever reducing)
- Prototype NSAID is aspirin

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Salicylates

- Analgesic, antipyretic and anti-inflammatory properties
- Primary analgesic actions are peripheral, not central
- Reduce fever by increasing blood flow to skin and inhibit prostaglandin synthesis
- Primary antipyretic action is central, probably in the hypothalamus

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Aspirin Dosages

- More than 4 g per day can cause problems
- 10 g or more can cause death

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Reye's Syndrome

- Aspirin should not be given to children
- Effects of Reye's Syndrome
 - Mental changes
 - Coma
 - Seizures
 - Relaxed muscles
 - Dilated pupils
 - Respiratory failure

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Aspirin and Cardiovascular Disease

- Daily low-dose aspirin (81 mg to 325 mg) reduces risk of heart attack and stroke
- Alters platelet aggregation for clotting
- Enteric coated daily aspirin to protect stomach lining
- Plain aspirin for MI to quickly enter bloodstream to prevent clot formation

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Mixed Analgesics

- Contains a narcotic and NSAID or acetaminophen
- Chronic use can lead to kidney failure
- Alcohol can cause a problem with OTC analgesics
 - Acetaminophen: risk of liver toxicity
 - Ibuprofen: risk of GI bleeding

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Arthritis and Related Disorders

- Arthritis: joint inflammation
- Persistent pain most common complaint
- Pain originates from surrounding joint structures: bone, tendon, ligament, muscle
- Pain is caused by functional problems of the joints.

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Osteoarthritis

- Degenerative joint disease
- Results in loss of thickness and cartilage elasticity
- Bones wear and become deformed
- Commonly affected joints
 - Sternoclavicular joint, spine, hips, knees, fingers, and great toes
 - Knees and fingers especially affected

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Osteoarthritis

- Generally appears after age 40
- Characterized by progressive pain, stiffness, limitation of motion, and deformed joints
- Morning stiffness common

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Bursitis

- Inflammation of a bursa
- Bursa: saclike pouch filled with synovial fluid located at friction site
 - Point where a muscle or tendon passes over
- Unknown cause

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Rheumatoid Arthritis (RA)

- Autoimmune disease that attacks and destroys connective tissue
- Characterized by inflammation of a joint's synovial membrane
- Bone and cartilage reabsorption leaving bone-to-bone contact, can lead to joint fusion

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Treating Autoimmune Disease

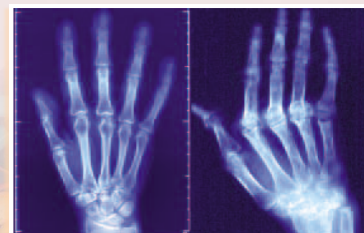
- Drugs used to treat RA turn off the immune system
- Makes the body susceptible to infections, cancer, other diseases
- Primary side effects of drugs: infection, malignancies

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Healthy Wrist and Hand

RA Affected



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Characteristics of RA

- Pain originates from bone, tendon, ligament, and muscle
- Symmetric morning stiffness lasting longer than 60 minutes
- Same joints on both sides affected about 70% of the time
- Small joints of fingers usually first affected

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Laboratory Tests for RA

- Erythrocyte sedimentation rate (ESR) indicates presence of inflammation
- Rheumatoid factor (RF)—80% of arthritis patients have positive result

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Criteria for Diagnosis of RA

- Joint tenderness or pain on motion
- Morning stiffness
- Presence of RF
- Soft-tissue swelling in a 1st joint, followed within 3 months by swelling in a 2nd joint
- Sterile, turbid synovial fluid
- X-ray changes showing erosions

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Therapy for Arthritis

- Aimed at relieving pain, maintaining or improving mobility, and minimizing disability
- May include medications, physical therapy, and patient education

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NSAIDs

- Relieve inflammation and swelling and therefore pain
- Take longer to reduce fever than other products, but effects last longer

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Therapeutic Uses of NSAIDs

- Inflammation and pain of arthritis and rheumatism
- Headache
- Menstrual cramps
- Backache
- Muscle aches
- Flu
- Fever
- Gouty arthritis

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Mechanism of Action of NSAIDs

- Inhibit PG synthesis in inflamed tissues
- Prevents sensitization of pain receptors to mediators of inflammation
- Generally act peripherally, not centrally like other pain killers

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The GI System and NSAIDs

- Primary side effect is GI upset
- One in five chronic NSAID users develop some type of GI gastropathy
- Many patients need to take a proton pump inhibitor with NSAIDs

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Discussion

Why do NSAIDs cause GI upset?

PGs are responsible for increased mucosal blood flow, mucus production, and decreasing free acid in the GI tract.

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COX-2 Inhibitors

- 2 enzymes critical in inflammation process
- Cyclooxygenase-1 (COX-1): extensive role in body, including protecting GI lining
- Cyclooxygenase-2 (COX-2): pain, inflammation
- Drugs only block the COX-2 enzyme which is induced during inflammation

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Disease-Modifying Antirheumatic Drugs (DMARDs)

- Early, mild RA should be treated with more than NSAIDs
 - Joint damage occurs earlier than previously thought
- DMARDs modify disease progression
 - Second-line treatments
 - May slow progression of disease, but side effects limit use

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Discussion

Why does depression of the bone marrow lead to increased risk of infection?

Depressing bone marrow depresses the formation of leukocytes which weakens the immune system.

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Gouty Arthritis (Gout)

- Usually affects single joints
 - Causes a tophus (deposit of sodium urate) to form around the joint
- Big toe usually the first affected
 - Painful, swollen, and red
- Usually inherited

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Gouty Arthritis (Gout)

- Overproduction or improper excretion of uric acid
- Avoid medications that can precipitate a gout attack
 - Cytotoxic agents
 - Diuretics
 - Ethanol
 - Nicotinic Acid
 - Salicylates, including aspirin

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Colchicine

- Drug of choice for acute gout attacks
- Reduces uric acid production
- High potential for phlebitis (inflammation of a vein)

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Assignments

- Complete Chapter Review activities
- Answer questions in Study Notes document
- Study Partner
 - Quiz in review mode
 - Matching activities
 - Drug tables



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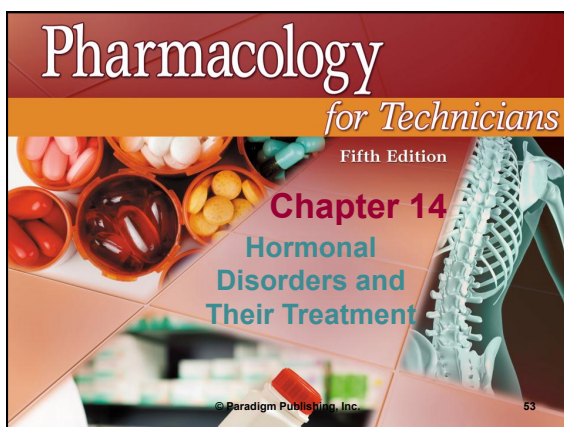
Pharmacology

for Technicians

Fifth Edition

Chapter 14

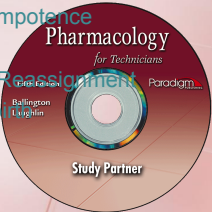
Hormonal Disorders and Their Treatment



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Chapter 14 Topics

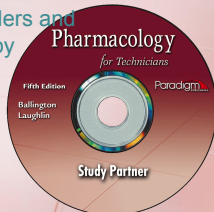
- The Endocrine System
- Thyroid Disorders
- Male Hormones and Impotence
- Female Hormones
- Hormones in Gender Reassignment
- Pregnancy and Childbirth



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Chapter 14 Topics

- Sexually Transmitted Diseases
- Drug Therapy for Bone Disease
- Adrenal Gland Disorders and Corticosteroid Therapy
- Diabetes
- Growth Disorders



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Learning Objectives

- Explain the concept of **hormones** and how they regulate the body.
- Discuss **thyroid replacement therapy**.
- Discuss **adrenal sex hormone** and **gonadotropin** dysfunction.
- Understand the concept of **hormone replacement therapy**.

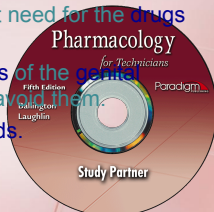


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Learning Objectives

- Understand the formulation of **oral contraceptives**.
- Recognize the urgent need for the **drugs used at delivery**.
- Describe the diseases of the **genital systems** and how to avoid them.
- Discuss **corticosteroids**.



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Learning Objectives

- Understand **diabetes** and the proper treatment and care of patients.
- Know the applications for **growth hormone**.



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The Endocrine System

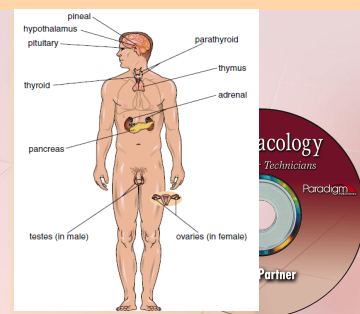
- Consists of glands and other structures that produce hormones released into the circulatory system
- Tissue affected by a hormone is the **target**
- Endocrine system maintains **homeostasis** of the body



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Endocrine System

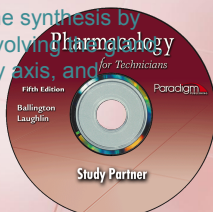


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Regulation

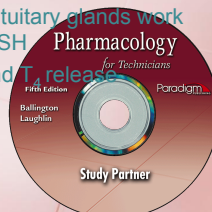
- Hormones of pituitary gland regulate other endocrine glands and body activities
- Regulation of hormone synthesis by negative feedback involving hypothalamic-pituitary axis, and autoregulation



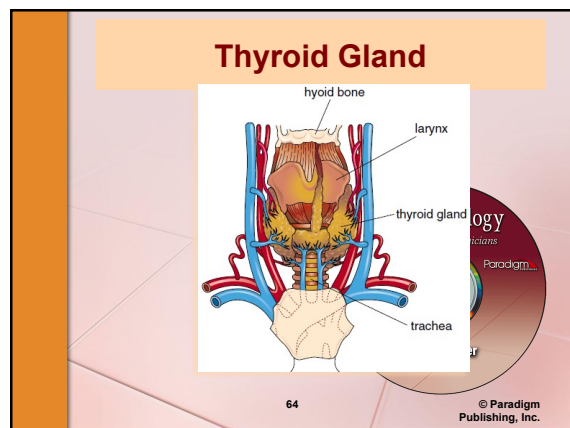
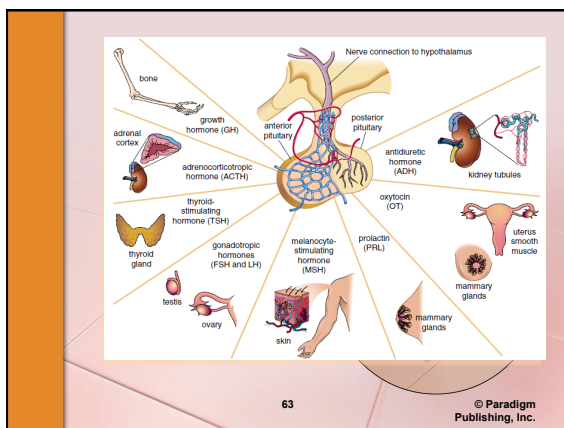
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Thyroid Disorders

- Produces hormones (T_3 and T_4) that stimulate metabolic activity of body tissues
- Hypothalamus and pituitary glands work together to release TSH
- TSH stimulates T_3 and T_4 release

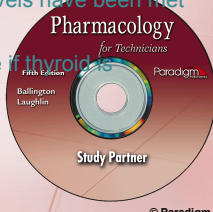


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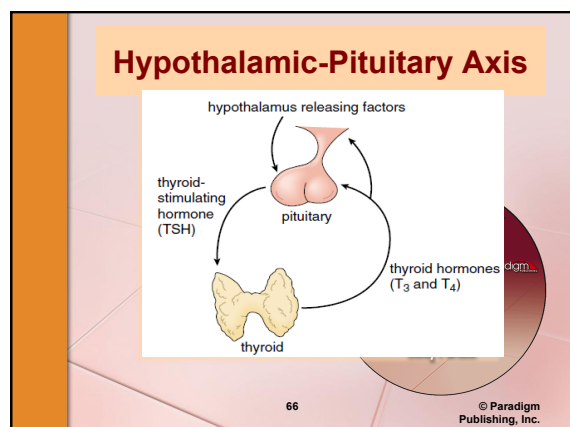


Thyroid Hormone Feedback Loop

- Thyroid hormones build up in blood
- Signals sent to the hypothalamic-pituitary axis that adequate levels have been met
- TSH levels decrease
- TSH levels determine if thyroid is functioning normally

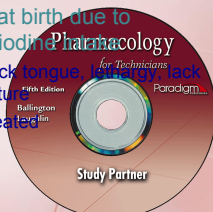


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Hypothyroidism

- Production of thyroid hormones below normal
- Cretinism in children at birth due to inadequate maternal iodine
 - Mental retardation, thick tongue, loss of reflexes, slow growth
 - Can be corrected if treated



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Hypothyroidism Symptoms

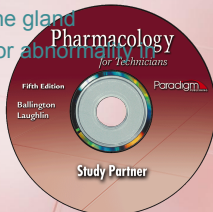
- Apathy
- Constipation
- Decreased heart rate
- Depression
- Dry skin, nails, scalp
- Easy fatiguing
- Enlarged thyroid
- Low voice pitch
- Myxedema
- Puffy face
- Reduced visual acuity
- Swelling of eyelids, thickened and thickened
- Weight gain



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Causes of Hypothyroidism

- Autoimmune destruction of the gland
- Radioactive iodine therapy
- Surgical removal of the gland
- Pituitary dysfunction or abnormality of hypothalamus



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Treatment for Hypothyroidism


- Thyroid replacement therapy
- Increases metabolism, but should not be used to treat obesity



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Hyperthyroidism

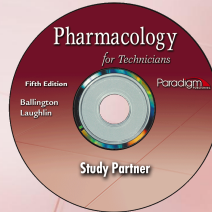
- Excessive thyroid hormone
- Most common cause: Graves disease
- Other causes
 - Excessive exogenous iodine
 - Thyroid nodules
 - Tumor in the pituitary causing overproduction of TSH



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Symptoms of Hyperthyroidism

- Hair loss
- Exophthalmos (protrusion of the eyeballs)
- Weight loss



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Exophthalmos



Study Partner

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Discussion

What are the treatment options for hyperthyroidism?

- In children: surgery and hormone replacement
- In adults: surgery or medications




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Male Hormones and Impotence

- Androgens: hormones that promote development and maintenance of male physical characteristics
- Androgens produced by
 - Testes: produces testosterone, the primary male hormone
 - Ovaries, adrenals, peripheral fat tissue




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Responsibilities of Testosterone

- Initiating sperm production
- Behavioral characteristics
- Libido
- Sexual potency
- Fertility
- Muscle mass and strength
- Fat distribution
- Bone mass
- Erythropoiesis
- Prevention of baldness




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Hypogonadism

- Deficient hormone production and secretion
- Medications must replace androgens
 - May cause virilization, and stimulation (muscle building), and stimulation erythropoiesis
 - Can be used to treat anemia, breast cancer, or endometriosis

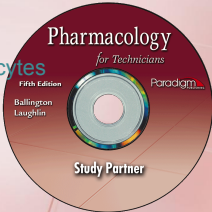


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Side Effects of Androgens

- Virilization
- Hirsutism (abnormal hairiness)
- Acne
- Hepatotoxicity
- High levels of erythrocytes
- Oily skin
- Ankle edema
- Gynecomastia
- Priapism




Study Partner

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Testosterone Derivatives and Dosage Forms

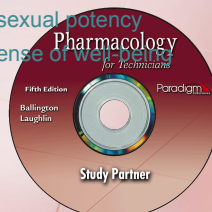
- Oral testosterone undergoes extensive first-pass metabolism in the GI tract and liver
- Various testosterone derivative dosage forms developed
- Testosterone substance classified as Schedule III



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Scrotal Transdermal Systems

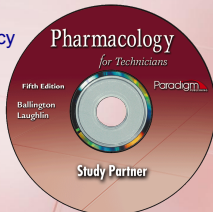
- Provides serum concentration that mimics natural circadian secretion of hormone
- Increases libido and sexual potency
- Improves patient's sense of well-being



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Male Impotence

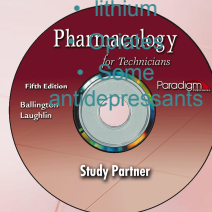
- Failure to initiate or maintain an erection until ejaculation
- Causes
 - Testosterone deficiency
 - Alcoholism
 - Cigarette smoking
 - Psychological factors
 - Medications



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Drugs That May Cause Impotence

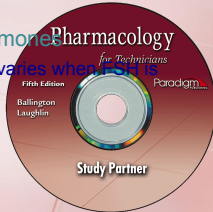
- Alcohol (most significant)
- Amphetamines
- Antihypertensives
- Corticosteroids
- Estrogens
- H₂ blockers
- haloperidol
- lithium
- some anti-depressants



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Female Hormones


- Can prevent conception, ease symptoms of menopause, and help prevent osteoporosis
- Two main female hormones
 - Estrogen, formed in ovaries when released
 - Progesterone



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Responsibilities of Estrogen

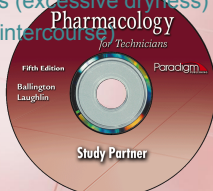
- Endometrial growth
- Increased cervical mucus
- Cornification of vaginal mucosa
- Growth of breast tissue
- Increased epiphyseal closure
- Sodium retention
- Calcium utilization



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Symptoms of Estrogen Deficiency


- Irregular bleeding and cycles
- Vasomotor symptoms: hot flashes
- Atrophic vulvovaginitis (excessive dryness)
- Dyspareunia (painful intercourse)
- Frequent infections



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Menopause

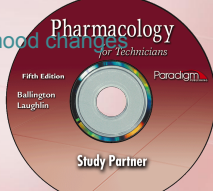
- As women reach menopause, estrogen production decreases
- Hormone therapy (HT) relieves symptoms of estrogen deficiency
- Climacteric characterized by gradual loss of ovarian function and irregular bleeding before menses ends



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Menopausal Symptoms

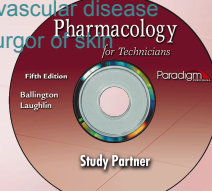
- Hot flashes
- Drying and atrophy of vaginal mucosa
- Insomnia
- Irritability and other mood changes
- Depression



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Hormone Therapy


- Reduces symptoms of menopause
- Decreases bone loss
- Lowers risk of cardiovascular disease
- Improves color and turgor of skin



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Progestin


- Synthetic progesterone
- Used primarily in birth control and to prevent uterine cancer
- Also used for menstrual dysfunction
- Lowers incidence of endometrial hyperplasia



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Hormone Therapy

- Estrogen supplements for hormone therapy for menopause may have same ingredients, but
 - They are not interchangeable
 - Doses differ slightly in each
- Estrogen plus nicotine increases risk of blood clots, increasing risk of DVT



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Risks and Benefits of Hormone Therapy


- Research constantly reveals new information about HTs
- Some studies: limit to shortest duration possible
- Some risk of breast cancer



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Risks and Benefits of Hormone Therapy


- Decision to use HT up to the woman and her physician
- Advantages and disadvantages differs for each woman, depending on
 - Family history
 - Physical condition



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Oral Contraceptives

- Advantages of OCs: ease of use, high efficacy rate, relative safety
- Most oral contraceptives (OCs) are combinations of estrogen and progestin
- Interfere with hormones responsible for regulation of the menstrual cycle
- Change the consistency of cervical mucus and alter the endometrial lining



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Progestin-Only Pills

- Rely on the effects of progestin on the cervical mucus and endometrium



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Benefits of Oral Contraceptives

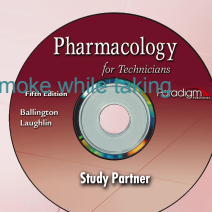
- Prevent pregnancy, regulate menstrual cycle, reduce menstrual flow, lessens severe menstrual cramps and pain
- Protect against ovarian and uterine cancer, benign breast disease, ectopic pregnancy, and ovarian cysts
- May reduce risk of pelvic inflammatory disease



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Oral Contraceptives

- Some studies: OCs not prescribed if
 - Hypertension
 - Diabetes
 - Elevated cholesterol
- Patients should not smoke while taking OCs



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Contraceptives

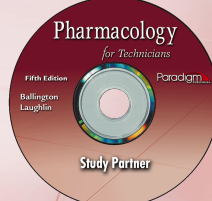
- Many forms of contraceptive on the market
- Available in pill form, creams, patches, rings, and implants
- Take OCs same time each day
- Taking OCs at bedtime reduces possibility of nausea



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Emergency Contraception

- In great demand
- Patients want them to be available OTC




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Discussion

What is one of the arguments for emergency contraceptives being OTC?

After making a doctor's appointment and then going to the get the prescription, sometimes it is too late to take the medication.



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Pregnancy Tests and Pregnancy


- Critical organ systems develop in the first month which is affected by
 - Mother's diet
 - Environment (smoking)
 - Medications
 - Consumption of alcohol and beverages



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Home Pregnancy Tests


- Based on detecting human chorionic gonadotropin (hCG)
- Levels can be measured as early as 6-8 days after conception
- Results are given within 1-5 minutes
- Tests are better than \$10 accurate



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START HERE 12/17 Pregnancy Needs

- Pregnancy often occurs without woman knowing
- Sexually active women get daily requirements
 - Folic acid: prevents tubular defects
 - Iron: prevents anemia, birth delivery, low birth weight in infants
 - Calcium: bone development
- Pregnant women: few OTC drugs



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Drugs Used During Childbirth

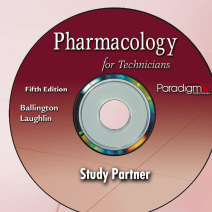
- Women may choose not to use drugs for simple delivery
- Drugs are necessary in emergencies
 - To restart labor
 - To decrease uncontrolled bleeding



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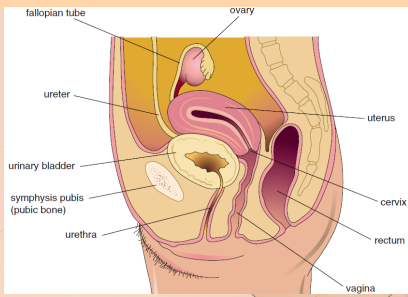
Sexually Transmitted Diseases (STDs)

- Most genital system diseases are transmitted by sexual activity



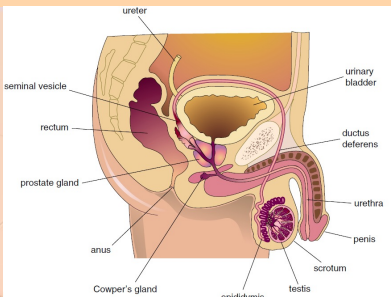
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Female Genital System Anatomy



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Male Genital System Anatomy



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Chlamydia


- If untreated, can progress to serious reproductive and other health problems
- Caused by *Chlamydia trachomatis*
- “Silent” disease, many have no symptoms
- Often occurs with gonorrhea
- Treated and cured with antibiotics



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Gonorrhea

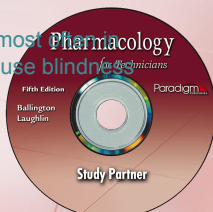
- Caused by *Neisseria gonorrhoeae* that attaches to mucosal cells in
 - Oropharyngeal area
 - Eye
 - Joints
 - Rectum
 - Male and female genitalia
- Treated with penicillin



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Untreated Gonorrhea

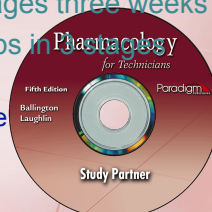
- Can cause systemic infection
 - Heart, meninges, eyes, pharynx, and joints (arthritis)
- Eye infections occur most often in newborns and can cause blindness



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Syphilis

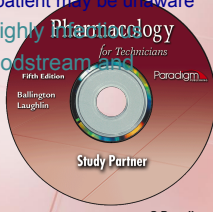
- Caused by *Treponema pallidum*
- Incubation averages three weeks
- Infection develops in three stages
 - Primary stage
 - Secondary stage
 - Tertiary stage



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Syphilis: Primary-Stage Infection

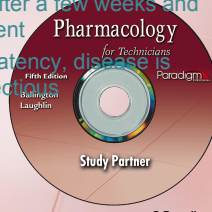
- Small, hard-based sore (chancre) develops at site of infection
 - May be painless and patient may be unaware
- Fluid in the sores is highly infectious
- Bacteria enter the bloodstream and lymphatic system



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Syphilis: Secondary-Stage Infection

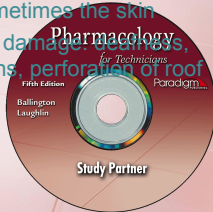
- Skin rashes, patchy hair loss, malaise, and mild fever
- Symptoms subside after a few weeks and disease becomes latent
- After 2 to 4 years of latency, disease is usually no longer infectious



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Syphilis: Tertiary-Stage Infection


- Occurs after an interval of at least 10 years
- Lesions appear as a rubbery mass in many organs and sometimes the skin
- May cause extensive damage: deafness, blindness, CNS lesions, perforation of roof of mouth



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Congenital Syphilis

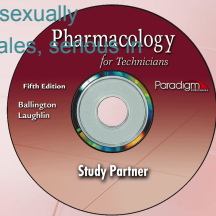
- Crosses the placenta into the fetus
- Neurologic damage if pregnancy occurs during the tertiary stage
- Pregnancy during primary or secondary stage likely to produce a stillborn child



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Nongonococcal Urethritis

- NGU may be caused by catheters or chemical agents
- Sometimes acquired sexually
- Symptoms: mild in males, severe in females



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Vaginitis

- Caused by *Gardnerella vaginalis*
- Results from interaction between this organism and anaerobic bacterium in the vagina
- Symptoms: frothy discharge with fishy odor and vaginal pH of 5 to 6

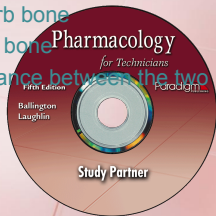


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Drug Therapy for Bone Disease

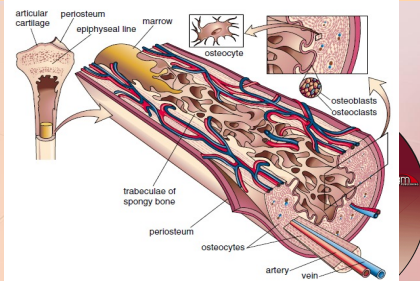
- Bone is living tissue continuously being replaced
- Osteoclast cells resorb bone
- Osteoblast cells form bone
- In healthy bones, balance between the two



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Microscopic View of Bone



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Bones and Age

- As age progresses, reabsorption of bone exceeds deposit of new bone
- Newly formed bone less dense and more fragile than original bone
 - Increases risk of bone fracture

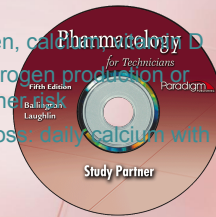


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Osteoporosis

- Condition of reduced bone mineral density, disrupted bone structure, and increased risk of fracture
- Deficiency in estrogen, calcium, and vitamin D
- Women with less estrogen production or intake may be at higher risk
- Prevention of bone loss: daily calcium with vitamin D

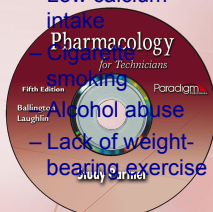


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Risk Factors for Osteoporosis


- Not Modifiable
 - Gender
 - Race
 - Heredity
 - Age
- Modifiable
 - Low calcium intake
 - Smoking
 - Alcohol abuse
 - Lack of weight-bearing exercise



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Osteoporosis

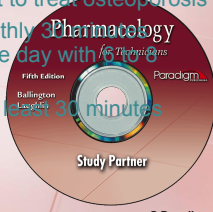
- Weight-bearing exercise helps strengthen bones
 - Walking
 - Jogging
 - Weight lifting
 - Dancing
- HRT also reduces rate of bone loss



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Biphosphonates

- Interfere with bone reabsorption by osteoclasts
- Drug class used most to treat osteoporosis
- Taken weekly or monthly before first meal of the day with 8 ounces of water
- Remain upright for at least 30 minutes

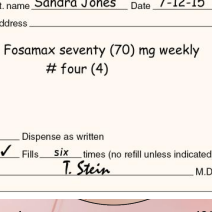


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Discussion

What definite instructions should this patient be given?

Take the medication with a full glass of water 30 minutes before any other food or drink. Do not lie down for 30 minutes afterward.



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Rx MT. HOPE MEDICAL PARK
ST. PAUL, MN (651) 555-3591

DEA# _____ Date 7-12-15

Pt. name Sandra Jones Address _____


Fosamax seventy (70) mg weekly
four (4)

Dispense as written
 Fills six times (no refill unless indicated)

T. Stein M.D.

Adrenal Gland Disorders and Corticosteroid Therapy


- Adrenal glands are on top of kidneys, produce steroid hormones: corticosteroids
- Each hormone has
 - **Glucocorticoid:** involved in metabolism and protein metabolism
 - **Mineralocorticoid:** involved in regulating electrolyte and water balance



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Cortisol

- Principal adrenal steroid hormone
- Responsible for
 - Gluconeogenesis
 - Protein catabolism
 - Anti-inflammatory reactions
 - Stimulation of fat deposition
 - Sodium and water retention



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Corticosteroids

- Adrenal hormones (excluding sex hormones)
- Steroid production follows a circadian rhythm

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Corticosteroids

- Used as anti-inflammatories and immunosuppressants and in treating diseases of the following origins
 - Hematologic
 - Allergic
 - Inflammatory (main use)
 - Neoplastic
 - Autoimmune

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Addison Disease

- Life-threatening deficiency of glucocorticoids and mineralocorticoids
- Treated with daily corticosteroids

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Symptoms of Addison Disease

- Debilitating weakness
- Hyperkalemia
- Bronze color of skin
- Low levels of serum sodium and glucose
- Reduced blood pressure
- Weight loss

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Cushing Disease

- Caused by an overproduction or excessive administration of corticosteroids over time
- Symptoms: protruding abdomen; round, puffy face; fat over the shoulders

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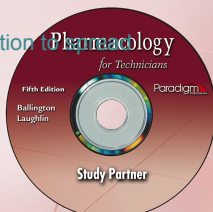
Reasons for Using Corticosteroids

- Inhibit inflammation
- Useful in treating asthma, rashes, and skin disorders
- Available in many different dosage forms

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Problems with Corticosteroids


- Lessen the ability of leukocytes to destroy infection which decreases fever, redness, and swelling
- Also may cause infection



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Corticosteroids

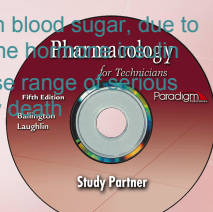
- Usage must be tapered off, not abruptly stopped
- May cause withdrawal symptoms
 - Anorexia, nausea, vomiting, arthralgia, lethargy, headache, slurred speech, weight loss, postural hypotension, fever, and depression
- Doses should be given in the morning



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Diabetes

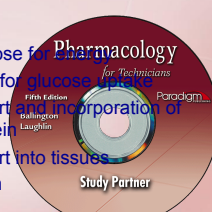
- Serious disease affecting millions of people
- Characterized by high blood sugar, due to insufficient levels of the hormone insulin
- If untreated, can cause a range of serious conditions, eventually leading to death



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Functions of Insulin

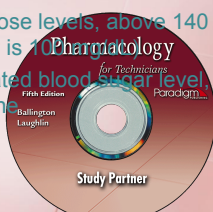
- Pancreas contains islets of specialized cells producing insulin
- Insulin
 - Helps cells burn glucose for energy
 - Works with receptors for glucose
 - Increases ion transport and incorporation of amino acids into protein
 - Increases ion transport into tissues
 - Inhibits fat breakdown



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Diabetes

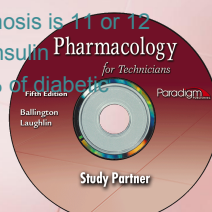
- Caused by inadequate secretion or utilization of insulin
- Excessive blood glucose levels, above 140 to 160 mg/dL (normal is 100 to 120 mg/dL)
- Hyperglycemia: elevated blood sugar level, glucose spills into urine



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Type I Diabetes

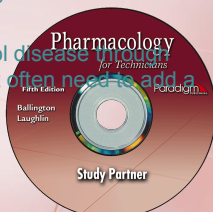
- Most commonly occurs in children and young adults
- Average age of diagnosis is 11 or 12
- Patients must have insulin
- Accounts for 5 to 10% of diabetic population



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Type II Diabetes

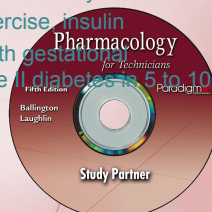
- 80-90% of diabetic cases
- Most over 40, majority are women
- Most overweight
- May be able to control disease through diet and exercise, but often need to add a drug or insulin



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Gestational Diabetes

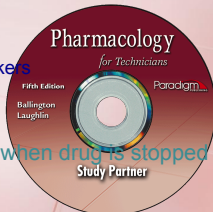
- Occurs during pregnancy
- Increases risk of fetal morbidity and death
- Treated with diet, exercise, insulin
- 30-40% of women with gestational diabetes develop type II diabetes in 5 to 10 years



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Secondary Diabetes

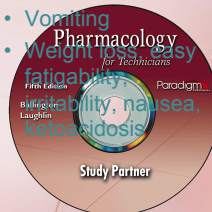
- Caused by medications
 - Oral contraceptives
 - Beta blockers
 - Diuretics
 - Calcium channel blockers
 - Glucocorticoids
 - phenytoin
- May return to normal when drug is stopped



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Symptoms of Diabetes

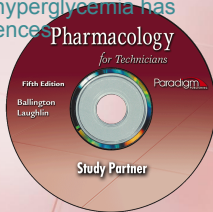
- Frequent infections
- Glycosuria
- Hunger
- Increased urination and nocturia
- Numbness, tingling
- Slow wound healing
- Thirst
- Visual changes
- Vomiting
- Weight loss, easy fatigability
- Irritability, nausea, ketonuria



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Hypoglycemia and Hyperglycemia


- Short-term hypoglycemia (drug level falls below 70 mg/dL) more dangerous
- Untreated long-term hyperglycemia has devastating consequences



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Complications of Long-Term Diabetes


- Retinopathy leading to blindness
- Neuropathy
- Vascular problems lead to atherosclerosis, decreased blood flow, and impaired healing. Could lead to amputation
- Dermatologic involvement
- Nephropathy is primary cause of end-stage renal disease



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Treating Diabetes

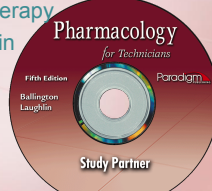
- Goal of treatment is to approximate nondiabetic physiology
- Treatment consists of diet, exercise, and medications
- Regular blood glucose monitoring



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Five-Step Treatment for Type II

1. Lifestyle changes
2. Oral monotherapy
3. Combination oral therapy
4. Oral drug plus insulin
5. Insulin only



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General Treatment Guidelines


- Attention to diet
- Blood pressure control
- Compliance with medications
- Control of hyperlipidemia
- Daily foot inspections
- Increased physical activity
- Recognizing hypoglycemia
- Blood glucose testing
- Monitoring in doctor's office
- Patient education
- Patient education on treatment of infections
- Setting goals



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Insulin

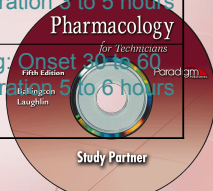
- Administered subcutaneously due to degradation in the GI tract
- Different types of insulin have different onset of action times and pharmacology times



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Insulin Duration of Action

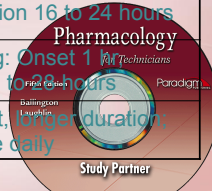
Type	Duration of Action
Humalog, NovoLog, Apidra	Rapid-Acting: Onset 10 to 30 minutes, duration 3 to 5 hours
Humulin-R, Novolin R (regular)	Short-Acting: Onset 30 to 60 minutes, duration 5 to 6 hours



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Insulin Duration of Action

Type	Duration of Action
Novolin N (NPH)	Intermediate-Acting: Onset 1 to 3 hrs, duration 16 to 24 hours
Lantus, Levemir	Long-Acting: Onset 1 hr, Duration 24 to 36 hours
mixed	Quick onset, long duration, dosed twice daily



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Rotation of Insulin Administration Sites

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Hypoglycemia

- Blood glucose levels of <70 mg/dL
- Can be caused by
 - Skipping meals
 - Too much exercise
 - Poor medication regimen
 - Certain drugs

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Signs and Symptoms of Hypoglycemia

- Confusion
- Double vision
- Headache
- Hunger
- Numbness and tingling in mouth and lips
- Nervousness
- Palpitations
- Sweating
- Thirst
- Visual disturbances
- Weakness

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Treatment of Hypoglycemia

- Give patient milk or sugars such as fruit juices, soft drinks, or candy
- Glucose tablets
- Type I should have Rx glucagon available

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Emergencies

- In an emergency, insulin does not require a Rx
- The 500 Units per mL and some new insulins always require a Rx
- Some states require a Rx for needles

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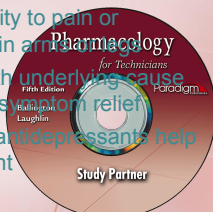
Oral Hypoglycemic Agents

- Cause pancreas to release stored insulin
- Not effective in type I diabetes—no insulin for body to release
- Goal of therapy: maintain an HbA1c (glycosylated hemoglobin) level of less than 7%

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Peripheral Neuropathy


- Many diabetic patients have some form of peripheral neuropathy
- Numbness, insensitivity to pain or temperature, tingling in arms and legs
- Therapy: first deal with underlying cause (hyperglycemia), then symptom relief
- Anticonvulsants and antidepressants help with pain management



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Growth Disorders

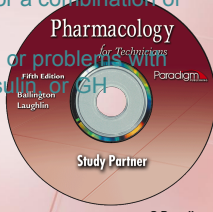
- Growth hormone (GH) has fundamental role in metabolism
- Deficiency of endogenous growth hormone causes growth retardation



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Causes of Growth Delay

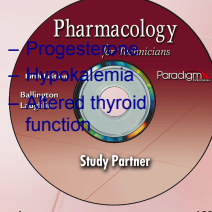
- Family growth patterns, genetic disorders, malnutrition, systemic or chronic illness, psychosocial stress, or a combination of these
- Endocrine deficiency, or problems with thyroxine, cortisol, insulin, or GH



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Growth Hormone

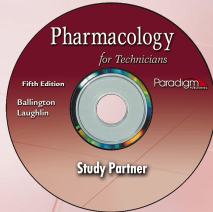
- Release of GH stimulated by release of growth hormone releasing factor (GHRF) secreted by the hypothalamus
- GH inhibited by
 - Glucocorticoids
 - Obesity
 - Depression



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Human Growth (GH) Hormone

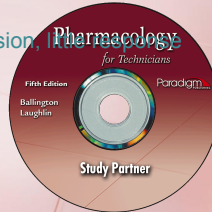
- Supplied through recombinant DNA technology



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Growth Hormone Therapy


- Younger the patient at time of treatment, greater the height that may be achieved through GH therapy
- Due to epiphyseal fusion, the response is seen after
 - Age 15 to 16 in boys
 - Age 14 to 15 in girls



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Assignments

- Complete Chapter Review activities
- Answer questions in Study Notes document
- Study Partner
 - Quiz in review mode
 - Matching activities
 - Drug tables



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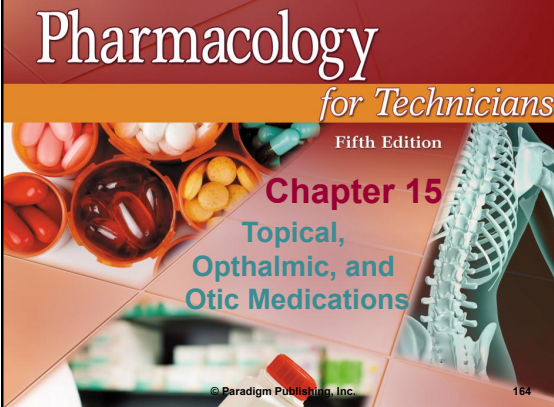
Pharmacology

for Technicians

Fifth Edition

Chapter 15

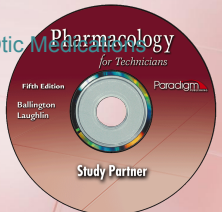
Topical, Ophthalmic, and Otic Medications



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Chapter 15 Topics

- Skin Ailments and Their Treatment
- Eye Conditions and Ophthalmic Medications
- Ear Conditions and Otic Medications



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Learning Objectives


- Describe the skin as an organ.
- Understand the physiology of the skin.
- Know the topical drugs and the conditions they treat.
- Explain the action of the topical corticosteroids and their application.



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Learning Objectives

- Recognize the classes of antiseptics and disinfectants.
- Recognize the ophthalmic and otic agents and their uses.



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Skin Ailments and Their Treatment


- Skin is a major organ
- Accounts for 10% of body weight
- Offers protection
- Source of sensory input
- Main organ involved in temperature regulation



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Anatomy of the Skin


- Epidermis
 - Top layer of skin
 - Continually forms new cells and sheds old, dead cells
 - Produces nails, hair, glands
- Dermis
 - Below epidermis
 - Made up of connective tissue with upward projections into the epidermis



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Types of Skin Glands

- Two types of glands widely distributed in the skin: sebaceous and sweat
- Sebaceous glands
 - Secrete sebum, a substance that coats the hair and is toxic to some bacteria
- Sweat glands
 - Produce water and salts



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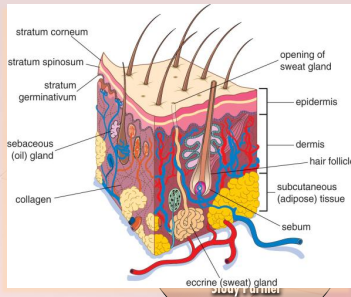
Types of Skin Glands

- Apocrine glands in skin of external ear canal produce cerumen (earwax)
- Cerumen
 - Has antibacterial and antifungal properties
 - Made up of secretions, mucous cells, and dust



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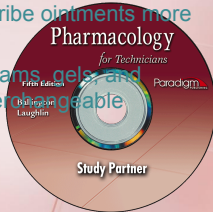
Anatomy of the Skin



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Filling Prescriptions for Skin Ailments


- Physicians generally prescribe creams more than ointments
- Dermatologists prescribe ointments more than creams
- When filling a Rx, creams, gels, and ointments are not interchangeable



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Sun and the Skin

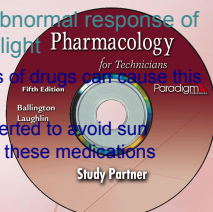
- Suntans can permanently damage the skin
- Sunscreens should contain combination of
 - Oxybenzone and para-aminobenzoic acid, or
 - Other UV-absorbing agent that can protect against both UV-A and UV-B rays



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Phototoxicity and Photosensitivity

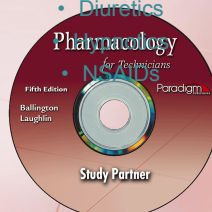
- Phototoxicity: a property of a chemical that becomes toxic on exposure to light
- Photosensitivity: an abnormal response of the skin or eye to sunlight
 - Many different classes of drugs can cause this sensitivity
 - Patients need to be alerted to avoid sun exposure when taking these medications



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Some Drugs That Cause Photosensitivity

- ACE Inhibitors
- Antibiotics
- Antidepressants
- Antihistamines
- Antipsychotics
- Cardiovascular drugs
- Chemotherapeutic agents
- Diuretics
- NSAIDs



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Skin and the Sun

- Fair-skinned people more likely to have atrophy, scaling, and skin cancer than dark-skinned people



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Skin Cancers

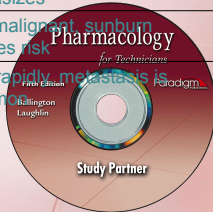
- Actinic Keratosis
- Basal Cell Carcinoma
- Melanoma
- Squamous Cell Carcinoma



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Skin Cancers

Actinic Keratosis	Precancerous condition
Basal Cell Carcinoma	Slow-growing tumor, rarely metastasizes
Melanoma	Highly malignant, sunburn increases risk
Squamous Cell Carcinoma	Grows rapidly, metastasizes uncommonly

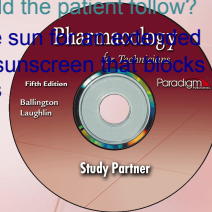


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Discussion

It is the middle of July and you have a patient receiving a new prescription for Bactrim. What precautions should the patient follow?

Do not stay out in the sun for a long period of time; wear sunscreen that blocks UV-A and UV-B rays



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Skin Disorders and Their Pharmaceutical Treatment


- Many drugs used for skin disorders and diseases may overlap
- Many are used to treat more than one skin disease
- One drug can be used for several ailments



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Acne Vulgaris

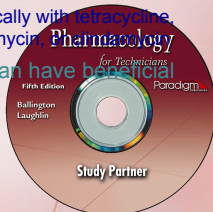
- Acne vulgaris: increased glandular activity at puberty
 - Usually resolves in early adulthood
 - Lesions most common on face



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Acne Treatment

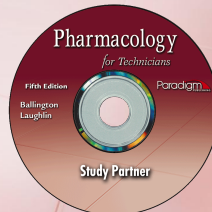
- Acne is treated
 - With tretinoin, azelaic acid, and adapalene
 - Systemically and topically with tetracycline, erythromycin, azithromycin
- Oral contraceptives can have beneficial effect on acne



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Actinic Keratosis


- Precancerous condition resulting from excessive exposure to the sun



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Treatment of Actinic Keratosis

- fluorouracil (Efudex)
 - Used topically
 - Antimetabolite, chemotherapy agent (antineoplastic drug that inhibits cell development and growth)
- aminolevulinic acid (Levulan)
 - Topical compound
 - Photodynamic reaction upon exposure in appropriate wavelength of light



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Treatment of Actinic Keratosis


- Imiquimod (Aldara)
 - Stimulates immune process at lesion sites
 - Approved for treatment of external, genital, and perianal warts, and psoriasis



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Allergic and Inflammatory Reactions


- Pruritis: itching associated with number of skin disorders or irritation from chemical substances
- Causes of excessive itching
 - Some systemic diseases: liver disease, uremia, Hodgkin disease, diabetes, thyroid disease
 - Pregnancy, senility, and various psychological disorders



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Treatment of Pruritis

- Topically applied baths with starch, sodium bicarbonate, magnesium sulfate (Epsom salts), colloidal oatmeal, potassium permanganate
- Camphor in liniments and ointments
- Antihistamines



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Rash Caused By Drugs

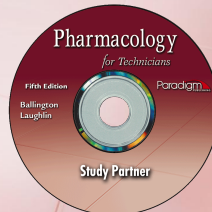
- Rash most common allergic reaction to a drug
- Pharmacy technician—notify pharmacist if you hear of a drug-caused rash



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Dandruff


- Rapid shedding of scales from the scalp



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Eczema

- Eczema: a hot, itchy, red, oozing condition; two types: atopic and contact
- Atopic eczema (atopic dermatitis)
 - Chronic pruritic eruption
 - Allergic, hereditary, and psychological factors may be involved
- Contact dermatitis
 - Inflammatory reaction in response to contact with irritating agent: poison oak, poison ivy



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Atopic Eczema



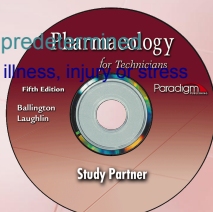
Contact Dermatitis



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Seborrhea

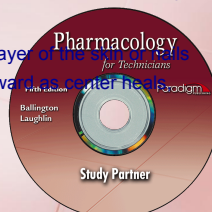
- Seborrhea: excessive secretion of sebum
 - Usually on elbows and knees, but any part of body can be affected
- Condition genetically predetermined
 - Attacks brought on by illness, injury or stress
 - No cure



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Fungal Infections

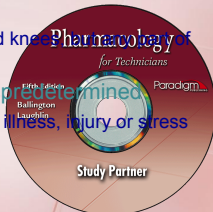
- Candidiasis
 - Causes lesions in the mouth (thrush) or vagina
- Ringworm
 - Infects horny (scaly) layer of the outer head
 - Infection spreads outward leaving a ring



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Psoriasis

- Psoriasis: chronic noncontagious condition producing patches of red, scaly skin (plaques)
 - Usually on elbows and knees, but any part of body can be affected
- Condition genetically predetermined
 - Attacks brought on by illness, injury or stress
 - No cure



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Psoriasis



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Treatment of Psoriasis

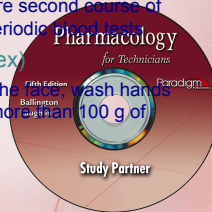
- Topical therapy, phototherapy, systemic therapy; may be combined
- methotrexate (Rheumatrex, Trexall)
 - Oral or injectable
 - May inhibit normal cell growth of bone marrow tissues



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Treatment of Psoriasis

- alefacept (Amevive)
 - Attacks T cells, intramuscular injections for 12 weeks and may require second course of treatment, requires periodic blood tests
- calcipotriene (Dovonex)
 - Topical, not used on the face, wash hands after application, no more than 100 g of ointment per week



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Treatment of Rosacea

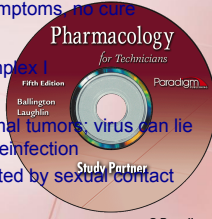
- Topical agents: MetroGel, Azelex, Sulfacet R, and Finacea
- Oral agent: Oracea



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Viral Infections



- Shingles
 - Caused by herpes zoster
 - Treatment relieves symptoms, no cure
- Cold sores
 - Caused by herpes simplex I
- Warts
 - Virally caused epidermal tumors; virus can lie dormant, then cause reinfection
 - Genital warts transmitted by sexual contact



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Treatment of Shingles and Cold Sores

- Shingles
 - Palliative. Antivirals such as acyclovir may prevent recurrent outbreaks
- Cold sores
 - docosanol (Abreva)



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Treatment of Warts

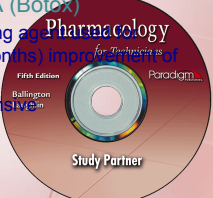
- Surgically removed or destroyed by local freezing
- Some OTC products may work
 - Contain salicylic acid



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Treatment of Wrinkles


- tretinoin (Renova)
 - Lower dose of tretinoin used for wrinkles
- botulinum toxin type A (Botox)
 - Neuromuscular blocking agent; temporary (about 3 months) improvement of wrinkles
 - Treatments very expensive



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Skin Infections

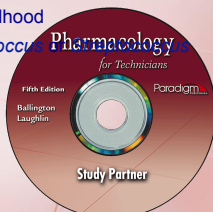
- Skin infections are common
- Most can be treated with OTC topical antimicrobial medications
- Impetigo, erysipelas, folliculitis, furunculosis, rosacea



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Impetigo and Erysipelas

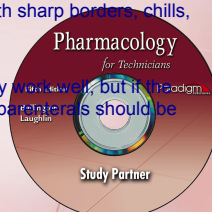
- Impetigo is a superficial, but highly contagious skin infection
 - Common in early childhood
 - Caused by *Staphylococcus aureus*



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Erysipelas

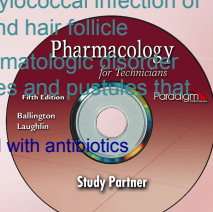
- Erysipelas is a form of cellulitis
 - Characterized by redness, warmth, local pain, edematous plaque with sharp borders, chills, malaise, fever
 - Spreads rapidly
 - Oral antibiotics usually effective, but if infection is systemic, parenterals should be used



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Folliculitis, Furuncle, and Rosacea

- Folliculitis: inflammation of a hair follicle
- Furuncle (boil): staphylococcal infection of a sebaceous gland and hair follicle
- Rosacea: chronic dermatologic disorder with erythema, papules and pustules that may become infected
 - Symptoms are treated with antibiotics



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Antifungals Under the Nails

- Antifungals often administered through pulse dosing to treat conditions under the nails




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Discussion

What different types of medications can be used to treat acne vulgaris?

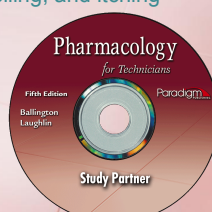
Oral and topical antibiotics and topical preparations to remove diacylglycerol from keratinocytes



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Topical Corticosteroids

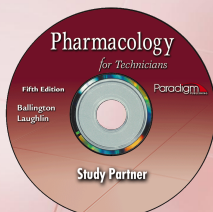
- Suppress the immune response
- Relieve redness, swelling, and itching



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External Parasites

- Lice and scabies are external parasites
- Use the human body as a host



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Adult Head Lice



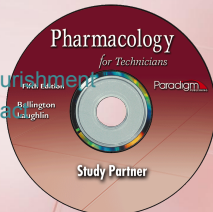
Scabies Mites



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Lice


- Remain on host's skin surface, hair, and clothing fibers
- Cause itching
- Live up to 45 days
- Human blood only nourishment
- Spread by direct contact



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Three Types of Lice


- Body lice in clothing and moist areas of body
- Head lice on scalp and hair
 - Transmitted by direct contact
- Pubic lice in pubic area
 - Transmitted by sexual contact



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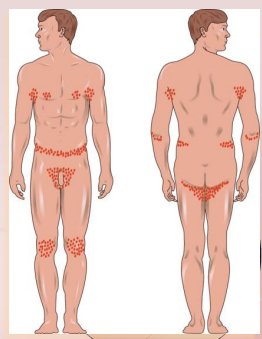
Scabies

- Small white mites cause scabies
- Causes intense itching
- Transmitted by close contact
- Itching is worse at night after bed is warmed by body heat
- Lesions appear as very small, wavy, threadlike, slightly elevated, grayish-white burrows



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Common Sites of Scabies Infestation



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Treatment of Lice and Scabies

- For head and public lice, comb hair with a clean, fine-toothed comb to remove nits (eggs)
- When treating lice, OTC drugs are as effective as prescription drugs
- Some products used for lice infestations are effective for treating scabies



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Antiseptics and Disinfectants


- Most desirable quality is the ability to destroy microorganisms
- Two uses: disinfect instruments and treat infections in oral cavity and on surfaces
- Two different agents may need to be used to achieve adequate cleaning



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Antiseptics and Disinfectants

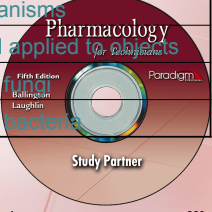
- When an antiseptic is used to disinfect instruments or to maintain sterility in a clean room, best to use two separate cleansers with different mechanisms of action



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Actions of Antiseptics and Disinfectants

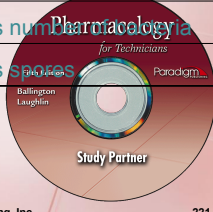
Agent	Action
Antiseptic	Inhibits growth of microorganisms
Disinfectant	Chemical applied to objects
Fungicide	Destroys fungi
Germicide	Destroys bacteria



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Actions of Antiseptics and Disinfectants

Agent	Action
Preservative	Prevents decomposition
Sanitizer	Reduces number of microorganisms
Sporicide	Destroys spores




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Discussion

What characteristics make an ideal antiseptic?

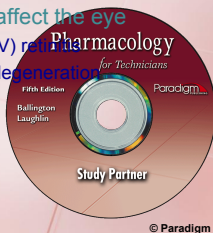
One that can inhibit all forms of microorganisms; is nontoxic; does not induce sensitization; can penetrate tissues and body fluids; is water soluble, noncorrosive, and inexpensive.



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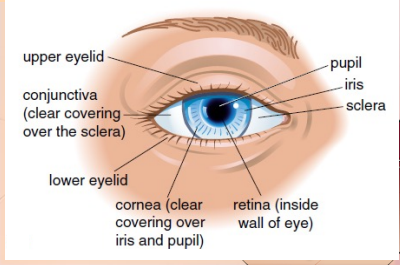
Eye Conditions and Ophthalmic Medications

- Ophthalmic medications are used to treat the eyes
- Some disorders that affect the eye
 - Cytomegalovirus (CMV) retinitis
 - Age-related macular degeneration
 - Chronic dry eye
 - Conjunctivitis



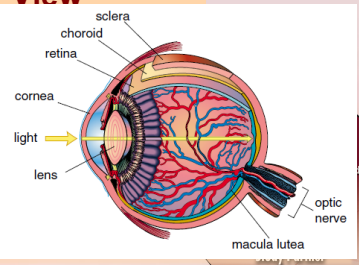
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The External Eye



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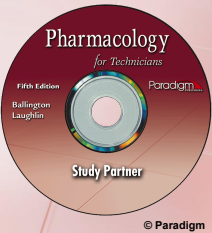
Internal Eye, Sagittal View



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CMV Retinitis

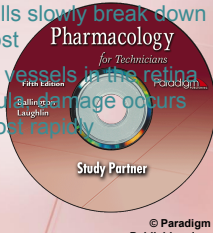
- Inflammation of the retina caused by cytomegalovirus (CMV)
- Treated with antivirals



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Age-Related Macular Degeneration (AMD)

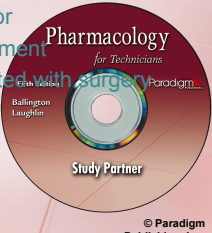
- Macula has highest concentration of photoreceptors in the retina
- Dry AMD: macular cells slowly break down and vision is slowly lost
- Wet AMD: new blood vessels in the retina grow toward the macula and image occurs rapidly and vision is lost rapidly



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AMD

- Neither form causes pain
- Unknown cause
- Age greatest risk factor
- Dry AMD has no treatment
- Wet AMD can be treated with surgery



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Chronic Dry Eye

- Eye cannot produce sufficient tears to lubricate and nourish the eye
- Rx cylosporine (Restasis)
 - Increases tear production
 - Decreases immune function in the eye
 - Not absorbed systemically



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Conjunctivitis

- Known as “pink eye”
- Common eye disorder, very contagious
- Increased tearing, itching, conjunctival swelling, redness
- Treatments include topical vasoconstrictors, mast cell stabilizers, antihistamines, corticosteroids, antibiotics, and antivirals

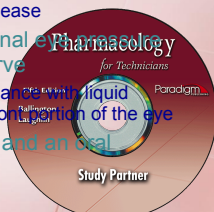


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Glaucoma

- Chronic disorder, causes vision loss, no cure
 - Most common eye disease
- Abnormally high internal eye pressure destroys the optic nerve
 - Pressure due to imbalance with liquid (aqueous humor) in front portion of the eye
- Treatment: eyedrops and an oral medication

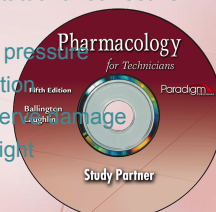


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Treatment Goals for Glaucoma

- Prompt reduction of intraocular pressure
- Stabilization of eye status for corrective surgery
- Gradual reduction of pressure
- Long-term normalization
- Prevention of optic nerve damage
- Preservation of eyesight



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Ear Conditions and Otic Medications

- Disorders of the ear include
 - Otolgia (ear pain)
 - Earache
 - Buildup of earwax (cerumen)



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Otalgia

- Otalgia usually treated with a prescription
- OTC products
 - Ear wax solvents
 - Products to dry water in the ear



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The Ear: Structural Components

The diagram illustrates the structural components of the human ear, categorized into three main regions:

- External Ear:** Includes the auricle (pinna) and the external auditory meatus.
- Middle Ear:** Contains the ossicular chain, which consists of the malleus, incus, and stapes. It also shows the tympanic membrane and the Eustachian tube.
- Internal Ear:** Features the vestibule, cochlea, and semicircular canals.

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Discussion

Why can eyedrops be used in the ear, but eardrops cannot be used in the eye?

Eyedrops must be sterile, but eardrops do not need to be sterile.

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Assignments

- Complete Chapter Review activities
- Answer questions in Study Notes document
- Study Partner
 - Quiz in review mode
 - Matching activities
 - Drug tables

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Pharmacology

for Technicians

Fifth Edition

Chapter 16

Recombinant Drugs and Chemotherapy

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Chapter 16 Topics

- Recombinant DNA
- Immune System
- Cancer

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Learning Objectives

- Understand recombinant DNA and the process for producing medications in this manner.
- Identify colony-stimulating factors and their uses.
- Understand the immune system and how it works.

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Learning Objectives

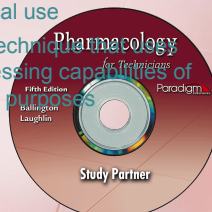
- Identify drugs used to treat specific disease states and the classifications of drugs used in its treatments



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Recombinant DNA


- Biotechnology: the method of applying biologic systems and organisms to industrial and technical use
- Recombinant DNA: technique that uses the information-processing capabilities of living cells for human purposes



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Natural Process for Making Proteins

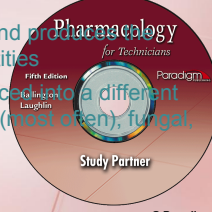
- Proteins
 - Large, complex organic molecules that carry out many chemical processing tasks for a cell
 - Can be reproduced by replication
- 3 steps to producing a protein
 - Replication of DNA
 - Transcription to RNA
 - Translation to manufacture the protein



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Recombinant Process for Manufacturing Proteins

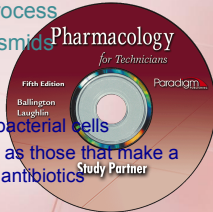
- DNA that codes for a valuable protein in the body is inserted into the DNA of a different organism
- Cell then multiplies and produces the protein in large quantities
- Desired gene introduced to a different kind of cell: bacterial (most often), fungal, or mammalian



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Plasmids

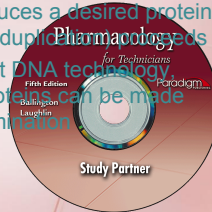
- Small circular rings of DNA in bacteria
- Often used to transport a gene into a host cell in recombinant process
- Characteristics of plasmids
 - Present in bacteria
 - Replicate themselves
 - Move freely between bacterial cells
 - Can carry genes such as those that make a bacterium resistant to antibiotics



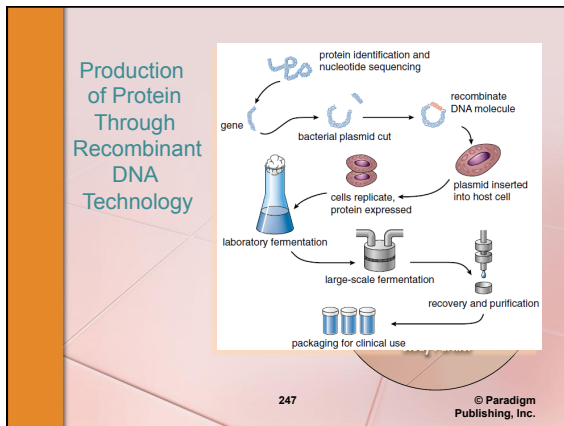
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Protein Replication

- Environment of the host cell is critical to replicate protein
- Once a cell that produces a desired protein is identified, cloning (duplication) of the cell is used
- By using recombinant DNA technology, large quantities of proteins can be made without risk of contamination



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Economic Challenges

- High cost of these products is offset by the savings in hospital bills for the patients

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Colony-Stimulating Factors (CSFs)

- Stimulate bone marrow to produce blood cells, well tolerated agents
- Decrease period of severe neutropenia (low number of white blood cells)
 - Chemotherapy or marrow transplant
 - Treatment of noncancerous anemia
 - Treatment of other immunodeficiency states associated with cytopenia (reduction in number of blood cells)

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Therapeutic Uses of CSFs

- Hematopoietic (red blood cell) malignancies
- Testicular cancer
- Ovarian cancer
- Small-cell carcinoma of the lung

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Biologic-Response Modifiers

- Chemicals that enhance immune system activity so that the body will attack and kill invading organisms

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Discussion

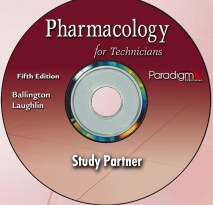
What are the three types of cells into which a desired gene can be introduced?

bacterial, fungal, or mammalian

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Immune System


- Highly complicated system
- Protects the body from invading pathogens



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The Body's Three Lines of Defense


- Body surfaces of intact skin and mucous membranes, body fluids, sneezing, coughing
- Nonspecific internal defense: phagocytosis, macrophages, and other infection-fighting chemicals
- Immune response: T cells and B cells



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Immune Response

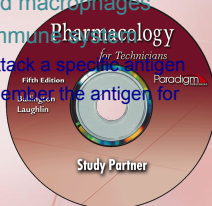
- Provides resistance to disease and malignancy by producing active phagocyte cells and antibodies
- Antibody: specialized protein molecule in response to an antigen
- Antigen: any substance that immune system cells view as foreign



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Immune System Cells


- Immune system has different types of white blood cells (leukocytes): T cells, B cells, small lymphocytes, and macrophages
- These cells give the immune system:
 - Specificity: ability to attack a specific antigen
 - Memory: ability to remember the antigen for future invasion



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T Cells

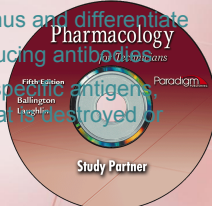
- Participate in cellular immunity
- Formed in bone marrow, reside in lymph nodes and spleen
- Respond to antigens by forming cytokines
 - Effector T cells: release cytokines
 - Cytotoxic T cells: directly kill infected cells, have receptors specific for different antigens
 - Memory T cells: reproduce forever afterward



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B Cells

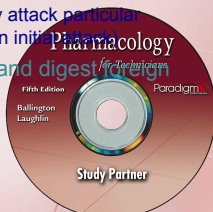
- Involved in humoral immunity
- Formed in bone marrow
- Do not enter the thymus and differentiate
- Responsible for producing antibodies
- Antibodies attach to specific antigens, forming a complex that is destroyed or inactivated



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Small Lymphocytes and Macrophages

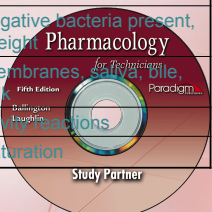
- Small lymphocytes produced by clones of T and B cells
 - Recognize and rapidly attack particulate antigens (more so than initiate)
- Macrophages ingest and digest foreign substances



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Immunoglobulins: Proteins with Antibody Activity

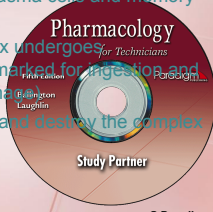
IgG	Most common and smallest. In saliva, tears, cerebrospinal fluid. Main defense against fever-producing organisms
IgM	Form when gram-negative bacteria present, highest molecular weight
IgA	Found in mucous membranes, saliva, bile, tears, and breast milk
IgE	Causes hypersensitivity reactions
IgD	May affect B-cell maturation



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Immune Response: Humoral Immunity

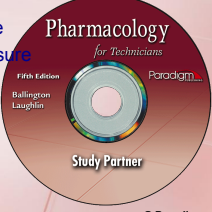
- Antigen enters the body, ending up in a lymph node or the spleen
- B cells are stimulated; plasma cells and memory cells are activated
- Antigen-antibody complex undergoes opsonization (pathogen marked for ingestion and destruction by a macrophage)
- Macrophages recognize and destroy the complex



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Antibody Response


- Magnitude of an antibody response depends on
 - Nature of the antigen
 - Frequency of exposure
 - Duration of each exposure



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Immune Response: Cellular Immunity


- Responsible for
 - Organ transplant rejections
 - Killing of tumor or virus-infected cells
 - Hypersensitivity reactions
- Main-line defense against invaders



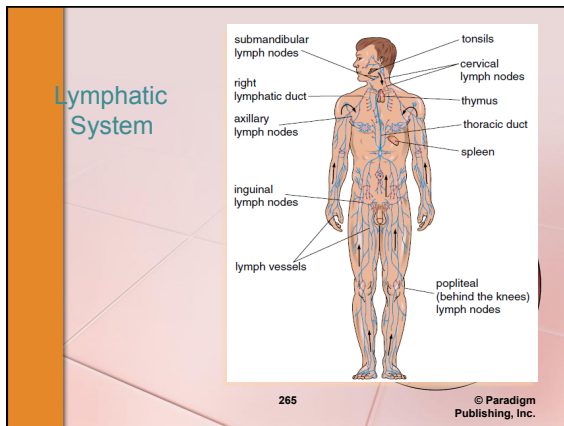
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Lymphatic System

- Key part of immune system
- Includes
 - Network of capillaries and vessels for collecting and transporting lymph
 - Lymph nodes
 - Lymphoid organs: tonsils, spleen, thymus



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Lymphatic System

- Lymphocytes formed in bone marrow pass to the thymus, maturing to become T cells
 - Recognize and respond to specific antigens
 - Move to peripheral tissues
- Lymphocytes formed from stem cells in bone marrow and do not migrate to the thymus become B cells

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Antirejection Drugs

- Given to patients who undergo a transplant to prevent the body from attacking the transplanted tissue
- Also decreases normal immune response

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Cancer

- Neoplastic disease (cancer): when cells become resistant to normal growth controls and growth patterns are altered
- Structural alteration with loss of normal cell type occurs regardless of cell type
- Uncontrolled reproduction results in nonfunctional cells that may multiply at a faster rate than other normal cells

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Characteristics of Malignancy

- Abnormal, uncontrolled growth that threatens normal body functions and can lead to death
- DNA and RNA synthesis is increased
- Tumors rob other cells of nutrients
- Cells lose their contact inhibition

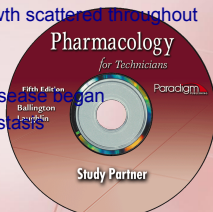
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A seminoma is a cancerous tumor found in the testis

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Types and Sites of Cancer

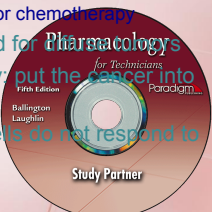
- Types of cancer
 - Solid tumors: a palpable growth
 - Diffuse tumors: a growth scattered throughout the body
- Sites of cancer
 - Primary site: where disease began
 - Secondary Site: metastasis



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Agents for Chemotherapy

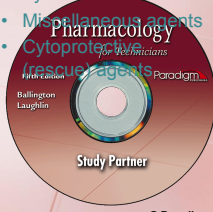
- Surgery is available for solid tumors that are accessible
 - Followed by radiation or chemotherapy
- Chemotherapy is used for diffuse tumors
- Goal of chemotherapy: put the cancer into remission
- Resistance: cancer cells do not respond to chemotherapy



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Agents for Chemotherapy

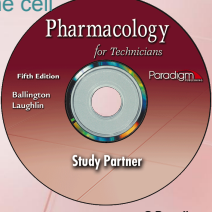
- Alkylating agents
- Antitopoisomerase Inhibitors
- Antibiotics
- Antimetabolites
- Hormones
- Nitrogen mustards
- Plant alkaloids
- Topoisomerase Inhibitors
- Tyrosinase inhibitors
- Miscellaneous agents
- Cytoprotective agents
- Rescue agents



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Alkylating Agents

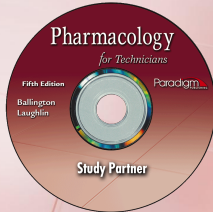
- Prevent cell division by binding cross-links in DNA strands
- Result: death within the cell



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Antibiotics

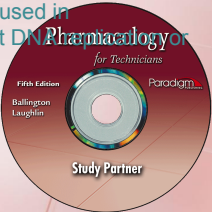
- Inhibit DNA-dependent RNA synthesis or delay or inhibit mitosis



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Antimetabolites

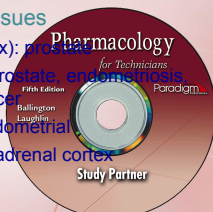
- Inhibit the normal function of a key enzyme and make them nonfunctional
- Most antimetabolites used in chemotherapy prevent DNA synthesis or transcription



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Hormones

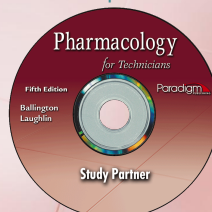
- Act against neoplasms of reproductive issues.
- Some of the target tissues
 - bicalutamide (Casodex): prostate
 - goserelin (Zoladex): prostate, endometrial, metastatic breast cancer
 - megestrol: breast, endometrial
 - mitotane (Lysodren): adrenal cortex



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Nitrogen Mustards

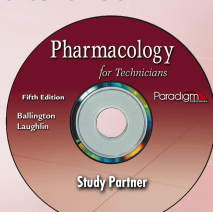
- Bind irreversible cross-links in cellular DNA
- Result: DNA and RNA cannot reproduce



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Plant Alkaloids


- Inhibit formation of spindle fibers, arresting the metaphase stage of cell division



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Topoisomerase I Inhibitors


- Lead to DNA damage when cells replicate
- Target tissues
 - irinotecan (Camptosar): colorectal cancer
 - topotecan (Hycamtin): ovarian cancer



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Tyrosine Inhibiting Agents

- Block tyrosine kinase activity, thus inhibiting cell growth and multiplication
- Seem as effective as other chemotherapy agents with fewer and less severe side effects



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Miscellaneous Agents

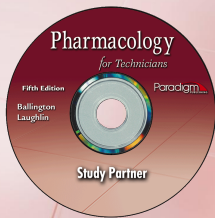
- A number of anticancer drugs do not fit into the previous categories
- They have different mechanisms of action and destroy malignant cells in a variety of ways



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Biologic-Response Modifiers

- Alter the host immune response to promote destruction of human malignancies



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Three Biologic-Response Modifiers

- Interferon inhibits viral replication
- Interleukin-2 secreted by T cells to activate lymphocytes and enhance ability to lyse broad variety of tumor cells
- Tumor-necrosis factor secreted by macrophages in response to endotoxin, causing lysis of susceptible tumor cells

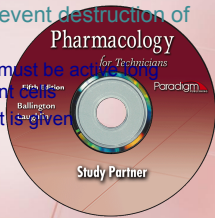


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Cytoprotective (Rescue) Agents

- Reduce side effects and toxicity of chemotherapy
- Timing is critical to prevent destruction of healthy cells
 - Chemotherapy agent must be active enough to kill malignant cells
 - Then the rescue agent is given



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Complications of Cancer and Chemotherapy: Pain

- Many times pain is not adequately controlled
- Weakens the patient's appetite, reduces sleep, and increases fear
- Little need to worry about addiction to pain medications

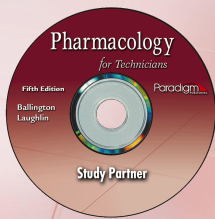


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Complications: Nausea and Vomiting

- Primary side effects of chemotherapy
- Drugs to control emesis discussed in Chapter 10

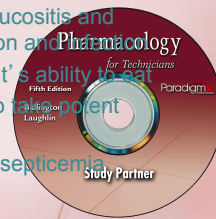


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Oral Complications

- Commonly occur due to toxicity and tissue injury of anticancer drugs and radiation
- Most common are mucositis and concomitant ulceration
- Can affect the patient's ability to eat
- Patients may need to take potent analgesics
- May increase risk of septicemia



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Discussion

What should the Technician do with this prescription?

Mix lidocaine, diphenhydramine, and Maalox in equal parts.

R MT. HOPE MEDICAL PARK
ST. PAUL, MN (651) 555-3591

DEA# _____

Pt. name John Green Date 8-7-15

Address _____

Pink Magic PRN
four-hundred-eighty (480) mL

____ Dispense as written _____

____ Fills _____ times (no refill unless indicated)

J. Beate _____ M.D.

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Breast Cancer

- Hormonal therapies are used to prevent recurrence of breast cancer
- Tumor growth is stimulated by estrogen
- These drugs cause hot flashes, mood swings, and weight gain



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Assignments

- Complete Chapter Review activities
- Answer questions in Study Notes document
- Study Partner
 - Quiz in review mode
 - Matching activities
 - Drug tables



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