Spring 2015

Instructor's Guide to Concepts of Biology, Chapters 12-21

Molly Smith
South Georgia State College, molly.smith@sgsc.edu

Sara Selby
South Georgia State College, sara.selby@sgsc.edu

compiled by Molly Smith, PhD

Instructor's Guide to *Concepts of Biology*

chapters 12-21

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Foreward

Creation of this guide, to accompany the OpenStax College textbook *Concepts of Biology*, was supported by a Textbook Transformation Grant from Affordable Learning Georgia. I would like to thank Lauren Fancher and Jeff Gallant for their intrepid leadership throughout the ALG Initiative. Also, thanks go to Nicole Finkbeiner from OpenStax College for her support during the textbook adoption process. Finally, I wish to thank the administration of South Georgia State College for the instructional opportunities that provided the impetus for this project.

This guide would have never come to fruition without the expertise in editing, formatting and researching of my best friend Sara Selby; if not for her, this would still be a text file on my desktop. It has been intellectually invigorating for both of us to bounce ideas back and forth. I would also like to express my sincere thanks to Sara and her brother, Robert Selby, for their spectacular photography of the flora and fauna of the Okefenokee Swamp, and to Sara for producing the closed captioned “Virtual Tour of the Okefenokee Swamp” that is included in the appendices.

The promotion of low- to no-cost course materials for students is a cause that has become near and dear to our hearts. Study after study has shown that students are choosing not to buy textbooks because of the prohibitive cost, and, as a consequence, their grades suffer. Sara and I have seen this situation firsthand throughout our combined 50+ years of teaching. By creating this ‘ancillary,’ it is our hope that more instructors will explore the use of Open Educational Resources, such as *Concepts of Biology*, for their courses.

Molly Smith
Waycross, Georgia
May 2015

How to Use this Guide

This Instructor's Guide contains the brief outlines of Chapters 12-21 as found in *Concepts of Biology*, though some underwent revision. Also, instructors will find detailed outlines of the text for use in lecturing, as well as structured outlines that may be used by students to take notes while reading the chapter or during lecture. All outlines are derived from the OpenStax text. Additionally, study guides that contain a variety of questions are provided for students.

The appendices contain Web resources where additional information can be found about the topics covered in the text; these Web resources may or may not be open resources, and copyright information is included in the appendix, but it is incumbent upon the instructor to ensure fair use. Teaching Tips are included to promote active learning and student engagement. A sample calendar is provided to illustrate the structure of the course. A link to Sara Selby's "Virtual Tour of the Okefenokee Swamp," which is licensed through Creative Commons, is included, or, if the iBooks version of this guide is used, the tour itself is included.

All photographs in this guide are by Sara Selby, and all graphics are provided by PresenterMedia.com.

12

Diversity of Life

Chapter 12 Outline

Introduction

12.1 Organizing Life on Earth

A. Levels of Classification

B. Classification and Phylogeny

C. Limitations of Phylogenetic Trees

12.2 Determining Evolutionary Relationships

A. Two Measures of Similarity

1. Misleading Appearances

2. Molecular Comparisons

B. Building Phylogenetic Trees

1. Shared Characteristics

2. Choosing the Right Relationships

Chapter 12 Instructor's Outline

Introduction

Bee and *Echinacea* flower look very different, yet are related.

12.1 Organizing Life on Earth

All life evolved from common ancestor

Biologists construct 'tree of life' to show relationships between different organisms and how organisms evolved.

Phylogeny – evolutionary history and relationships among species or groups of species

Systematics – the study of organisms with the purpose of deriving their relationships

A. Levels of Classification

Taxonomy – the science of classification

Three domains – Bacteria, Archaea, Eukarya

Additional levels of classification of Eukarya:
Kingdom, Phylum (Division), Class, Order, Family, Genus, Species

Species can be further divided into:
subspecies, strains, varieties, breeds, races, etc.

Taxon – a group at each level of classification with a common ancestor

Binomial nomenclature – the system of naming all organisms

Scientific name of each organism is its Genus and species – Homo sapiens

B. Classification and Phylogeny

Phylogenetic tree – reflects evolutionary relationships

Branch point – a point in a phylogenetic tree where a single lineage evolved into distinct new ones

Rooted tree – describes a phylogenetic tree that has a single ancestral taxon at the base; all organisms descend from that taxon

Sister taxa – two lineages from the same branch point; they share a common ancestor, but did not evolve from one another

Humans and chimpanzees had common ancestor that lived about 6 million years ago (mya)

C. Limitations of Phylogenetic Trees

1. Closely related organisms may look very different from each other and visa versa.
   - Lizards are reptiles and salamanders are amphibians

2. Branches do not indicate length of time, only order of evolution

3. When new branches form, the other line continues to evolve

4. Groups that evolve under similar conditions may look similar to each other, but are not related

12.2 Determining Evolutionary Relationships

A. Two Measures of Similarity

Organisms that share physical features and genetic sequences are more closely related.
- Physical features (morphology)

Homologous structures – have the same embryological origin, but different functions; they share an evolutionary path that led to the development of the trait
- Genetic sequences (rRNA)

1. Misleading Appearances

a. Humans and chimps – 99% gene similarity, but very different anatomies

b. Unrelated organisms may look alike due to common adaptations to similar environmental conditions

Analogous structures – have different embryological origins, but have the same function

Ex. Fish and whales (mammals) have fins
Bats and insects have wings

2. Molecular Comparisons

Molecular systematics – describes the use of information on the molecular level

a. amino acid sequences – of proteins

b. nucleotide sequences – of a gene

c. gene sequences – arrangement of genes along chromosomes

B. Building Phylogenetic Trees

Cladistics – method used to construct phylogenetic trees; sorts organisms into clades

Clade (monophyletic group) – group of organisms that are closely related to each other and the ancestor from which they descended; have one evolutionary relationship

Fig. 12.2 shows clades

1. Shared Characteristics

Three assumptions

a. Living organisms are related due to descent from common ancestor.

b. One species splits into two (never more) species at one point in time.

c. Traits change over time to a different state.
Ex. Older ancestral state is non-amniotic egg
Newer state of same characteristic is amniotic egg

Shared ancestral character – characteristic found in all members of a group; no change in trait during descent of each member of clade

Shared derived character – trait changes at some point during descent

2. Choosing the Right Relationships

Use of computers to develop trees – computers now can use data (morphological and molecular) and develop a phylogenetic tree where all of the clades share the same derived characters

The ‘best’ tree has the ‘simplest’ evolutionary pathway (maximum parsimony)

Maximum parsimony – the simplest pathway

New technologies have found that humans are more closely related to fungi than plants are.

Chapter 12 Student's Outline

Introduction

12.1 Organizing Life on Earth

All life evolved from common ancestor

Biologists construct 'tree of life' to show relationships

Phylogeny –

Systematics –

A. Levels of Classification

Taxonomy –

Three domains –

Additional levels of classification –

Further divisions of species -

Taxon –

Binomial nomenclature –

Scientific name –

B. Classification and Phylogeny

Phylogenetic tree –

Branch point –

Rooted tree –

Sister taxa –

Humans and chimpanzees had common ancestor that lived about 6 million years ago (mya)

C. Limitations of Phylogenetic Trees

1.

2.

3.

4.

12.2 Determining Evolutionary Relationships

A. Two Measures of Similarity

- Physical features (morphology)

  Homologous structures –

- Genetic sequences (rRNA)

1. Misleading Appearances

a. Humans and chimps –

b. Unrelated organisms may look alike –

Analogous structures -

2. Molecular Comparisons

Molecular systematics

a. amino acid sequences

b. nucleotide sequences

c. gene sequences

B. Building Phylogenetic Trees

Cladistics –

Clade (monophyletic group) –

Fig. 12.2 shows clades

1. Shared Characteristics

Three assumptions

a.

b.

c

Shared ancestral character –

Shared derived character –

2. Choosing the Right Relationships

Use of computers to develop trees –

Maximum parsimony –

New technologies have found that humans are more closely related to fungi than plants are.

Chapter 12 Study Guide

Be able to list, define, describe or discuss the following:

12.1 Organizing Life on Earth

1. Why do biologists construct ‘a tree of life’?
2. Define the following: phylogeny, systematics, taxonomy
3. List the 3 domains into which all organisms are placed.
4. List the levels of organization of all living things – domain, kingdom, phylum (division), etc.
5. What is a taxon?
6. What is binomial nomenclature?
7. What is a phylogenetic tree? What is a branch point? What are sister taxa?
8. What is a ‘rooted’ phylogenetic tree?

12.2 Determining Evolutionary Relationships

9. What are two ways that scientist measure similarity between organisms?
10. When scientists are making molecular comparisons between organisms, what are the three ‘sequences’ that are often compared?
11. What is cladistics? What is a clade?
12. Differentiate and give examples of analogous vs. homologous structures.
13. Latest sequencing data has shown that humans are more closely related to _____ than plants are.

13

Diversity of Microbes, Fungi and Protists

Chapter 13 Outline

Introduction

13.1 Prokaryotic Diversity

A. Prokaryotic Diversity

1. Early Life on Earth

B. Biofilms

C. Characteristics of Prokaryotes

D. The Prokaryotic Cell

1. The Cell Wall

E. Reproduction

1. How Prokaryotes Obtain Energy and Carbon

F. Bacterial Diseases in Humans

G. Historical Perspective

H. The Antibiotic Crisis

I. Foodborne Diseases

J. Beneficial Prokaryotes

K. Prokaryotes, and Food and Beverages

L. Using Prokaryotes to Clean Up Our Planet: Bioremediation

1. Prokaryotes In and On the Body

13.2 Eukaryotic Origins

A. Endosymbiosis

1. Mitochondria

2. Chloroplasts

13.3 Protists

A. Characteristics of Protists

1. Protist Structure

B. How Protists Obtain Energy

C. Reproduction

D. Protist Diversity

E. Human Pathogens

1. Plasmodium Species

2. Trypanosomes

F. Plant Parasites

G. Beneficial Protists

1. Protists as Food Sources

2. Agents of Decomposition

13.4 Fungi

A. Cell Structure and Function

1. Growth and Reproduction

2. How Fungi Obtain Nutrition

B. Fungal Diversity

C. Pathogenic Fungi

D. Plant Parasites and Pathogens

E. Animal and Human Parasites and Pathogens

F. Beneficial Fungi

1. Importance to Ecosystems

2. Importance to Humans

Chapter 13 Instructor's Outline

Introduction

Organisms were grouped into 5 kingdoms – Animal, Plant, Fungi, Protista, Bacteria

Carl Woese, based on rRNA, proposed 3 Domains
Bacteria – Prokaryotic
Archaea – Prokaryotic
Eukarya – Eukaryotic

13.1 Prokaryotic Diversity

Prokaryotes are ubiquitous

Millions live on/in us, more than we have body cells

First forms of life on Earth

A. Prokaryotic Diversity

2 groups of prokaryotic cells that are very different from each other
- Bacteria
- Archaea

1. Early Life on Earth

Earth is @ 4.5 billion years old

(work done by Clare Patterson in 1956 using evidence from the dating of meteorite material and since backed up by other evidence)

First 2 billion years – atmosphere anoxic; only anaerobes could survive

When Earth was 1 billion years old phototrophs appeared and used carbon from organic sources

1 billion years later cyanobacteria appeared – carbon source was CO_2; began the oxygenation of the atmosphere

Other conditions on primitive Earth – strong radiation and volcanic activity

Earliest forms of life were microbial mats @ 3.5 bya

They are large sheets of microorganisms (aka biofilms) held together by sub-stances they secrete.

Microbial mats probably got Energy from hydrothermal vents

About 3 bya, photosynthesis evolved; sunlight was the Energy source

Stromatolite – fossilized microbial mats

Extremophiles – prokaryotes that thrive and actually require extreme environ-ments such as:

- Harsh chemical environments
- Dry environments
- High radiation environments

Categories:
a. halophiles – high salt
b. barophiles – high pressures
c. thermophiles – high temperatures
d. cryophiles/psychrophiles – low temperatures

B. Biofilms

Microbial communities that are protected by the polysaccharide matrix that they se-crete

Colonize all types of surfaces and are very hard to destroy

C. Characteristics of Prokaryotes

Characteristics of all cells:
a. plasma membrane
b. cytoplasm
c. genetic material
d. ribosomes

3 main shapes of prokaryotic cells:

- coccus – round
- bacillus – rod
- sprillum – spiral

D. The Prokaryotic Cell

Physical characteristics

a. no membrane around nucleus
b. one circular DNA chromosome within nucleoid
c. cell wall - different in Bacteria vs. Archaea
d. ribosomes - 70S
e. capsule * - attachment; prevents dehydration
f. flagella * - motility
g. pili * - attachment; conjugation
h. plasmid * - small circular piece of DNA
** may not be seen in all prokaryotic cells*

1. The Cell Wall

Made of peptidoglycan (Bacteria)/pseudopeptidoglycan (Archaea)

Two groups based on reaction to Gram stain:
Gram + bacteria have a thick layer of peptidoglycan (up to 30 + layers)
Gram – bacteria have a thin layer of peptidoglycan

E. Reproduction

Binary fission – cell simply splits in two; results in clones that are genetically alike

Other mechanisms of genetic exchange in bacteria
a. transformation – uptake of 'naked' DNA by bacterial cell
b. transduction – transfer of genes using a bacterial virus
c. conjugation – transfer of genes via contact using a conjugation pilus

Any of the above mechanisms can change the characteristics of the cell such as convert a non-pathogen to a pathogen

1. How Prokaryotes Obtain Energy and Carbon

Different categories based on source of Energy and Carbon

Phototroph – energy source = sun
carbon source = CO_2

Chemotroph – energy source = organic compounds
carbon source = organic compounds

F. Bacterial Diseases in Humans

All known pathogens are in Domain Bacteria (none in Archaea)

In mid-1800's people began to note what reduced their chances of getting sick such as:

- staying away from sick people
- improved sanitation
- disposing of corpses and personal belongings of sick people

1880's – Louis Pasteur came up with the Germ Theory of Disease

G. Historical Perspective

Several pandemics have been documented throughout history

Many were zoonosis – caught from animals

Infectious diseases remain leading cause of death worldwide

- antibiotics have dropped mortality rates
- antibiotic resistance is major concern now

Sanitation and clean drinking water have helped more than antibiotics to prevent high mortality rates due to infectious disease

a. 430 BC – plague of Athens killed ¼ of the population in four years; may have been typhoid fever

b. 541 - 750 AD – plague of Justinian decreased the population of Europe by ½ during the outbreak; was the bubonic plague

c. 1346 -1361 – Black Death (bubonic plague) reduced the population of the world from 450 million to 350-375 million; transmitted by fleas (vector) that live on black rats (reservoir).

d. mid 1600's – Bubonic plague raged through London

e. 1854 – Cholera outbreak in London led to science of Epidemiology

Europeans brought diseases to 'New World' that almost killed off whole populations of Native Americans due to the fact that they had no resistance to these 'new' diseases like smallpox

Measles adversely affected the population of the Hawaiian Islands (brought in by Europeans – Captain Cook's expedition in 1778)

H. The Antibiotic Crisis

Antibiotic – 'against life' – substance made by one microorganism that kills or inhibits another microorganism

'Superbugs' are evolving resistance to everything

Resistance due to 3 main causes
a. overuse of antibiotics
b. incorrect use of antibiotics
c. excessive use in all livestock

MRSA – methicillin-resistant *Staphylococcus aureus*
a common nosocomial infection
average age of person affected = 68 years

CA-MRSA – community-associated MRSA
average age of person affected = 23 years

Researchers are working in developing new antibiotics, but it is a slow process

I. Foodborne Diseases

Food poisoning can be due to

a. a contaminating organism
- *Salmonella*
- *Shigella*

b. a toxin produced by an organism (food intoxication)
- Staphylococcal food poisoning
- botulism

CDC data – 76 million sickened; 300,000 are hospitalized; 5,000 die annually

Most cases today are linked to food contaminated with animal feces
- raw spinach – *E. coli* O157:H7
- vegetable sprouts
- peanut butter
- eggs

Foreign countries continue to use animal and human wastes

J. Beneficial Prokaryotes

Life on Earth could not exist without prokaryotic cells

They occupy an important 'niche' in the 'Web of Life'

K. Prokaryotes, and Food and Beverages

Biotechnology – "any technological application that uses biological systems, living organisms or derivatives thereof, to make or modify products or processes for specific use"

Ex. – cheese, yogurt, sour cream, vinegar, cured meats, sauerkraut, fish sauce

L. Using Prokaryotes to Clean Up Our Planet: Bioremediation

Bioremediation – using microorganisms to clean up toxins in environment

Microorganisms have been used to clean up
- pesticides/fertilizers
- toxic metals
- oil spills

1. Prokaryotes In and On the Body

There are anywhere from 10 to 100X as many prokaryotic cells in/on us as we have body cells

Most are commensals – bacteria benefit; we are neither helped nor harmed (bacteria on our skin)

Commensals can help us out by
a. covering attachment sites that could be used by pathogens
b. busing nutrients that could by used by pathogens
c. making chemicals that are toxic to pathogens

Some are mutualists – both benefit such as the bacteria in our gut that make Vitamin K (we get Vitamin K and they get nutrients, etc.)

13.2 Eukaryotic Origins

First cells were prokaryotic and appeared 3.5 bya. Some were photosynthetic.
Anaerobic respiration was gradually replaced by aerobic respiration.
Oxygen was made by photosynthesis. Aerobic prokaryotes developed into eukaryotes.

A. Endosymbiosis

Symbiosis is living together

Endosymbiont Theory

Proposed in 1960's by Lynn Margulis.

States that one prokaryotic cell engulfed another. Both benefitted from the merger so they stayed together and became one cell.

Evidence
a. Many eukaryotic genes and the way in which these genes are replicated and expressed is more like Archaea
b. Metabolic organelles and genes related to photosynthesis and cell respiration are more like those seen in Bacteria

1. Mitochondria

'Powerhouse of the cell' – site of cellular respiration

May have been a free-living aerobic prokaryotic cell which was engulfed by an anaerobic cell

Evidence
a. have an inner and outer membrane (inner one like bacteria)
b. replicate like bacteria
c. have their own circular piece of DNA like bacteria
d. have 70S ribosomes like bacteria

All cells have mitochondria; only a subset of eukaryotic cells has chloroplasts

2. Chloroplasts

Plastids store things such as starch, fats, proteins and pigments

Site of photosynthesis

May have been a free-living photosynthetic cyanobacterium

Evidence
a. have inner and outer membrane
b. have a circular genome like photosynthetic cyanobacteria
c. replicate like bacteria

13.3 Protists

Organisms unlike those in Animal, Plant or Fungi kingdoms

Can be single-celled or multicellular

Live in aquatic and terrestrial environments. Most common single-celled eukaryotes in pond water

Some Protists are genetically closer to animals or fungi than to other Protists; the kingdom continues to be reclassified

A. Characteristics of Protists

Over 100,000 described species. Actual number unknown since many live in symbiotic relationships

Characteristics:
- most aquatic (fresh and salt water, damp soil, snow)
- some species are parasites
- some species are saprophytes

1. Protists Structure

a. microscopic; unicellular
b. some live as colonies (groups)
c. some made up of large multinucleate cells
d. size – from less than 1 μm to 3 feet (giant kelp)

Four different groups based on means of locomotion:
1. flagella – Flagellates
2. cilia – Ciliates
3. pseudopods – Amoeba
4. non-motile – Sporozoans

B. How Protists Obtain Energy

Photosynthetic – have chloroplasts

Heterotrophic – consume organic material (other organisms)
a. phagocytosis – ‘cell eating’; engulf and digest material
b. saprophytic – live on dead organisms and absorb organic molecules

C. Reproduction

1. binary fission – asexual; cell splits in two

2. multiple fission – asexual; cell splits into multiple cells

3. budding – asexual; one cell separates from larger cell

4. meiosis – sexual; seen in times of environmental stress. Allows new combinations of genes which may result in a survival advantage

The formation of cysts, seen in many species, also allows organisms to survive a harsh environment

D. Protist Diversity

Diversity is due to convergent evolution – the similar morphology between protists is due to similar selective pressures and not a common ancestor

Eukaryotic organisms now divided into six ‘Supergroups’ and each one contains protists

E. Human Pathogens

Some Protists are pathogenic parasites of humans

1. Plasmodium Species

Causes malaria – *P. falciparum*

Pathology – organisms multiply in liver cells then infect RBCs eventually causing them to rupture; organism remains in liver cells causing relapses involving fever and delirium

In 2010 and estimated 500,000 - 1,000,000 deaths occurred, mostly African children

Vector – *Anopheles* mosquito
Prevention – mosquito control
Treatment – quinine, chloroquine

2. Trypanosomes

Cause African Sleeping Sickness and Chagas disease

a. African sleeping sickness – *T. brucei*

Pathology – damages nervous system and causes death; with each cycle of replication organism gains a new glycoprotein coat making it hard for the immune system to clear the organism

Vector – tsetse fly

b. Chagas disease – *T. cruzi*

Pathology – causes digestive problems and heart arrhythmias; 10,000 deaths in 2008

Vector – kissing bug

F. Plant Parasites

1. Downy mildew – in grape plants

2. Potato blight – Irish potato famine in 1800's lead to the deaths of 1 million and another million emigrated

G. Beneficial Protists

1. Protists as Food Sources

a. Plankton – food source for marine animals

b. Photosynthetic Protista make glucose for other organisms
¼ of the world's photosynthesis is carried out by aquatic protists
Primary producers in aquatic environments

c. Symbiotic relationships

i. Photosynthetic dinoflagellates and coral polyps

Dinoflagellate provides energy for coral polyps and the coral provides protection and nutrients

ii. Protist (and bacteria) living in gut of termites

Bacteria, in cells of protist, makes enzymes that digests cellulose

2. Agents of Decomposition

Saprophytic Protista live on dead organic matter (or their own wastes) and absorb nutrients, thereby helping to cycle elements by returning nutrients to the soil and water

13.4 Fungi

100,000 species identified; probably 1,000,000 or more exist

Fungus – Latin for mushroom (ex. mushrooms, yeast, black bread mold, *Penicillium*)

Suffix '-mycota' indicates fungus

Eukaryotic

DNA shows Fungi more closely related to Animals than to Plants (were thought to be plants since they did not move)

Heterotrophic – saprophytic

Decomposers – cycle elements

Part of symbiotic relationships – lichens and mycorrhiza

Some are pathogens of plants (Dutch elm disease) and animals (ringworm)

Many useful products from this kingdom

- baked goods (bread rises due to gases made by yeast fermenting)
- alcohol
- fermentation products (vinegar)
- antibiotics
- enzymes

A. Cell Structure and Function

Eukaryotic

Cell characteristics
- true nucleus
- mitochondria
- endoplasmic reticulum
- Golgi apparatus
- no chloroplasts (some have plastids with other pigments that may be toxic - *Amanita*)
- rigid cell wall of chitin and glucan
- plasma membranes have ergosterol
- most are non-motile

1. Growth and Reproduction

Unicellular – Yeast

Most are multicellular

Multicellular have two morphological stages
- vegetative – characterized by tangle of hyphae
- reproductive – more conspicuous

Hyphae – similar to roots of plants; they reach into whatever fungus is growing on

Mycelium – mass of hyphae

Reproduction
- sexual - meiosis
- asexual - mitosis

Reproductive structures produce and release spores

Largest organism on Earth – 'honey mushroom' in Oregon; it covers 2,000 acres (1,600 football fields) and is 2,400 years old

2. How Fungi Obtain Nutrition

Heterotrophic – obtain nutrition from another organism

Saprophytic – live on dead organic matter

Decomposers – return elements trapped in living organisms back to environment

Some fungi can be used in bioremediation to clean up oil and heavy metals

B. Fungal Diversity

Five traditional divisions:

1. Chytridomycota – chytrids
2. Zygomycota – black bread mold
3. Ascomycota – sac fungi
4. Basidiomycota – mushroom
5. Deuteromycota – yeast

C. Pathogenic Fungi

Cause diseases in plants and animals

Parasites and pathogens

D. Plant Parasites and Pathogens

Ergot – disease of cereal crops (rye, wheat) caused by *Claviceps purpurea* which produces lysergic acid, a precursor of LSD

Aflatoxins – toxic and carcinogenic compounds produced by *Aspergillus* mold growing on peanuts

Smuts and rusts on corn and other plants

Mildews

E. Animal and Human Parasites and Pathogens

Mechanism of damage

- directly attack tissue
- produce toxins that are ingested

Can cause allergic reactions in some people – ‘sick building syndrome’

Types of infections:

Cutaneous mycoses – of skin, hair and nails (dermatophytes)
ex. ringworm, athlete’s foot and jock itch

Systemic infections – due to inhaling spores
ex. coccidioidomycosis (Valley fever), histoplasmosis

Opportunistic infections – seen in immunocompromised patients (AIDS)

Superinfections – following antibiotic treatment (yeast infections)

F. Beneficial Fungi

Occupy important niche in ecosystems

Thrive in hostile environments

1. Importance to Ecosystems

a. Decomposers – cycle elements such as carbon, nitrogen and phosphorus

b. Fungal enzymes – breakdown cellulose and lignan

c. Symbiotic relationships
- mycorrhiza – fungi living on the roots of plants
- lichens – fungus and an algae (found on rocks and tree trunks)

2. Importance to Humans

a. cycle nutrients and elements

b. control populations of damaging pests

c. mycorrhizal associations increase productivity of farmland

d. food source – mushrooms (morels, truffles, shitake)
blue cheese, bread rises

e. fermentation products – alcohol, vinegar

f. other products – antibiotics, cyclosporine

Chapter 13 Student's Outline

Introduction

Organisms were grouped into 5 kingdoms

Carl Woese, based on rRNA proposed 3 Domains

13.1 Prokaryotic Diversity

Prokaryotes are ubiquitous

Millions live on/in us

A. Prokaryotic Diversity

2 groups of prokaryotic cells:

•

•

1. Early Life on Earth

Earth is @ 4.5 billion years old –

First 2 billion – atmosphere anoxic

When Earth was 1 billion year old phototrophs appeared –

1 billion years later cyanobacteria appeared –

Other conditions on primitive Earth –

Earliest forms of life were microbial mats

Stromatolite –

Extremophiles –

Categories:

a.

b.

c.

d.

B. Biofilms

Microbial communities –

Colonize all types of surfaces and are extremely hard to destroy

C. Characteristics of Prokaryotes

Characteristics of all cells:

a.

b.

c.

d.

Main Shapes:

a.

b.

c.

D. The Prokaryotic Cell

Physical characteristics:

a.

b.

c.

d.

e.

f.

g.

h.

1. The Cell Wall

Made of peptidoglycan (Bacteria)/pseudopeptidoglycan (Archaea)

Two groups based on reaction to Gram stain:

Gram + cells –

Gram – cells –

E. Reproduction

Binary fission –

Other mechanisms of genetic exchange

a. transformation –

b. transduction –

c. conjugation –

1. How Prokaryotes Obtain Energy and Carbon

Different categories based on source of Energy and Carbon

Phototroph –

Chemotroph –

F. Bacterial Diseases in Humans

All known pathogens are in Domain Bacteria

In mid-1800's people began to note what reduced their chances of getting sick

-
-
-

1880's – Louis Pasteur came up with the Germ Theory of Disease

G. Historical Perspective

Several pandemics have been documented throughout history

Many were zoonosis –

Antibiotics have dropped mortality rates, but infectious diseases remain leading cause of death worldwide.

Antibiotic resistance is major concern now

a. 430 BC – plague of Athens

b. 541 - 750 AD – Plague of Justinian

c. 1346 -1361 – Black Death

d. mid-1600s – Bubonic plague struck London

e. 1854 – outbreak of cholera in London

Europeans brought diseases to ‘New World’ which almost killed off whole populations

H. The Antibiotic Crisis

Antibiotic –

‘Superbugs’ are evolving

Due to 3 main causes

a.

b.

c.

MRSA –

CA-MRSA –

Researchers are working to develop new antibiotics, but it is a slow process

I. Foodborne Diseases

Food poisoning can be due to

a. a contaminating organism

1.

2.

b. a toxin produced by an organism (food intoxication)

1.

2.

CDC data –

Most cases today are linked to food contaminated with animal feces

-
-
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J. Beneficial Prokaryotes

Life on Earth could not exist without prokaryotic cells

They occupy an important ‘niche’ in the ‘Web of Life’

K. Prokaryotes, and Food and Beverages

Biotechnology –

Examples

L. Using Prokaryotes to Clean Up Our Planet: Bioremediation

Bioremediation –

Microorganisms have been used to clean up

-
-
-

1. Prokaryotes In and On the Body

Numbers –

Commensals –

Benefits:

a.

b.

c.

Mutualists –

13.2 Eukaryotic Origins

First cells –

A. Endosymbiosis

Endosymbiosis –

Endosymbiont Theory

Proposed by –

States that –

Evidence:

a

b.

1. Mitochondria

Function –

Evidence:

a.

b.

c.

d.

All cells have mitochondria

2. Chloroplasts

Functions of plastids –

Function of chloroplasts –

Evidence:

a.

b.

c.

13.3 Protists

Organisms unlike those in Animal, Plant or Fungi kingdoms

Live in aquatic and terrestrial environments

Can be single-celled or multicellular

Some Protists are genetically closer to animals or fungi than to other Protists; the kingdom continues to be reclassified

A. Characteristics of Protists

Over 100,000 described species:

- most aquatic
- parasites
- saprophytes

1. Protist Structure

a. microscopic; unicellular

b. some live as colonies (groups)

c. some made up of large multinucleate cells

d. size –

Four different groups based on means of locomotion:

1. flagella –

2. cilia –

3. pseudopods –

4. non-motile –

B. How Protists Obtain Energy

Photosynthetic –

Heterotrophic –

a. phagocytosis –

b. saprophytic –

C. Reproduction

1. binary fission –

2. multiple fission –

3. budding –

4. meiosis –

Some species form cysts –

D. Protist Diversity

Convergent evolution -

Eukaryotic organisms now divided into six ‘Supergroups’

E. Human Pathogens

Some Protists are pathogenic parasites of humans

1. Plasmodium Species

Causes malaria

Pathology –

Vector –

Prevention –

Treatment –

2. Trypanosomes

Cause African Sleeping Sickness and Chagas disease

a. African sleeping sickness

Pathology –

Vector –

b. Chagas disease

Pathology –

Vector –

F. Plant Parasites

1. Downy mildew –

2. Potato blight –

G. Beneficial Protists

1. Protists as Food Sources

a. Plankton –

b. Photosynthetic Protists –

c. Symbiotic relationships

1. Photosynthetic dinoflagellates and coral polyps

2. Protist (and bacteria) living in gut of termites

2. Agents of Decomposition

Saprophytic Protists

13.4 Fungi

100,000 species identified

Fungus – Latin for mushroom

Suffix ‘-mycota’ indicates fungus

Eukaryotic

DNA shows Fungi more closely related to Animals than to Plants

Heterotrophic – saprophytic

Decomposers

Part of symbiotic relationships

Some are pathogens

Many useful products from this kingdom:

-
-
-
-
-

A. Cell Structure and Function

Eukaryotic

Cell characteristics

-
-
-
-
-
-
-

1. Growth and Reproduction

Unicellular – Yeast

Most are multicellular

Multicellular have two morphological stages

- vegetative –
- reproductive

Hyphae –

Mycelium –

Reproduction

- sexual
- asexual

Reproductive structures produce and release spores

Largest organism on Earth – ‘honey mushroom’ in Oregon

2. How Fungi Obtain Nutrition

Heterotrophic –

Saprophytic –

Decomposers –

Used in bioremediation –

B. Fungal Diversity

Five traditional divisions:

1. Chytridomycota –

2. Zygomycota –

3. Ascomycota –

4. Basidiomycota –

5. Deuteromycota –

C. Pathogenic Fungi

Cause diseases in plants and animals

Parasites and pathogens

D. Plant Parasites and Pathogens

Ergot –

Aflatoxins –

Smuts and rusts –

Mildews

E. Animal and Human Parasites and Pathogens

Mechanism of damage

- directly attack tissue
- produce toxins that are ingested

May cause allergic reactions in some people

Types of infections

Cutaneous mycoses –

Systemic infections –

Opportunistic infections –

Superinfections –

F. Beneficial Fungi

Occupy important niche in ecosystems

Thrive in hostile environments

1. Importance to Ecosystems

a. Decomposers –

b. Fungal enzymes –

c. Symbiotic relationships –

- mycorrhiza –
- lichens –

2. Importance to Humans

a.

b.

c.

d.

e.

f.

Chapter 13 Study Guide

Be able to list, define, describe or discuss the following:

13.1 Prokaryotic Diversity

1. Which of the three domains include prokaryotic organisms?
2. What does it mean to say that prokaryotes are ‘ubiquitous’?
3. Approximately how old is the Earth?
4. For about the first 2 billion years, how would you describe the atmosphere of the Earth?
5. What process evolved that changed the atmosphere of early Earth and lead to its oxygenation?
6. What are other hypothesized (since no one was there!) conditions found on primitive Earth?
7. What are microbial mats? What is a stromatolite?
8. What are ‘extremophiles’? Give several of specific types.
9. What are biofilms? Why are they important medically?
10. What are 4 characteristics of all cells?
11. What are 8 characteristics of prokaryotic cells?
12. Describe the cell wall of bacteria.
13. What is binary fission? What is the result?
14. What are the 3 mechanisms that are used by bacteria to exchange genetic material?
15. Differentiate between a phototroph and a chemotroph with regards to their source of energy and carbon.
16. What is a pandemic? What is a zoonosis?
17. What are several causes of reduced mortality rates seen since the mid to late 1880s and into the early 1900s?
18. What are some of the great ‘plagues’ that have occurred throughout history?
19. What are ‘superbugs’? What are three causes of their development?
20. What is MRSA and CA-MRSA?
21. What is a ‘food intoxication’? What are the two examples that we discussed?
22. What are several types of food which have been linked to cases of food poisoning?
23. What are several products that result from the activities of prokaryotes?
24. What is bioremediation?
25. What are some ways in which the prokaryotic cells that live in us and on us benefit us?

13.2 Eukaryotic Origins

1. What is the Endosymbiotic Theory?
2. What are several lines of evidence that suggest mitochondria may have been free-living prokaryotic cells?

3. What are several lines of evidence that suggest chloroplast may have been free-living prokaryotic cells?

13.3 Protists

1. Describe the structure of a typical protist.
2. What are the more animal-like protists called? What are the more plant-like protists called. What features separate them into these groups?
3. List the 4 phyla of protozoans based on means of locomotion.
4. How do protists obtain energy?
5. What are several methods of reproduction seen in protists?
6. Give two examples of pathogenic protists and the diseases they cause in humans.
7. What are two examples of diseases in plants caused by members of this group of organisms?
8. What is the role of protists as a food source?
9. Why are some protists called saprophytes?

13.4 Fungi

1. Describe the structure of a typical fungus, paying particular attention to features that make them unique.
2. How to fungi grow and reproduce?
3. Differentiate between a hypha and mycelium.
4. Hyphae are analogous to what in a plant?
5. What is the largest organism on Earth?
6. How do fungi obtain nutrition?
7. What are the 4 divisions of fungi and on what basis are they separated into these groups?
8. List several examples of parasitic and pathogenic fungi (for both plants and animals).
9. Why are fungi an invaluable member of all ecosystems?
10. List several reasons fungi are important to us?
11. Give several examples of fungi.

14

Diversity of Plants

Chapter 14 Outline

Introduction

14.1 The Plant Kingdom

A. Plant Adaptations to Life on Land

1. Alternation of Generations

2. Sporangia in the Seedless Plants

3. Gametangia in the Seedless Plants

4. Apical Meristems

B. Additional Land Plant Adaptations

C. The Major Divisions of Land Plants

14.2 Seedless Plants

A. Non-vascular - Bryophytes

1. Liverworts

2. Hornworts

3. Mosses

B. Vascular Plants

1. Characteristics

a. Vascular Tissue: Xylem and Phloem

b. Roots: Support for the Plant

c. Leaves, Sporophylls, and Strobili

2. Seedless Vascular Plants

a. Club Mosses

b. Horsetails

c. Ferns and Whisk Ferns

14.3 Seed Plants: Gymnosperms

A. The Evolution of Seed Plants

B. Gymnosperms

1. The Life Cycle of a Conifer

C. Diversity of Gymnosperms

1. Conifers

2. Cycads

3. Gingkophytes

4. Gnetophytes

14.4 Seed Plants: Angiosperms

A. Flowers

B. Fruit

C. The Life Cycle of an Angiosperm

D. Diversity of Angiosperms

1. Basal Angiosperms

2. Monocots

3. Eudicots

Chapter 14 Instructor's Outline

Introduction

14.1 The Plant Kingdom

Characteristics
- Number of species – 300,000 catalogued species; 260,000 make seeds
- Most are photosynthesizers
- Reproduction – most use sexual reproduction
- Cell walls – contain cellulose (insoluble fiber)
- Indeterminate growth – continue to grow body mass until death

A. Plant Adaptations to Life on Land

Challenges of living on land
- Dessication – drying out
- Structural support
- Way for male gametes to reach female gametes
- Gametes and zygotes protected from dessication

Advantages of life on land
- Abundant sunlight
- CO_2 more readily available
- No predators at first; then to avoid this, spines, thorns and toxins evolved

Adaptations to life on land
- Had to live close to water source
- Developed drought tolerance (mosses)
- Colonized areas with high humidity and low chance of drought (ferns)
- Developed drought resistance (cacti)

Four major adaptations that lead to diversity and predominance of plants

1. Alternation of Generations

   Between haploid (N) gametophyte and diploid (2N) sporophyte stage

   Haplontic plant – haploid stage is dominant

   Diplontic plant – diploid stage is dominant

   Most plants are haplodiplontic – alteration of generations; both sporophyte and gametophyte are multicellular

2. Sporangia in the Seedless Plants

Sporophyte is diploid stage – results when two gametes (N) fuse (syngamy)

Sporophyte has sporangia – a reproductive sac that contains the spores (N)

Within sporangia – sporocytes (2N) undergo meiosis and produce spores (N)

Two types of spores produced in all seed plants (heterosporous)
a. microspores – male
b. megaspores – female

Seedless plants are homosporous – one type of spore

No matter which form is dominant, embryo is protected

3. Gametangia in the Seedless Plants

Gametangia – structures on gametophytes of seedless plants which produce gametes by mitosis

Male gametangia – antheridium produces and releases sperm

Female gametangia – archegonia houses embryo

4. Apical Meristems

Apical meristem – tissue at the end of shoot tips and root tips where cell division takes place allowing plant to grow up toward sunlight and down into thesoil for water and minerals

Lateral meristem – allows plant to grow in diameter

B. Additional Land Plant Adaptations

- Shoots allow growth upward toward sunlight
- Rigid molecules in stems (later trunks)
- Vascular tissue – xylem and phloem
- Root system to anchor larger plants
- Cuticle to prevent water loss (covers stems and leaves)
- Stomata to allow exchange of gasses (CO_2 in and O_2 out)
- Noxious molecules and toxins to deter predation
- Molecules (nectar) to lure animals to help with pollination and seed dispersal

C. The Major Divisions of Land Plants

Two major groups based on presence or absence of vascular tissue

Non-vascular plants – lack vascular tissue and seeds
Ex.: bryophytes (liverworts, mosses, and hornworts)

Vascular plants – have vascular tissue

Seedless
1. lycophytes – club mosses
2. pterophytes – ferns, horsetails, whisk ferns

Seeded
1. gymnosperms – conifers
2. angiosperms – flowering plants

14.2 Seedless Plants

300 mya seedless plants dominated landscape
Grew in swampy forests
Remnants formed coal we mine today

A. Non-vascular Plants – Bryophytes

Grouping of non-vascular plants that includes the liverworts, hornworts and mosses
Relatives of early terrestrial plants
First bryophytes may have appeared 490 mya
18,000 species, most in moist environments; some in deserts; some in tundra

Dominant stage – gametophyte (haploid – N)

1. Liverworts

6,000 species
Gametophyte looks like lobes of liver
Most closely related to first land plants

2. Hornworts

100 species
Named for sporophyte form – a pipe-like structure that emerges from gameto-phyte

3. Mosses

12,000 species
Found from tundra to rain forests
Very sensitive to air pollution; used to monitor air quality

B. Vascular Plants

275, species – 90% of Earth's vegetation; includes the club mosses, horsetails, ferns, whisk ferns and seed plants (Section 14.3)

Most dominant and conspicuous group of land plants

1. Characteristics

- Vascular Tissue: Xylem and Phloem

a. Xylem – conducts water and minerals up the plant; found in center
b. Phloem – transports sugars, proteins and other solutes throughout plant; found around xylem

- Roots: Support for the Plant

a. transfers water and minerals from soil to plant
b. stabilizes trees in soil; acts as anchor

mycorrhizae – symbiotic relationship between the roots of some plants and a fungus; increases surface area for absorption

- Leaves, Sporophylls, and Strobili

Leaves – increase area for sunlight capture
Sporophylls – leaves modified to have sporangia
Strobili – contain the sporangia (cones in the conifers)

2. Seedless Vascular Plants

Thrived 350-300 mya

a. Club Mosses

Small evergreen plants with stem and small leaves called microphylls

b. Horsetails

Found in – damp environments and marshes
'jointed plants' – leaves and branches come out as whorls evenly spaced on the stem
photosynthesis occurs in stems

c. Ferns and Whisk Ferns

Ferns – most advanced and recognizable of the seedless vascular plants;
large fronds
12,000 species
Live from tropics to temperate forests
Found in moist and shady areas

Whisk ferns – no roots or leaves; photosynthesis takes place in stem
DNA analysis shows a close relationship to ferns

14.3 Seed Plants: Gymnosperms

A. The Evolution of Seed Plants

Dominate stage – sporophyte stage (diploid – 2N)
Heterosporous – have microspores and megaspores
Adaptations to drought – pollen and seeds

B. Gymnosperms – 'naked seed'

1. The Life Cycle of a Conifer

Pine tree – male and female sporophylls on same plant
Heterosporous – male and female gametes
Male cones – microspores produced from meiosis
Female cones – two ovules per scale
One megasporocyte undergoes meiosis; one haploid (N) cell survives
Fertilization – union of two haploid cells (male and female) produces zygote;
Embryo develops within seed coat
Occurs up to two years after pollination

C. Diversity of Gymnosperms

Four phyla (divisions); 1,000 species

1. Conifers – Dominate phylum (division) – most variety of species

    a. leaves – scale-like or needle-like
    b. environment – predominate in high altitudes and cold climates
    c. examples – pines, spruces, firs, cedars, sequoias, yews
    d. wood – soft wood

2. Cycads

    a. environment – mild climates; often mistaken for palms
    b. cones – large cones; pollinated by beetles
    c. number of species –@ 100 species left and are protected

3. Gingkophytes

    a. single surviving species – *Ginkgo biloba*
    b. leaves – fan-shaped leaves; turn yellow in fall
    c. cultivated by Buddhist monks
    d. resistant to pollution
    e. male and female plants – female seeds smell like rancid butter

4. Gnetophytes

    a. closest relative to modern angiosperms
    b. leaves – broad leaves
    c. example – *Ephedra sp*. is source of decongestant ephedrine (similar in structure and effect to amphetamine)

14.4 Seed Plants: Angiosperms

Reproductive success due to flowers and fruit

Flowers – used to disperse, in cooperation with animals, pollen which contains the male microspore (sperm) to female part of plant

Fruit – ripened ovary; protects embryo and disperses seed

A. Flowers

Modified leaves around a central stalk

Sepals – modified leaves below petals; photosynthetic

Calyx – whorl of sepals

Petals – colorful; attract pollinators

Corolla – whorl of petals

Carpel – female reproductive structure

Stigma – sticky top of style
Style – tube leading to ovary
Ovary – contains ovules; site of fertilization

Stamen – male reproductive structure

Filament – stalk bearing anther
Anther – produces pollen grains with microspore (sperm)

B. Fruit

Ripened ovary
All fruits have seeds
Fleshy fruits – peach, apple, grape
Dry fruits – rice, wheat, nuts

C. The Life Cycle of an Angiosperm (figures in text)

Alteration of generations – Sporophyte (visible) stage alternates with gametophyte

Heterosporous – male and female gametes

a. microspores (male) – develop into pollen grains

Two cells:

a. generative cell that will divide into two sperm cells
b. cell that will become pollen tube cell

b. megaspores (female) – develops into ovule

Three cells within embryo sac:
a. egg and two more cells at one end
b. cell with 2N nucleus in the center
c. three cells at other end

Double fertilization – two sperm cells unite with two cells within egg sac

Steps:

a. Pollen grain lands on stigma of flower
b. Pollen tube cell forms tube that grows through style; two sperm follow
c. Pollen tube reaches embryo sac
d. One sperm fuses with egg to form zygote
e. Second sperm fuses with diploid cell in center of embryo sac forming 3N cell that will become the endosperm

Endosperm – food for the developing embryo

D. Diversity of Angiosperms

1. Basal Angiosperms

Have traits found in Monocots and Eudicots

Represented by a grouping called Magnoliidae:
a. magnolia trees
b. laurel trees
c. water lilies
d. pepper family

2. Monocots

a. cotyledon – single seed leaf
b. venation – parallel
c. symmetry of flower parts – 3 - 6
d. tissue – no woody tissue
e. vascular tissue – no pattern to vascular tissue
f. examples – corn, lilies

3. Eudicots

a. cotyledons – two seed leaves
b. venation – pinnate or palmate
c. symmetry of flower parts – 4 - 5
d. tissue – herbaceous or woody
e. vascular tissue – vascular tissue in rings
f. examples – roses, azaleas

Chapter 14 Student's Outline

Introduction

14.1 The Plant Kingdom

Characteristics

- Number of species –
- Most are photosynthesizers
- Reproduction –
- Cell walls –
- Indeterminate growth

A. Plant Adaptations to Life on Land

Challenges of living on land

-
-
-
-

Advantages of life on land

-
-
-

Adaptations to life on land

-
-
-
-

Four major adaptations that lead to diversity and predominance of plants

1. Alternation of Generations

Between haploid (N) gametophyte and diploid (2N) sporophyte stage

Haplontic plant –

Diplontic plant –

Most plants are haplodiplontic –

2. Sporangia in the Seedless Plants

Sporophyte is diploid –

Sporophyte has sporangia –

Within sporangia –

Two types of spores produced in all seed plants (heterosporous)

a. microspores –
b. megaspores –

Seedless plants are homosporous

No matter which form is dominant, embryo is protected

3. Gametangia in the Seedless Plants

Gametangia –

Male gametangia –

Female gametangia –

4. Apical Meristems

Apical meristem –

Lateral meristem –

B. Additional Land Plant Adaptations

-
-
-
-
-
-

C. The Major Divisions of Land Plants

Two major groups based on presence or absence of vascular tissue

Non-vascular plants –

Examples:

Vascular plants –

Seedless

1.
2.

Seeded

1.

2.

14.2 Seedless Plants

300 mya seedless plants dominated landscape

A. Non-vascular plants – Bryophytes

Grouping of non-vascular plants

Dominant stage –

1. Liverworts

   6,000 species
   gametophyte looks like lobes of liver
   Most closely related to first land plants

2. Hornworts

   100 species
   Named for sporophyte form -

3. Mosses

   12,000 species
   Found from tundra to rain forests
   Very sensitive to air pollution; used to monitor air quality

B. Vascular Plants

275,000 species –

Most dominant and conspicuous group of land plants

1. Characteristics

a. Vascular Tissue: Xylem and Phloem

Xylem –

Phloem –

b. Roots: Support for the Plant

1.

2.

mycorrhizae -

c. Leaves, Sporophylls, and Strobili

Leaves –
Sporophylls –
Strobili –

2. Seedless Vascular Plants

Thrived 350-300 mya

a. Club Mosses

Small evergreen plants with stem and small leaves called microphylls

b. Horsetails

Found in –
'jointed plants' –
photosynthesis occurs in stems

c. Ferns and Whisk Ferns

Ferns –

Whisk ferns –

14.3 Seed Plants: Gymnosperms

A. The Evolution of Seed Plants

Dominate stage –

Heterosporous –

Adaptations to drought –

B. Gymnosperms – 'naked seed'

1. The Life Cycle of a Conifer

Pine tree –

Male cones –

Female cones –

Fertilization -

C. Diversity of Gymnosperms

Four phyla (divisions); 1,000 species

1. Conifers – Dominate phylum (division) -

a. leaves –
b. environment –
c. examples –
d. type of wood –

2. Cycads

a. environment –
b. cones –
c. number of species

3. Gingkophytes

a. single surviving species –
b. leaves –
c. cultivated by Buddhist monks
d. resistant to pollution
e. male and female plants

4. Gnetophytes

a. closest relative to
b. leaves –
c. example –

14.4 Seed Plants: Angiosperms

Reproductive success due to:

Flowers –

Fruit –

A. Flowers

Modified leaves around a central stalk

Sepals –

Calyx –

Petals –

Corolla –

Carpel –

Stigma –
Style –
Ovary –

Stamen –

Filament –
Anther –

B. Fruit

Ripened ovary

All fruits have seeds

Fleshy fruits –

Dry fruits –

C. The Life Cycle of an Angiosperm (figures in text)

Alteration of generations –

Heterosporous –

1. microspores –

    Two cells
        a.
        b.

2. megaspores –

    Three cell within embryo sac
        a.
        b.
        c.

Double fertilization –

Steps:

a.
b.
c.
d.
e.

Endosperm –

D. Diversity of Angiosperms

1. Basal Angiosperms

Have traits from Monocots and Eudicots

Represented by grouping called Magnoliidae:

a.
b.
c.
d.

2. Monocots

a. cotyledon –
b. venation –
c. symmetry of flower parts–
d. tissue –
e. vascular tissue –
f. examples –

3. Eudicots

a. cotyledons –
b. venation –
c. symmetry of flower parts –
d. tissue –
e. vascular tissue –
f. examples –

Chapter 14 Study Guide

Be able to list, define, describe or discuss the following:

14.1 The Plant Kingdom

1. What are four challenges the plants faced when moving onto land?
2. What are three advantages of living on land?
3. What are four adaptations which had to occur in order for plants to move onto land?
4. What four adaptations made plants a diverse and dominant group of organisms at that particular time in the history of the Earth?
5. Differentiate between the following:
    a. haploid vs. diploid
    b. gametophyte vs. sporophyte
    c. haplontic vs. diplontic
    d. homosporous vs. heterosporous
    e. microspore vs. megaspore
    f. antheridium vs. archegonia
6. What are several other adaptations to life on land?
7. What are the two major divisions of land plants?
8. What are the two divisions of vascular plants?
9. Give examples of plants in each of the following groups:
    a. lycophytes
    b. pterophytes
    c. gymnosperms
    d. angiosperms

14.2 Seedless Plants

1. Give examples of each of the three types of Bryophytes.
2. Differentiate between the xylem and phloem.
3. What are several functions of roots? What is a mycorrhizae?
4. Differentiate between leaves, sporophylls, and strobili.
5. What are the three groups of seedless vascular plants?

14.3 Seed Plants: Gymnosperms

1. What are two adaptations to drought that are first seen with the evolution of seed plants?
2. What does the term ‘gymnosperm’ mean?
3. What occurs in fertilization?
4. List the four divisions of gymnosperms, giving examples of each.

14.4 Seed Plants: Angiosperms

1. What two structures evolved that assured the reproductive success of angiosperms?
2. Know all of the parts of a flower (and their functions) and be able to identify them on any diagram.
3. What is a fruit?
4. What occurs in ‘double fertilization’ seen in angiosperms?
5. Differentiate between a monocot and dicot angiosperm.

* For each of the major groups of plants we discussed (seedless/non-vascular; seedless/vascular; gymnosperms and angiosperms), know which phase of their life cycle is dominant.

15

Diversity of Animals

Chapter 15 Outline

Introduction

15.1 Features of the Animal Kingdom

- A. Complex Tissue Structure
- B. Animal Reproduction and Development
  - 1. Sexual Reproduction and Embryonic Development
  - 2. Asexual Reproduction
- C. Classification Features of Animals
  - 1. Body Symmetry
  - 2. Layers of Tissues
  - 3. Presence or Absence of a Coelom
  - 4. Protostomes and Deuterostomes

15.2 Sponges and Cnidarians

- A. Sponges
  - 1. Physiological Processes of Sponges
- B. Cnidarians
  - 1. Physiological Processes of Cnidarians
  - 2. Cnidarian Diversity

15.3 Flatworms, Nematodes, and Arthropods

- A. Flatworms
  - 1. Physiological Processes of Flatworms
  - 2. Diversity of Flatworms

B. Nematodes

1. Physiological Processes of Nematodes

C. Arthropoda

1. Physiological Processes of Arthropods

2. Arthropod Diversity

15.4 Mollusks and Annelids

A. Phylum Mollusca

1. Mollusk Diversity

B. Annelida

1. Physiological Processes of Annelids

2. Annelid Diversity

15.5 Echinoderms and Chordates

A. Echinoderms

1. Physiological Processes of Echinoderms

2. Echinoderm Diversity

B. Chordates

C. Invertebrate Chordates

15.6 Vertebrates

A. Fishes

1. Jawless Fishes

2. Jawed Fishes

3. Bony Fishes

B. Amphibians

    1. Amphibian Diversity

C. Reptiles and Birds

    1. Reptiles

    2. Birds

D. Mammals

    1. Primates

Chapter 15 Instructor's Outline

Introduction

Animal evolution began in ocean 600 mya

1.4 million described species; may be up to 6.8 million

15.1 Features of the Animal Kingdom

a. eukaryotic
b. multicellular with specialized tissue
c. motile
d. require source of food
e. heterotrophic
f. may be carnivores, herbivores, omnivores or parasites
g. most reproduce sexually
h. determined body plan

A. Complex Tissue Structure

Four types of tissue each with a unique function

a. nervous – neurons conduct nerve impulses
b. muscle – aids in movement; smooth, cardiac, skeletal
c. connective – connects one type of tissue to another; bone, cartilage, adipose, blood
d. epithelial – covers external and internal surfaces

B. Animal Reproduction and Development

In most animals somatic cells are diploid (2N) and gametes are haploid (N)

1. Sexual Reproduction and Embryonic Development

Male and female gametes – male gamete (sperm) typically smaller; unites with female gamete (egg/ovum) which is larger

Fertilization – fusion of gamete nuclei to form zygote (2N)

Internal – land animals
External – aquatic animals (and frogs and amphibians)

Development – cells of zygote divide and differentiate

Differentiation – cells move from an unspecialized state to a specialized state due to genes being turned on/off

- Young may look like adult
- Young may undergo metamorphosis
- Young may undergo incomplete metamorphosis

2. Asexual Reproduction

a. budding
b. fragmentation
c. parthenogenesis – unfertilized eggs develop

C. Classification Features of Animals

1. Body Symmetry

a. asymmetrical – no symmetry/plane of symmetry; sponge

b. radial – multiple planes of symmetry when cut from top to bottom; mirror image halves result; sea anemone

c. bilateral – “two sides”; vertical plane cut from front to back results in two mirror image right and left sides; humans

2. Layers of Tissues

Germ layers – specialized groups/layers of tissue in embryo; each layer develops into a specific type of tissue/organ

a. Diploblasts
   Radial symmetry
   Two germ layers
      1. endoderm
      2. ectoderm
b. Triploblasts
   Bilateral symmetry
   Three germ layers
      1. endoderm – gut (digestive system)
      2. mesoderm – muscle, bone
      3. ectoderm – skin, nervous tissue

3. Presence or Absence of a Coelom

Coelom – internal body cavity which originates from mesodermal tissue
Lined with epithelial tissue
Found between digestive system and body wall
Contains kidneys, spleen, circulatory system

a. acoelomates – flatworms
No cavity develops within mesoderm layer
Do have a digestive cavity within endoderm layer

b. eucoelomates – earthworms, snails, insects, vertebrates
A cavity forms within mesoderm layer

c. psuedocoelomates – roundworms
A body cavity forms from mesoderm and endoderm tissue

4. Protostomes and Deuterostomes

Both are eucoelomates
Difference is which opening of digestive tract develops first – mouth or anus – from the blastopore in early embryo

a. Protostomes

1. “mouth first”
2. blastopore develops into mouth at one end of embryo first
3. anus develops at other end of embryo

b. Deuterostomes

1. “mouth second”
2. blastopore develops into anus at one end of embryo first
3. mouth develops at other end

15.2 Sponges and Cnidarians

95% of animal species are invertebrates (32 phyla)
Sponges and Cnidarians are the simplest animals

A. Sponges (Phylum Porifera)

Characteristics

- Have specialized cells; no true tissue
- All aquatic; most marine
- Sessile (attached to surface) as adults
- Asymmetric body plan – cylinder with large central cavity (spongocoel) with an opening at the top (osculum)
- Filter/suspension feeders – water moves through body and food is filtered out

Structural Features

- Mesohyl – jelly-like substance between the two layers of cells
- Spicules – protein fibers
- Choanocyte – “collar cell”; ingests and packages food in vacuoles
- Amoebocytes – take in vacuoles with nutrients and deliver to other cells

1. Physiological Processes of Sponges

a. Digestion – intracellular within choanocytes; food particles must be smaller than cells

b. Gas exchange, circulation and excretion – simple diffusion between cells and water

c. Reproduction –

1. Asexual

a. fragmentation – piece breaks off
b. budding – outgrowth detaches
c. gemmules – clusters of cells

2. Sexual

Monoecious – hermaphroditic; one organism can produce eggs and sperm

Sponges may be sequentially hermaphroditic:

Eggs produced first in amoebocytes and kept within spongocoel
Sperm are made in choanocytes and exit through osculum to fertilize eggs of other sponges
Larvae are released through osculum

Adults are sessile

B. Cnidarians

99% are marine

Characteristics:

- cnidocytes – “stinging cells”
- nematocysts – organelle within cnidocytes with with a coiled thread and barb
- two body plans:
  a. polyp – sessile as adults; mouth up with tentacles around it; Hydra
  b. medusa – motile; mouth and tentacles hang from a bell-shaped body; jelly-fish

Organisms may exhibit one form or another; sometimes both forms

1. Physiological Processes of Cnidarians

a. two tissue layers
   1. epidermis
   2. gastrodermis
b. mesoglea (jelly-like substance) between layers
c. differentiated cells in each layer
   1. nerve cells
   2. enzyme-secreting cells
   3. nutrient absorbing cells
d. no organs or organ systems
e. nerve cells in nerve net
f. extracellular digestion
g. food taken into gastrovascular cavity and enzymes are secreted into cavity
h. gastrovascular cavity has one opening which serves as mouth and anus

2. Cnidarian Diversity

a. Anthozoa – sea anemones, corals; sessile polyp

b. Scyphozoa – jellies; motile; marine; medusa is dominant stage in life cycle; tentacles surround mouth

c. Cubozoa – “box jellyfish”; tentacles are arranged differently than in Scyphozoa; polyp and medusa forms

d. Hydrozoa – Portuguese Man O’ War; both polyp and medusa forms seen as a colony

15.3 Flatworms, Nematodes, and Arthropods

Triploblastic – ectoderm, mesoderm, endoderm
Bilaterally symmetrical – mirror images of left and right sides
Cephalization – nervous tissue and sensory organs in head

A. Flatworms – Phylum Platyhelminthes

Characteristics

- acoelomate
- bilaterally symmetrical
- layers – epidermal, muscle, digestive system
- most parasites

1. Physiological Processes of Flatworms

a. free-living or parasitic
b. incomplete digestive system
c. ‘mouth’ also expels wastes; some species have anus
d. extracellular digestion – enzymes secreted into digestive tract and digested material taken into same cells via phagocytosis
Cestodes do not have digestive system; absorb nutrients across body wall
e. excretory system – network of tubules open to environment; nearby flame cell cilia direct wastes out of body
f. nervous system – pair of nerve cords running length of body
g. at head end – concentration of nerve, photosensory and chemosensory cells
h. nutrient exchange – simple diffusion
i. monoecieous – hermaphroditic; have both sets of sex organs
j. internal fertilization
k. asexual reproduction (fragmentation) seen in some groups

2. Diversity of Flatworms

a. Turbellaria – Planaria; regenerates from small fragments

b. Monogenea – external parasites of fish

c. Trematoda – flukes; primary host is snail; larvae penetrate host skin while in water

d. Cestoda – tapeworms

Types – beef, pork and fish tapeworms

Structural features

scolex – head
proglottids – sections behind head

Gravid proglottids are full of eggs; break off and exit host

Fertilized eggs are eaten by intermediate host and worms infect muscle tissue; intermediate host is eaten by primary host

B. Nematodes – Phylum Nematoda – roundworms

More than half of 28,000 species are parasites
Pseudocoelomates with complete digestive system; have mouth and anus
External cuticle (exoskeleton) of chitin that is shed and replaced
Within mouth – sharp barb that can protrude and pierce cells
Mouth leads to muscular pharynx and intestine
Ex.: *Ascaris*

1. Physiological Processes of Nematodes

a. nitrogenous wastes removed by diffusion
b. four nerve cords run length of body – top, bottom and sides
c. nerve cords fuse in ring around pharynx to form ganglion or ‘brain’
d. longitudinal muscles – results in side to side motion
e. may be monoecious, dioecious or show parthenogenesis

C. Arthropoda – “jointed legs”

85% of known species of animals; largest group within phylum – Insects
Principle characteristics – functional segmentation of body; jointed appendages
Exoskeleton of chitin
True coelomates
Protostomes – mouth develops first

1. Physiological Processes of Arthropods

a. functional body segments
    1. head, thorax, abdomen
    2. cephalothorax and abdomen
    3. head and trunk
b. open circulatory system – blood bathes internal organs
c. hemocoel – blood cavity
d. two-chambered heart
e. respiratory systems vary
    1. Insects have tracheae that open through spiricles
    2. Crustaceans have gills
    3. Arachnids have book lungs which are internal stacks of air pockets

2. Arthropod Diversity

a. Trilobitomorpha (trilobites)
- extinct group
- 17,000 species identified from fossils

b. Hexapoda (insects and relatives)
- three pairs of jointed legs
- head, thorax and abdomen
- wings and legs on thorax

c. Myriapoda (millipedes, centipedes and relatives)
- all terrestrial; live in humid environments
- 10 – 750 legs

d. Crustacea (crabs, lobsters, crayfish, isopods, barnacles and zooplankton)
- some terrestrial – pill bugs (roly poly)
- cephalothorax – head and thorax fused
- exoskeleton infused with calcium carbonate making it strong
- open circulatory system – blood pumped into hemocoel
- mostly separate sexes
- most are carnivorous

e. Chelicerata (horseshoe crabs, arachnids, scorpions, daddy longlegs)

- mainly terrestrial
- two part body; no distinct head
- chelicerae – first pair of appendages which are specialized mouthparts
  1. used for feeding
  2. inject venom in spiders
- open circulatory system
- heart pumps blood into hemocoel
- respiration
  1. gills (aquatic)
  2. tracheae or book lungs (terrestrial)

15.4 Mollusks and Annelids

Mollusks – mostly marine; squid, octopus, clams, snails
Annelids – earthworms and leeches

A. Phylum Mollusca – “soft-body”

23% of all marine species; 75,000 species
Bilateral symmetry
Open circulatory system (exceptions: octopus and squid)
Body plan:
- ventral muscular foot – locomotion and anchorage
- visceral mass with internal organs
- dorsal mantle – may or may not secrete shell

Radula – scraping structure at mouth; teeth of chitin

1. Mollusk Diversity

a. Bivalves – “two shells”; clams, oysters, mussels, scallops

- pair of shells that are hinged
- filter feeders; no radula
- gas exchange – pair of gills
- excretion and osmoregulation – pair of nephridia
- oysters and mussels deposit nacre (mother of pearl) around foreign particles that enter mantle cavity

b. Gastropods – “stomach foot”; snails, slugs, conchs
- asymmetrical; usually have coiled shell
- foot used for crawling
- radula scrapes food from surface
- have pairs of gills and nephridia

c. Cephalopods – “head foot”; octopus and squid

- color used for camouflage; can adjust color
- predators; beak-like jaws
- well-developed nervous system
- complex eyes
- closed circulatory system
- foot – has developed into tentacles with suckers
- locomotion – jet propulsion
- separate sexes

B. Annelida

“Annellus” – small ring
Segmented worms; marine and terrestrial
Bilateral symmetry
Segmented body plan – metamerism – the same internal and external features are seen in each segment

1. Physiological Processes of Annelids

- skin protected by cuticle
- chaetae – chitin extensions seen in each segment
- two layers of muscle – longitudinal and circular
- true coelom with organs
- complete digestive system – mouth, pharynx, esophagus, crop
- closed circulatory system – dorsal and ventral blood vessel
- muscular pumping hearts
- excretion – pairs of metanephridia
- well-developed nervous system – two ventral nerve cords
- reproduction:
  1. monoecious – earthworms and leeches
  2. dioecious - polychaetes

2. Annelid Diversity

a. Polychaeta

- chaetae within parapodia on each segment

b. Clitellata

1. Oligochaeta – earthworms

Clitellum – structure in skin which secretes mucous that binds mating individuals and forms a protective place for eggs

2. Hirudinoidea – leeches

No chaetae
Suckers at anterior and posterior ends
Need a host – obligate symbionts

15.5 Echinoderms and Chordates

Deuterostomes – mouth develops second (after anus develops from blastopore at one end)

A. Echinoderms – “spiny skin”

Ex.: sea stars, sand dollars, sea urchin, sea cucumber
All marine
Pentaradial symmetry – five arms
Endoskeleton made of ossicles
True coelom
Water vascular system – a type of circulatory system
Regeneration

1. Physiological Processes of Echinoderms

- Water vascular system
  Used for:
  a. gas exchange
  b. nutrient circulation
  c. locomotion

Parts:
a. central ring canal
b. radial canals
c. madreporite – on top of body; adjusts amount of water in the water vascular system
d. tube feet – stick through openings in endoskeleton; expand or contract due to hydrostatic pressure

- Nervous system
  Parts:
  a. nerve ring
  b. five radial nerves
  c. no central nervous system
- Reproduction
  a. sexual – separate sexes; external fertilization
  b. asexual - regeneration

2. Echinoderm Diversity

a. Asteroidea – sea stars

- organs penetrate into arms
- tube feet grasp prey
- two stomachs – one can evert through mouth and pre-digest prey

b. Ophiuroidea – brittle stars

- no organs in long, thin arms

c. Echinoidea – sea urchins, sand dollars

- no arms; flat

d. Crinloidea – sea lilies

e. Holothuroidea – sea cucumbers

- tube-like shape
- tube feet modified into tentacles

B. Chordates

Most species within phylum are in subphylum Vertebrata – 60,000 species

All have the following features

- Notochord – flexible rod-shaped structure between digestive tube and nerve cord
  Present during embryonic development in vertebrates: after birth it is replaced by vertebral column

- Dorsal hollow nerve cord – above notochord; develops into brain and spinal cord

- Pharyngeal slits – in aquatic environments, they allow the exit of water that enters mouth during feeding; in some organisms, they filter food from water
  In fish – become gill supports
  In tetrapods – become components of tonsils and ears

- Post-anal tail – made of skeleton and muscle
  In fish – aids in locomotion
  In terrestrial vertebrates – may function in balance, locomotion, courting, and communication
  In many species – present in embryo, but not in adult

C. Invertebrate Chordates

1. Tunicates – sea squirts
   - Larvae show all four characteristics
   - Adults only have pharyngeal slits

2. Lancelets
   - Adults show all four characteristics

15.6 Vertebrates

62,000 species; only a fraction of the vertebrates that have inhabited the Earth (dinosaurs)

A. Fishes

31,000 species

1. Jawless Fishes

   a. Hagfishes – eel-like scavengers; feed on dead organisms

      Enter the bodies of dead or dying organisms and eat them from the inside
      Are not Vertebrates since notochord is not replaced by vertebral column; skeleton and notochord of cartilage

   b. Lampreys – similar to hagfishes in size and shape

      As adults – have notochord, incomplete vertebrae and brain case
      Some are parasitic; have a toothed, sucking mouth
      Attach to fish and suck body fluids
      Larvae – take 3 -15 years before sexual maturity reached
      Adults reproduce and die within days

2. Jawed Fishes

   Gnathostomes – “jaw mouths”

   a. Cartilaginous fishes – Chondricthyes

- sharks, rays, skates
- skeleton of cartilage

- sharks:

  carnivorous
  teeth are modifies scales
  well-developed sense organs:
    a. ampullae of Lorenzini – detects electromagnetic fields
    b. lateral line – detects movement and vibration
  internal fertilization; different methods seen:
    a. eggs hatch in uterus and young are born alive
    b. eggs exit body and hatch; embryos are protected by egg case (mermaid’s purse)
    c. young develop within body and are born alive

- rays and skates have flat bodies

b. Bony Fishes - Osteichthyes

- 30,000 species
- skeleton of bone
- skin has scales covered with mucous
- lateral line detects movement
- some use eyesight to detect prey
- have taste cells in head/truck; can detect minute concentrations molecules in water
- have swim bladders – controls buoyancy (gas-filled)

B. Amphibians

Salamanders, frogs, caecilians
Vertebrate tetrapods
Cutaneous respiration – moist permeable skin
Adults are carnivorous – some extend sticky tongue to catch prey

1. Amphibian Diversity

a. salamanders and newts

- resemble lizards

b. frogs and toads

- life cycle – two stages; larva (tadpole) and adult
- metamorphosis – change from larval stage to adult
- jump
- skin – used for camouflage; may contain poisonous glands
- external fertilization
- four limbs
- large jaws
- short gut of predator
- air-breathing lungs
- eardrum

c. caecilians

- no limbs
- burrow into soil
- look like large eathworms

C. Reptiles and Birds

Amniotes – shelled eggs
Embryo protected by amniotic membrane
For terrestrial lifestyle, the inside of the egg is wet
Shells retain water, but allow gas exchange
Some shells hard (birds) and some shells are soft (reptiles)
Mammals do not have shelled eggs; embryo within amnion

1. Reptiles

- lay shelled eggs
- scaly, waxy skin that prevents water loss
- use lungs for respiration; can't use skin
- excrete Nitrogen as uric acid paste
- ectotherms – body heat from environment
- four groups:

1. Crocodilia – "small lizard"
   - crocodiles
   - alligators
   - caimans

2. Squamata – "scaly"
   - lizards – have limbs and eyelids; chameleons, gecko, Komodo dragon
   - snakes - carnivorous

3. Testudines – "having shell"
   - turtles – in sea; lay eggs on land
   - tortoises – on land

4. Sphenodontia – "wedge tooth"; one living genus

2. Birds

Data suggests that birds belong within the Reptile clade

- endothermic
- feathers are modifies scales
  two types: contour and down
- pneumatic bones
- fused skeleton and cranium
- one ovary
- no teeth

D. Mammals

Hair and mammary glands

Hair – insulating, sensory and protective coloration

Glands in skin – three types
- sebaceous – sebum
- sudoriferous – sweat, scent
- mammary – mammary

Heterodont – different types and shapes of teeth; incisors, canines, pre-molars, molars; two sets of teeth

Three broad groups:

1. Monotremes
   - platypus
   - leathery eggs retained within reproductive tract
   - one opening for urine, feces, baby

2. Marsupials
   - opossum
   - kangaroo, koala, Tasmanian devil
   - pouch for young after birth

3. Eutherian
   - anteaters
   - rodents
   - bats
   - whales
   - carnivores

1. Primates are a class of carnivorous mammals

Features :

a. Hands and feet adapted for brachiation
   1. rotating shoulder
   2. big toe separated from others
   3. thumb separated from fingers
   4. stereoscopic vision – overlapping visual fields

b. larger brains
c. nails (not claws)
d. typically one offspring per preganancy
e. walk upright

2. Two Primate groups

- Prosimians – lemurs, tarsiers
- Anthropoids – apes, humans

Chapter 15 Student's Outline

Introduction

15.1 Features of the Animal Kingdom

a.
b.
c.
d.
e.
f.
g.
h.

A. Complex Tissue Structure

Four types of tissue

a.
b.
c.
d.

B. Animal Reproduction and Development

1. Sexual Reproduction and Embryonic Development

Male and female gametes –

Fertilization –

Internal –
External –

Development –

Differentiation –

•
•
•

2. Asexual Reproduction

a.
b.
c.

C. Classification Features of Animals

1. Body Symmetry

a. asymmetrical

b. radial

c. bilateral

2. Layers of Tissues

Germ layers

a. Diploblasts
Radial symmetry
Two germ layers
1.
2.

b. Triploblasts
Bilateral symmetry
Three germ layers
1.
2.
3.

3. Presence or Absence of a Coelom

Coelom

a. acoelomates

b. eucoelomates

c. psuedocoelomates

4. Protostomes and Deuterostomes

a. Protostomes

1.
2.
3.

b. Deuterostomes

1.
2.
3.

15.2 Sponges and Cnidarians

A. Sponges (Phylum Porifera)

Characteristics

-
-
-
-
-

Structural Features

- Mesohyl –
- Spicules –
- Choanocytes –
- Amoebocytes –

1. Physiological Processes of Sponges

a. Digestion –

b. Gas exchange and excretion –

c. Reproduction –

1. Asexual

a. fragmentation –
b. budding –
c. gemmules –

2. Sexual

Monoecious –

Sponges may be sequentially hermaphroditic:

-
-
-

B. Cnidarians

Characteristics:

- cnidocytes
- nematocysts
- two body plans:

    a. polyp –

    b. medusa –

1. Physiological Processes of Cnidarians

    a. two tissue layers

        1.

        2.

    b. mesoglea

    c. differentiated cells in each layer

        1.

        2.

        3.

    d.

    e.

    f.

    g.

    h.

2. Cnidarian Diversity

a. Anthozoa –

b. Scyphozoa –

c. Cubozoa –

d. Hydrozoa –

15.3 Flatworms, Nematodes, and Arthropods

Triploblastic –

Bilaterally symmetrical –

Cephalization –

A. Flatworms – Phylum Platyhelminthes

Characteristics

-
-
-
-

1. Physiological Processes of Flatworms

a.

b.

c.

d.

e.

f.

g.

h.

i.

j.

k.

2. Diversity of Flatworms

a. Turbellaria –

b. Monogenea –

c. Trematoda –

d. Cestoda –

Types –

Structural features

scolex –

proglottids –

B. Nematodes – Phylum Nematoda

Most species parasitic

Pseudocoelomates

Exoskeleton –

Muscular pharynx –

1. Physiological Processes of Nematodes

a.

b.

c.

d.

e.

C. Arthropoda – “jointed legs”

Largest group within phylum - Insects

Functional segmentation

Exoskeleton –

True coelomates

Protostomes –

1. Physiological Processes of Arthropods

a.

1.

2.

3.

b.

c.

d.

e.

    1.

    2.

    3.

2. Arthropod Diversity

    a. Trilobitomorpha (trilobites)

        •

        •

    b. Hexapoda (insects and relatives)

        •

        •

        •

    c. Myriapoda (millipedes, centipedes and relatives)

        •

        •

d. Crustacea (crabs, lobsters, crayfish, isopods, barnacles and zooplankton)

-
-
-
-
-
-

e. Chelicerata (horseshoe crabs, arachnids, scorpions, daddy longlegs)

-
-
-
-
-
    1.
    2.
-
-
-
    1.
    2.

15.4 Mollusks and Annelids

Mollusks –

Annelids –

A. Phylum Mollusca – “soft-body”

Species –

Symmetry –

Circulatory system –

Body plan:

-

-

-

Radula –

1. Mollusk Diversity

a. Bivalves – “two shells”

-

-

-

-

-

b. Gastropods – “stomach foot”

-
-
-
-

c. Cephalopods – “head foot”

-
-
-
-
-
-
-
-
-
-

B. Annelida

“Annellus” –

Segmentation –

Symmetry –

Metamerism –

1. Physiological Processes of Annelids

-
-
-
-
-
-
-
-
-
-
    1.
    2.

2. Annelid Diversity

    a. Polychaeta

    -

    b. Clitellata

        1. Oligochaeta – earthworms

            Clitellum –

2. Hirudinoidea - leeches

-
-
-

15.5 Echinoderms and Chordates

Deuterostomes –

A. Echinoderms – “spiny skin”

Examples:

All marine

Pentaradial symmetry –

Endoskeleton –

True coelom

Water vascular system

Regeneration

1. Physiological Processes of Echinoderms

- Water vascular system

Used for

a.

b.

c.

Parts

a.

b.

c.

d.

- Nervous system

Parts

a.

b.

c.

- Reproduction

a. asexual –

b. sexual –

2. Echinoderm Diversity

a. Asteroidea – sea stars

-

-

-

b. Ophiuroidea – brittle stars

-

c. Echinoidea – sea urchins, sand dollars

-

d. Crinloidea – sea lilies

e. Holothuroidea – sea cucumbers

-

-

B. Chordates

Most species within phylum are in subphylum Vertebrata – 60,000 species

All have the following features

-

-

-

-

C. Invertebrate Chordates

1. Tunicates – sea squirts

-

-

2. Lancelets

•

15.6 Vertebrates

62,000 species; only a fraction of what has inhabited Earth

A. Fishes

1. Jawless Fishes

a. hagfishes

b. lampreys

2. Jawed Fishes

Gnathostomes – “jaw mouths”

a. Cartilaginous fishes – Chondricthyes

- sharks, rays, skates
- skeleton of cartilage
-

- sharks:

  carnivorous

  teeth –

  well-developed sense organs:

    1.

    2.

  internal fertilization:

    1.

    2.

    3.

- rays

b. Bony Fishes - Osteichthyes

-

-

-

-

-

-

-

B. Amphibians

Salamanders, frogs, caecilians

Vertebrate tetrapods –

Cutaneous respiration –

Adults are carnivorous

1. Amphibian Diversity

a. salamanders and newts

b. frogs and toads

c. caecilians

-
-
-

C. Reptiles and Birds

Amniotes –

Embryo protected –

Inside of egg is wet

Shells may be soft or hard

Mammals do not have shelled eggs

1. Reptiles

-
-
-
-
-

- four groups:

1. Crocodilia – “small lizard”

-
-
-

2. Squamata – “scaly”

-
-

3. Testudines – “having shell”

-
-

2. Birds

Recent data suggests that birds belong with the Reptile clade

-
-
-
-
-

D. Mammals

Hair and mammary glands

Hair –

Glands

- sebaceous –
- sudoriferous –
- mammary –

Heterodont –

Three groups:

1. Monotremes:
    -
    -
    -
2. Marsupials:
    -
    -
    -
3. Eutherian
    - anteaters
    - rodents
    - bats
    - whales
    - carnivores

1.) Primates are a class of mammals

Features

a. Hands and feet adapted for brachiation

1.

2.

3.

4.

b.

c.

d.

e.

2.) Two Primate groups:

- Prosimians –
- Anthropoids –

Chapter 15 Study Guide

Be able to list, define, describe or discuss the following:

15.1 Features of the Animal Kingdom

1. List characteristics that describe the animal kingdom. (The text mentions about 8)
2. What are the four types of tissue found in all animals?
3. Define fertilization. What results from the process?
4. What happens during ‘development’?
5. What occurs when cells ‘differentiate’?
6. What are STEM cells?
7. What accounts for cell differentiation?
8. What is metamorphosis?
9. What is asexual reproduction? Name three types.
10. What are the four major features used to classify animals?
11. What are the three types of body symmetry?
12. What is a germ layer?
13. What are the three types of germ layers and give examples of tissues that are derived from each.
14. Differentiate between a diploblast and a triploblast.
15. What is a coelom?
16. What are the three classification groups based on the absence or presence of a coelom and give examples of each.
17. Differentiate between a protostome and a deuterostome.

Chapter 15 Animal Diversity Study Guide

Porifera - sponges

spongocoel
osculum
mesohyl
spicules
choanocyte
amoebocyte
gemmules

adults are sessile

Cnidaria - jellyfish

cnidocytes
nematocysts
polyp and medusa stages
mesoglea - jelly-like layer
tentacles
nerve net

Platyhelminthes - flatworms

Planaria, flukes, tapeworms
flame cells - in excretory system
tapeworms - scolex, proglottids
absorb nutrients from host - no digestive system

Nematoda - roundworms

ex. Ascaris
cuticle (exoskeleton) of chitin which is shed regularly

Arthropoda

'jointed legs'
Insects - largest group in phylum
funtional body segments - head, thorax, abdomen
cephalothorax
hemocoel
open circulatory system

respiratory system - may have: tracheae/spiracles - insects
gills - crustaceans
book lungs - arachnids
exoskeleton of chitin

Insects - 6 legs; head, thorax, abdomen
Millipedes, centipedes - 10 - 750 legs
Crustaceans - cephalothorax; crabs, lobsters crayfish
Chelicerata - 8 legs and 2 part body; spiders, scorpions, horseshoe crab
chelicerae
gills or book lungs

Mollusca

'soft body'
body plan - ventral muscular foot, visceral mass, dorsal mantle (may or may not have shell)
radula
Bivalves - 'two shells' - clams, oysters, scallops
hinged shells
gills
nephridia
nacre

Gastropods - 'stomach foot' - snails, slugs
coiled shell
radula
gills
nephridia

Cephalopod - 'head foot' - octopus, squid
foot developed into tentacles with suckers
jet propulsion
complex eyes
well-developed nervous system

Annelida

'segmented' body - metamerism
earthworms and leeches
chaetae
complete digestive system - mouth, pharynx, esophagus, crop
muscular hearts

metanephridia
clitellum

Echinodermata

'spiny skin'
sea stars, sand dollars, sea urchins, sea cucumber
pentaradial symmetry
endoskeleton of ossicles
water vascular system consisting of: central ring canal
radial canals
madreporite
tube feet
nervous system - 5 radial nerves
regeneration
sea stars can evert 2nd stomach through mouth

Chordata - 4 characteristics:
notochord
dorsal hollow nerve chord
pharyngeal slits
post-anal tail

Invertebrates - tunicates - sea squirts
lancelets

Vertebrates - bony vertebral column

Fishes

Jawless - hagfish - scavengers
lampreys - parasites; larval form for up to 15 yrs.

Jawed - *Chondrichthyes* - sharks, rays, skates
cartilage skeleton
teeth are modified scales
ampullae of Lorenzini
lateral line

Osteichthyes - bony fish
skeleton of bone
lateral line/eyesight to find prey
scales

taste cells
swim bladder

Amphibia

cutaneous respiration
carnivorous - sticky tongue

salamanders and newts

frogs and toads - jump
poisonous skin glands
tadpole/adult
4 limbs
eardrum
air breathing lungs

Reptiles and Birds - amniotes; eggs have protective shell
embryo within amniotic membrane

Reptiles

shelled eggs
scaly skin
lungs for respiration
nitrogen excreted as uric acid paste
ectotherms

Crocodilia - 'small lizard' - crocodiles and alligators

Squamata - 'scaly' - lizards (limbs and eyelids) and snakes

Tetudines - 'having shell' - turtles (sea) and tortoises (land); both lay eggs on land

Birds - reptile clade

endothermic
feathers are modified reptile scales; contour and down
pneumatic bones
fused bones in cranium

1 ovary
no teeth

Mammals

hair and mammary glands
endothermic
skin with glands - sebaceous, sudoriferous, mammary
heterodont

Monotremes - platypus

Marsupials - opposum, kangaroo, kaola
pouch for young

Eutherians - primates - brachiation (shoulder, hands, feet, stereoscopic vision)
larger brain
nails
walk upright
1 offspring/pregnancy

Prosimians

Anthropoids

16

The Body’s Systems

Chapter 16 Outline

Introduction

16.1 Homeostasis and Osmoregulation

- A. Homeostasis
- B. Thermoregulation
- C. Osmoregulation
  - 1. Excretory System

16.2 Digestive System

- A. The Human Digestive System
  - 1. Oral Cavity
  - 2. Esophagus
  - 3. Stomach
  - 4. Small Intestine
  - 5. Large Intestine
  - 6. Accessory Organs
- B. Nutrition

16.3 Circulatory and Respiratory Systems

- A. The Respiratory System
- B. The Circulatory System
- C. The Heart
- D. The Cardiac Cycle
- E. Blood Vessels

16.4 Endocrine System

A. Hormones

B. How Hormones Work

C. Endocrine Glands

D. Regulation of Hormone Production

16.5 Musculoskeletal System

A. Skeletal System

B. Joints and Skeletal Movement

C. Muscles

D. Skeletal Muscle Fiber Structure and Function

16.6 Nervous System

A. Neurons and Glial Cells

B. How Neurons Communicate

C. The Central Nervous System

D. The Brain

E. Spinal Cord

F. The Peripheral Nervous System

Chapter 16 Instructor's Outline

Introduction

All multicellular animals have mechanisms (most have tissues/organs/organ systems) that get nutrients to all cells and remove wastes from body cells.
All activities of cells/tissues are coordinated and responses of the organism to its environment are coordinated

16.1 Homeostasis and Osmoregulation

Homeostasis – maintenance of a stable internal environment
Maintained by negative feedback
Controlled conditions – blood sugar, body temperature, heart rate, blood pressure, pH of blood

A. Homeostasis

Conditions in the body are constantly monitored
Equilibrium is maintained around a 'set point' or within a specific range

Ex. Blood ph = 7.35 – 7.45
Blood glucose = 100 – 120 mg/dl

Stimulus – a change in the external or internal environment

Once a stimulus is detected mechanisms are triggered that bring the condition back into range.

Change is detected by receptor; information is sent to control center (CNS); message from control center causes response from effector

Negative feedback – stimulus is reversed
Positive feedback – stimulus is enhanced

B. Thermoregulation

Ectotherms – no internal control over body temperature; temperature similar to the environment

Endotherms – maintain a constant body temperature
Conserve or lose heat by a variety of mechanisms:
- fur
- fat (insulation)

- feathers
- shivering (hair stands up when cold)
- vasoconstriction (conserve heat)
- vasodilation (lose heat)
- behavior – burrow/dig on hot day; lay in sun on cold day

Body temperature is controlled in hypothalamus within brain

Fever occurs when chemicals called pyrogens reset the hypothalamus

C. Osmoregulation

Maintenance of salt (electrolyte) and water balance; osmotic balance

Body fluids consist of:
- water
- electrolytes – Na^+, Cl^-, K^+, Ca^+
- non-electrolytes – glucose

Types of body fluids:
- blood plasma
- intracellular fluid – inside cells
- intercellular (interstitial) fluid – between cells

Fluids and electrolytes come into body and must be eliminated to maintain osmotic balance

Food and water enter; excess excreted in
- sweat
- urine
- feces

If toxic wastes build up tissue/organism dies
- crushing injuries lead to compartment syndrome

If electrolytes move, water follows

Blood pressure is affected when fluid moves between compartments
- BP increases if water moves into plasma
- BP decreases if water move from plasma

1. Excretory System

One of three systems that remove wastes:
- Lungs – remove CO_2; water
- Skin – remove water and electrolytes through sweat
- Kidneys – remove wastes as urine

Parts:
- Kidneys – remove wastes in the form of urine; adrenal glands on top
- Ureters – tube leading from kidneys to bladder
- Bladder – hold urine
- Urethra – tube leading from bladder to outside

Each kidney has @ 1 million nephrons (functional unit)
Filter blood 60 time per day
Concentrate filtered wastes in form of urine

Pathway of urine formation:
a. Renal artery enters kidney
b. Blood enters capillary within nephron
c. Wastes filtered from capillary into tubule system
d. Filtered blood enters renal artery
e. Reabsorption and secretion occur in tubule system
f. Urine formed and is moved from tubule
g. Urine exits both kidneys via ureters
h. Ureters move urine to bladder
i. Urine collects in bladder; stretch receptors triggered
j. Sphincters (muscles) relax and urine enters urethra and exits body

16.2 Digestive System

Animals are heterotrophic; they consume other organisms
Digestion is the breakdown of carbohydrates, proteins and fat into their monomers which are then absorbed
Digestion is both a chemical and mechanical process
A greater food intake without energy use will be stored as fat

A. The Human Digestive System

1. Oral Cavity (mouth)

Digestion begins in the mouth:
a. mechanical – chewing

b. chemical – amylase in saliva breaks down starch
lipase breaks down fat

Bolus (mass of food held together by saliva) forms and is moved to pharynx (throat) by tongue
Once bolus reaches pharynx, swallowing is an involuntary process
Epiglottis covers opening to trachea to prevent food from entering

2. Esophagus

Tube leading from mouth to stomach
Bolus enters and moves down by peristalsis (contraction of circular and longitudinal muscles).
Sphincters are found at the top (UES) and bottom (LES) of esophagus
The lower esophageal sphincter is known as gastro-esophageal sphincter; when it malfunctions, stomach acid can enter the esophagus – 'heartburn'

3. Stomach

J-shaped
Protein digestion begins due to the presence of pepsin (activated by HCl)
Mechanical digestion – churning due to three layers of muscle (circular, longitudinal and diagonal
Chyme – liquefied food; very acidic

Mucous protects lining of stomach from acidic chime
Stomach emptying begins 2 – 6 hours after eating; longer if meal is high in fat
Small amounts of chyme squirt through pyloric sphincter

4. Small Intestine

Length – 19.6 feet (21 feet in cadaver)
Three parts:
a. duodenum
b. jejunum
c. ileum
Digestion of carbohydrates, protein and fat is completed in duodenum
Final breakdown of nutrients due to pancreatic juice with seven different enzymes and bile (made in liver; stored in gallbladder)
Bile emulsifies fats
Monomers (monosaccharides, amino acids and monoglycerides and fatty acids are absorbed
Villi and microvilli increase surface area for absorption

5. Large Intestine (colon)

Three parts:
a. cecum
b. colon – contains gut bacteria
c. rectum – stores feces
Main function is to reabsorb water

6. Accessory Organs

Liver – makes bile; detoxifies drugs/alcohol; makes plasma proteins
Gallbladder – stores bile
Pancreas – makes enzymes for final digestion in small intestines; makes bicarbonate to neutralize acidic chyme entering small intestines

B. Nutrition

Carbohydrates:
a. digestible – glucose and other simple sugars
b. complex carbohydrates – cellulose (fiber)

Fate of excess glucose:
a. stored as glycogen in liver and muscle
b. converted to fat

Proteins are broken down into amino acids which can be used to form any proteins needed by the body
a. essential – must be obtained from diet
b. non-essential – body can make (11 of the 20)

Fats are broken down into monoglycerides and fatty acids
Found in all cell membranes
Needed for absorption of fat soluble vitamins
Needed for the synthesis of certain hormones

a. essential fatty acids (EFA) – must obtain from diet; omega 3 and 6; found in cold water fish

Other essential nutrients:

a. Vitamins – organic; co-enzymes
1. Fat soluble – A, D, E, K
2. Water soluble – all others

b. Minerals – inorganic; trace elements
Ex.: Ca^+, Fe^+, Na^+, K^+, Mn, Co, Se

16.3 Circulatory and Respiratory Systems

Both work together to take in O_2 and get rid of CO_2
Circulatory system transports gases and exchange occurs in lungs

A. The Respiratory System

We breathe @ 15 times/minute; 900 breaths/hour; 21,600 breaths/day
Involves process of inhalation (inspiration) and exhalation (expiration)
Voluntary and involuntary process:

- You can hold your breath to a point (voluntary)
- Elevated levels of CO_2 in blood will trigger respiratory center in brain and cause you to inhale (involuntary)

Diaphragm moves down and lungs inflate

Pathway of air as it moves into lungs:

a. nasal cavity – warms and filters air
b. pharynx – throat
c. larynx – voice box
d. trachea – windpipe; 'C'- shaped rings of cartilage keep it from collapsing; lined with mucous and cilia; in front of esophagus
e. bronchi – Left and right; branch into secondary, and tertiary bronchi
f. bronchioles – smooth muscle; constrict in asthma
g. respiratory bronchioles
h. alveolar duct
i. alveolar sacs with alveoli – 20-30 per sac
j. alveoli – site of gas exchange; very thin walls; blood vessels cover surfaces of alveoli and gas exchange occurs through respiratory membrane; surface area is about the size of a tennis court

B. The Circulatory System

Composed of arteries, capillaries, veins and the heart to pump
Closed vs. open circulatory system

C. The Heart

About the size of a closed fist

Four chambers; two upper atria and two lower ventricles
Ventricles pump blood:

a. right ventricle – pumps blood through pulmonary artery to lungs (pulmonary circulation)
b. left ventricle – pumps blood through aorta to body (systemic circulation)

Pathway of blood from right atrium to body:

a. superior and inferior vena cava drain blood (deoxygenated) into right atrium
b. tricuspid valve (atrioventricular - AV)
c. right ventricle
d. pulmonary artery (PA)
e. lungs – blood loses CO_2 and picks up O_2
f. pulmonary veins (PV)
g. left atrium
h. bicuspid (mitral) valve (AV)
i. left ventricle
j. aorta
k. body

D. The Cardiac Cycle

Contraction and relaxation of heart during one beat
a. systole – contraction
b. diastole – relaxation

Sinoatrial (SA) node sends signal for contraction

Heart sounds:
a. ‘lub’ – atria contract; AV valves close
b. ‘dub’ – ventricles contract; semilunar valves (at base of PA and aorta) close

Cardiac muscle cells connected by intercalated disks to aid in quick transmission of impulse so that all cells contract at the same time

ECG (EKG) – measurement of electrical impulse as it move through heart

E. Blood Vessels

Arteries – carry blood away from heart; elastic
Capillaries – site of gas exchange between body cell and the blood; microscopic
Veins – return blood back to heart; contain valves

16.4 Endocrine System

Produces hormones that control/regulate almost all body processes
One of the two systems that maintain homeostasis – endocrine and nervous system
Hormones are released in response to nerve impulses

One of three effectors of neurons:
a. another neuron
b. a muscle
c. a gland

A. Hormones

Chemical messengers which bind to specific target cells (because of a specific receptor) and cause a particular response from that target cell/tissue

Ex.: Increase in blood glucose causes the release of insulin
Insulin causes target cells to take glucose in
Blood glucose decreases (glucose now in cells)

Endocrine gland – releases hormones into the bloodstream

Exocrine gland - releases substances (not hormones) into ducts that go to a surface (internal or external)

Ex.: sweat glands, digestive glands

B. How Hormones Work

Released into blood stream and travel to target cells

Target cells have specific receptors for that hormone

Hormone causes a response from the target cell that is recognized as the effect of the hormone

Ex.: Insulin lowers blood glucose; insulin actually causes cells to take it in, therefore lowering the glucose in the blood

Up regulation – number of receptors increase (cells become less sensitive to hormone)

Down regulation – number of receptors decrease (cells become more sensitive to hormone)

Steroid hormones (lipid) go through cell membrane and bind to receptor inside cell

Protein hormones bind to receptors at surface of cell

C. Endocrine Glands

1. Pituitary
   a. Anterior
      - Growth hormone
      - Prolactin
      - Thyroid stimulating hormone
      - Follicle stimulating hormone
      - Leutinizing hormone
      - Adenocorticotropic hormone

   b. Posterior
      - Oxytocin
      - Antidiuretic hormone

2. Thyroid
   - T_4 and T_3
   - calcitonin

3. Parathyroid
   - parathyroid hormone

4. Adrenal gland
   a. cortex
      - aldosterone
      - cortisone
   b. medulla
      - epinephrine (adrenalin)
      - norepinephrine (noradrenalin)

5. Pancreas
   - insulin
   - glucagon

6. Thymus
   - thymosin

7. Testes
   - testosterone

8. Ovaries
   - estrogen
   - progesterone

D. Regulation of Hormone Production

Hormones are controlled by negative feedback

Ex.: Control of thyroid hormones

TRH from hypothalamus causes anterior pituitary to release TSH. TSH causes thyroid to release T_4 and T_3. When sufficient amounts made they feedback and shut down hypothalamus

16.5 Musculoskeletal System

Involved in movement and support
Bones – support and protection (skull/rib cage)
Muscles – contract and cause bones to move

Improved prosthetics now replace missing limbs

A. Skeletal System

206 bones – smallest in inner ear (3 ossicles); largest is femur

Functions:
- support
- protection
- stores minerals
- produces blood cells (bone marrow)
- movement (with muscles)

Axial skeleton forms central axis of body
- skull bones – facial and cranium
- bones of inner ear
- hyoid bone (not directly attached to skeleton)
- vertebral column – vertebrae, sacrum, coccyx
- thoracic cage

Appendicular skeleton (appendages)

- limbs
- pectoral girdle – clavicles and scapulae
- pelvic girdle – hip bones and pelvic bones

B. Joints and Skeletal Movement

Joint is where two or more bones meet (articulation)
Ligament connects bone to bone

Three structural classifications:

- fibrous – immovable; skull and teeth in sockets
- cartilaginous – little movement; discs between vertebrae
- synovial – freely movable; joint enclosed within capsule; joint cavity filled with fluid; ends of bones covered with cartilage; knee, elbow, shoulder and hip
  types of movements at synovial joints: flexion and extension
  abduction and adduction
  rotation

C. Muscles

Main function is movement (along with bones)
Tendons attach muscle to bone
Aid with respiration and digestion

Three types of muscle tissue

- skeletal – attached to bone; voluntary and striated
- smooth – found in hollow organs, respiratory/digestive tracts and blood vessels; involuntary and no striations
- cardiac – found in heart; involuntary and striated; intercalated discs

D. Skeletal Muscle Fiber Structure and Function

Muscle fiber = muscle cell

Cross section of muscle fiber shows the following structures:

- sarcolemma – plasma membrane of muscle cell
- sarcoplasm – cytoplasm within muscle cell
- myofibril – grouping of myofilaments
- myofilaments – actin (thin) and myosin (thick)

Overlapping of myofilaments causes striations seen in skeletal and cardiac muscle
Muscle contraction is described by a 'sliding filament' mechanism; filaments do not shorten, they slide past each other
Sarcomere is the unit of contraction
Lots of ATP is needed to hook up filaments so that they can slide past each other (contraction) and to unhook the filament from one another (relaxation)

Rigor mortis – no ATP produced after death; filaments remain hooked up (contracted)

16.6 Nervous System

Nervous and endocrine system control homeostasis
Nervous system responds more quickly via chemical and electrochemical signals (action potentials)

Input (stimulus detected by sensory organ/cell) goes to control center (CNS) then message goes to effector (muscle, gland, neuron) for a response

A. Neurons and Glial Cells

Neurons receive and transmit chemical and electrochemical signals
Glial cells support neurons; smaller and more numerous

Parts of neuron:
- dendrite (most neurons)
- cell body
- axon – transmits impulse to effector

Action potential – alternate depolarization and repolarization of neuron cell membrane

Depolarization – Na^+ enters cell
Repolarization – K^+ exits the cell

Na^+/K^+ pump restores ions back to original positions

Nerve impulse – action potential moves down neuron cell membrane
Some neurons are covered by myelin sheath (insulates), so impulse jumps along axon

B. How Neurons Communicate

Synaptic cleft – space between neuron and effector cell; filled with fluid

Chemicals (neurotransmitters) from one neuron enter synaptic cleft, diffuse across cleft and bind to receptors on membrane of next membrane. Na^+ channels open up and action potential is triggered

C. The Central Nervous System

Brain and spinal cord; both covered with membranes called meninges and float in cerebrospinal fluid (CSF)

D. The Brain

Major parts:

- cerebral cortex – gray matter (neurons); four lobes; two hemispheres connected by band of nerve fibers (corpus callosum)
- thalamus – gateway to cortex; regulates consciousness, arousal, sleep
- hypothalamus – endocrine function (makes hormones); controls body temperature
- limbic system – center of emotions such as fear, motivation, memory association
- cerebellum – controls balance, coordination of body parts
- brain stem – controls breathing, swallowing, digestion, walking; cardiovascular and respiratory centers

E. Spinal Cord

Spinal cord connect CNS with peripheral nerves

- sensory information travels up and into brain
- motor information travels down to some effector

Spinal cord made up of white and gray matter

- white matter – myelinated nerve tracts (bundles of axons)
- gray matter – unmyelinated cell bodies

Center of spinal reflexes – controlled, automatic, unconscious response to a stimulus in order to avoid tissue damage; impulse makes it to brain and you become ‘aware’ only after action has occurred

F. The Peripheral Nervous System

Connection between CNS (brain and spinal cord) to rest of body

Two divisions:

1. Autonomic – automatic; without conscious control
   - parasympathetic – rest and digest
   - sympathetic – ‘fight or flight’ response; epinephrine (adrenalin) released

   Effectors:
   - cardiac muscle
   - smooth muscle
   - glands

   Controls – lungs, heart, smooth muscle, exocrine and endocrine glands

2. Sensory somatic – effectors are skeletal muscle; conscious control

   Sensory input from
   - skin
   - skeletal muscle
   - special senses

CNS acts on sensory input and sends motor impulse to effector (skeletal muscle)

Chapter 16 Student's Outline

Introduction

16.1 Homeostasis and Osmoregulation

Homeostasis –
Maintained by
Controlled conditions –

A. Homeostasis

Conditions in the body are constantly monitored
Equilibrium is maintained around a 'set point'

Examples: Blood ph =
Blood glucose =

Stimulus –

Once a stimulus is detected,

Change is detected by receptor;

Negative feedback –
Positive feedback –

B. Thermoregulation

Ectotherms –

Endotherms –

Conserve or lose heat by a variety of mechanisms:

-
-
-
-
-
-
-

Hypothalamus –

Pyrogens –

C. Osmoregulation

Definition –

Body fluids consist of:

-
-
-

Types of body fluids:

-
-
-

Fluids and electrolytes –

Food and water enter; excess excreted in

•

•

•

If toxic wastes build up tissue/organism dies

•

If electrolytes move, water follows

Blood pressure is affected when fluid moves between compartments

- BP increases –
- BP decreases –

1. Excretory System

One of three systems that remove wastes:

- Lungs –
- Skin –
- Kidneys –

Parts:

- Kidneys –
- Ureters –
- Bladder –
- Urethra –

Nephron –

Functions

a.

b.

Pathway and steps in urine formation:

a.

b.

c.

d.

e.

f.

g.

h.

i.

j.

16.2 Digestive System

Animals are heterotrophic -

Digestion –

Digestion is chemical and mechanical process

A greater food intake without energy use results in fat storage

A. The Human Digestive System

1. Oral Cavity (mouth)

Digestion begins in the mouth

a. mechanical –

b. chemical –

Bolus –

Bolus reaches pharynx and

Epiglottis –

2. Esophagus

Tube leading from mouth to stomach

Peristalsis –

Sphincters –

The lower esophageal sphincter is known as gastro-esophageal sphincter

Heartburn –

3. Stomach

Shape –

Protein digestion begins due to

Mechanical digestion –

Chyme –

Mucous protects stomach lining

Timing of stomach emptying –

Mechanism of stomach emptying –

4. Small Intestine

Length –

Three parts:

a.

b.

c.

Digestion of carbohydrates, protein and fat is completed

Final breakdown of nutrients due to –

Bile –

Monomers absorbed –

Villi and microvilli –

5. Large Intestine (colon)

Three parts:

a.

b.

c.

Main function –

6. Accessory Organs

Liver –

Gallbladder –

Pancreas –

B. Nutrition

Carbohydrates:

a. digestible –

b. complex carbohydrates –

Fate of excess glucose:

a.

b.

Proteins are broken down into amino acids that can be used to form any proteins needed by the body

a. essential –

b. non-essential –

Fats are broken down into monoglycerides and fatty acids

Found in all cell membranes

Needed for absorption of –

Needed for the synthesis of –

a. essential –

Other essential nutrients:

a. Vitamins –

1. Fat soluble –

2. Water soluble –

b. Minerals –

Examples:

16.3 Circulatory and Respiratory Systems

A. The Respiratory System

We breathe @ 15 times/minute; 900 breaths/hour; 21,600 breaths/day

Involves processes of –

Voluntary and involuntary process:

-
-

Movement of diaphragm –

Pathway of air as it moves into lungs:

a. nasal cavity –

b. pharynx –

c. larynx –

d. trachea –

e. bronchi –

f. bronchioles –

g. respiratory bronchioles

h. alveolar duct

i. alveolar sacs with alveoli –

j. alveoli –

B. The Circulatory System

Composed of arteries, capillaries, veins and heart

Closed vs. open circulatory system

C. The Heart

Size –

Four chambers –

Ventricles pump blood:

a. right ventricle –

b. left ventricle –

Pathway of blood from right atrium to body:

a.

b.

c.

d.

e.

f.

g.

h.

i.

j.

k.

D. The Cardiac Cycle

Definition –

a. systole –

b. diastole –

Sinoatrial (SA) node –

Heart sounds:

a. ‘lub’ –

b. ‘dub’ –

Intercalated discs –

ECG (EKG) –

E. Blood Vessels

Arteries –

Capillaries –

Veins –

16.4 Endocrine System

Produces hormones that control/regulate almost all body processes

One of the two systems that maintain homeostasis –

Release of hormones –

One of three effectors of neurons:

a.

b.

c.

A. Hormones

Chemical messengers which bind to specific target cells (because of a specific receptor) and cause a particular response from that target cell/tissue

Example:

Endocrine gland –

Exocrine gland –

Examples:

B. How Hormones Work

Released into blood stream

Target cells –

Effect of hormone on target cell –

Example:

Up regulation –

Down regulation –

Steroid hormones (lipid) –

Protein hormones –

C. Endocrine Glands

1. Pituitary

a. Anterior

•

•

-
-
-
-

b. Posterior

-
-

2. Thyroid

-
-

3. Parathyroid

-

4. Adrenal gland

a. Cortex

-
-

b. Medulla

-
-

5. Pancreas

-
-

6. Thymus

-

7. Testes

-

8. Ovaries

-

-

D. Regulation of Hormone Production

Control of hormone production and release –

Example: Control of thyroid hormones

16.5 Musculoskeletal System

Function –

Bones –

Muscles –

Improved prosthetics now replace missing limbs

A. Skeletal System

206 bones –

Functions:

-
-
-
-

Axial skeleton forms central axis of body

-
-
-
-
-

Appendicular skeleton (appendages)

-
-
-

B. Joints and Skeletal Movement

Joint is where two or more bones meet (articulation)

Ligament –

Three structural classifications:

- fibrous –
- cartilaginous –

- synovial –

  examples:

  types of movements at synovial joints : flexion and extension

  abduction and adduction

  rotation

C. Muscles

Main function –

Tendons –

Aid with respiration and digestion

Three types of muscle tissue

- skeletal –
- smooth –
- cardiac –

D. Skeletal Muscle Fiber Structure and Function

Muscle fiber =

Cross section of muscle fiber shows the following structures:

- sarcolemma –
- sarcoplasm –
- myofibril –
- myofilaments –

Overlapping of myofilaments causes striations seen in skeletal and cardiac muscle

‘Sliding filament’ mechanism –

Sarcomere –

Muscle contraction requires a lot of ATP

Rigor mortis –

16.6 Nervous System

Control of homeostasis –

Nervous system responds more quickly due to –

Pathway from stimulus to response

A. Neurons and Glial Cells

Neurons receive and transmit chemical and electrochemical signals

Glial cells support neurons; smaller and more numerous

Parts of neuron:

-
-
-

Action potential –

Depolarization –

Repolarization –

Na^+/K^+ pump –

Nerve impulse –

Some neurons are covered by myelin sheath (insulates), so impulse jumps along axon

B. How Neurons Communicate

Synaptic cleft –

Transmission of nerve impulse from neuron to neuron –

C. The Central Nervous System

Parts –

Meninges –

D. The Brain

Major parts:

- cerebral cortex –
- thalamus –
- hypothalamus –
- limbic system –
- cerebellum –
- brain stem –

E. Spinal Cord

Spinal cord connect CNS with peripheral nerves

-
-

Spinal cord made up of white and gray matter

- white matter –
- gray matter –

Center of spinal reflexes –

F. The Peripheral Nervous System

Connection between CNS (brain and spinal cord) to rest of body

Two divisions:

1. Autonomic –
   - parasympathetic –
   - sympathetic –

   Effectors:
   -
   -
   -

   Controls –

2. Sensory somatic –

   Sensory input from
   -
   -
   -

   CNS acts on sensory input and sends motor impulse to effector

   (skeletal muscle)

Chapter 16 Study Guide

Be able to define, discuss, and explain any of the following.

16.1 Homeostasis and Osmoregulation

1. Define homeostasis. What are some conditions in the body that are constantly monitored?
2. What is a stimulus?
3. What is the role of each of the following in maintaining homeostasis?
    a. receptor
    b. control center
    c. effector
4. Differentiate between a negative and positive feedback mechanism.
5. Differentiate between an ectotherm and an endotherm.
6. What are several ways the endotherms maintain a constant body temperature.
7. What part of the brain controls body temperature?
8. What are pyrogens?
9. What is osmoregulation?
10. What are the components of body fluids? (3)
11. Where are body fluids located? (3 places)
12. How are excess body fluids excreted?
13. How does the movement of electrolytes affect the movement of water between compartments?
14. How is blood pressure affected when fluid moves between compartments?
15. What are the three organs that remove wastes from the body?
16. Give the function of each of the following parts of the excretory system.
    a. nephron
    b. kidney
    c. ureter
    d. bladder
    e. urethra
17. What three processes are involved in making urine?
18. Follow the pathway of urine from its formation in the nephron to its exit from the body.

16.2 Digestive System

1. Briefly, what happens during the process of digestion?
2. Differentiate between mechanical and chemical digestion.
3. Describe and give the functions of the following parts of the digestive system
    a. oral cavity
    b. esophagus
    c. stomach

    d. small intestine
    e. large intestine
4. What is a bolus?
5. Be able to follow the track that food takes from mouth to anus.
6. What is the function of the epiglottis?
7. What is peristalsis?
8. What causes heartburn?
9. What is chyme?
10. Give the functions of the three accessory organs.
11. What is the function of bile? Where is it made? Where is it stored?
12. Where does the chemical breakdown of each of the following nutrients begin and what enzymes/chemicals are involved?
    a. starch
    b. protein
    c. fats
13. What is emulsification?
14. Where are each of the following monomers absorbed?
    a. amino acids
    b. monosaccharides
    c. fatty acids
    d. monoglycerides
15. Differentiate between essential vs. non-essential nutrients.
16. Differentiate between vitamins and minerals.

16.3 Circulatory and Respiratory Systems

1. What is the function of the respiratory system?
2. Is breathing a voluntary or involuntary event?
3. What is a normal breathing rate?
4. What is the function of the following parts of the respiratory system?
    a. nasal cavity
    b. pharynx
    c. larynx
    d. trachea
    e. bronchus
    f. bronchiole
    g. alveolus
5. Follow the path of air from the nostrils to the alveoli.
6. What are the four chambers of the heart? What is the function of each?
7. What are the two circulatory circuits?
8. Trace a drop of blood from the right atrium through the body and back to the right atrium.

9. Differentiate between systole and diastole.
10. What is responsible for the characteristic lub/dup sound of a heartbeat?
11. What is the S.A. node?
12. What is an ECG?
13. Describe each of the three different types of blood vessels.

16.4 Endocrine System

1. What is the function of the endocrine system?
2. What two body systems maintain homeostasis?
3. When a nerve impulse reaches the end of a neuron, what three effectors might it trigger?
4. What are hormones and how do they function? What is a target cell?
5. Differentiate between an endocrine and exocrine gland.
6. Differentiate between up-regulation and down-regulation of hormone receptors.
7. How do lipid and protein hormones interact with their target cells?
8. Know the source and function of each of the hormones in Table 16.1.
9. How is hormone production regulated?

16.5 Musculoskeletal System

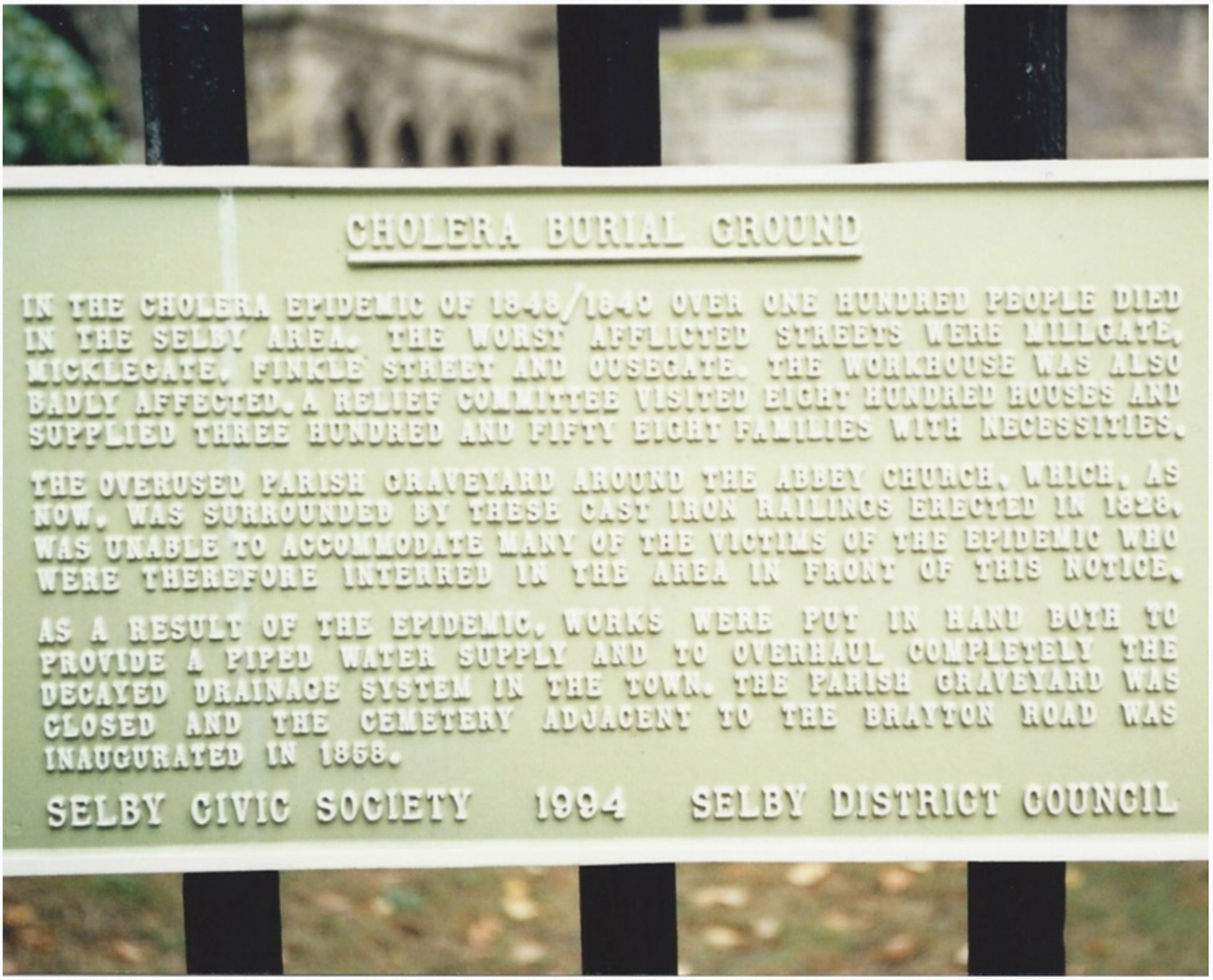
1. What are 5 functions of the skeletal system?
2. Name the parts of the axial skeleton.
3. Name the parts of the appendicular skeleton.
4. Where are the smallest bones in the body?
5. What is the largest bone in the body?
6. What is a joint?
7. What are the three structural classifications of joints?
8. Differentiate between a ligament and a tendon.
9. Differentiate between the three types of muscle tissue based on the following:
    a. location
    b. voluntary or involuntary
    c. striated or not
10. Identify the following parts of a muscle fiber/cell.
    a. asarcolemma
    b. sarcoplasm
    c. myofilaments
    d. myofibril
11. Myofilaments are made of what two proteins? How are they different?

16.6 Nervous System

1. What two systems help to maintain homeostasis?
2. Know the pathway of a nerve impulse from stimulus to an effect.
3. What are the 3 possible effectors of a motor neuron (what 3 things might a neuron trigger)?
4. What two types of cells are found in the nervous system.
5. What are the 3 parts of a neuron?
6. What ions are involved in the triggering and transmission of a nerve impulse?
7. What is an action potential?
8. How do neurons communicate with one another (or a muscle or a gland)?
9. What is the synaptic cleft?
10. What are the two parts of the central nervous system (CNS)?
11. What are meninges?
12. Know the function of the following parts of the brain.
    a. cerebral cortex
    b. thalamus
    c. limbic system
    d. cerebellum
    e. brain stem
13. What is the corpus callosum?
14. What is a nerve?
15. Differentiate between white matter and gray matter.
16. What is a reflex?
17. What is the function of the peripheral nervous system (PNS)?
18. What are the two divisions of the PNS?
19. What are the two divisions of the autonomic nervous system (ANS) and what types of responses do we see from each?
20. What are the three effectors of the ANS?
21. What is the effector of the sensory somatic nervous system (SSNS)?

17

The Immune System and Disease



Chapter 17 Outline

Introduction

17.1 Viruses

A. How Viruses Replicate

1. Steps of Virus Infections

B. Viruses and Disease

1. Vaccines for Prevention

2. Vaccines and Antiviral Drugs for Treatment

17.2 Innate Immunity

A. External and Chemical Barriers

B. Internal Defenses

1. The Inflammatory Response and Phagocytes

2. Natural Killer Cells

3. Complement

17.3 Adaptive Immunity

A. B and T Cells

B. Humoral Immune Response

C. Cell-Mediated Immunity

D. Immunological Memory

E. The Lymphatic System

F. Mucosal Immune System

G. Immune Tolerance

17.4 Disruptions in the Immune System

A. Immunodeficiency

B. Hypersensitivities

1. Allergies

2. Autoimmunity

Chapter 17 Instructor's Outline

Introduction

Variolation – early form of 'vaccination' against smallpox; introduced from Ottoman Empire; did not know how it worked

17.1 Viruses

Viruses are NOT cells – they are acellular agents of infection; parasites of cells

They infect host cell and hijack metabolic machinery to make copies of themselves

They do replicate (reproduce) – they do so only inside of a host cell; obligate intracellular parasites

Do not know a lot about origin and evolution

1886 – Tobacco mosaic virus (TMV) could be transferred with plant extracts
1892 – Ivanowski showed that the filtered fluid from TMV could transmit disease; bacteria were trapped on filter so these 'filterable agents' had to be smaller

Size – measured in nm; only seen with electron microscope

Virion – mature virus particle

Parts of virus

Nucleocapsid made of:
a. Capsid – protein coat; made up of units called capsomeres
b. Nucleic acid – DNA or RNA not both
DNA – double-stranded or single-stranded
RNA – double-stranded or single-stranded

Nucleic acid may be linear or circular; could be segmented

May or may not have:
a. Envelope – picked up when virus buds out of cell; phospholipid bilayer of host cell the virus is exiting

enveloped virus – has envelope
naked virus – no envelope

b. Protein spikes – used to attach to host cell

Viruses use protein spikes (if present) to attach to host-cell receptors (glycoproteins) which often have another function; they are exploited by the virus

DNA viruses: chickenpox, hepatitis B, herpes, genital warts

RNA viruses: HIV; hepatitis C, measles, rabies, influenza

Various replication schemes depending on whether it is a DNA or RNA virus

DNA ————> mRNA ————> protein
DNA ————> DNA

RNA ————> protein
RNA ————> RNA

Retroviruses – have enzyme (reverse transcriptase) to make DNA from RNA; HIV

RNA viruses mutate quickly – RNA polymerases make mistakes; the influenza virus mutates quickly because it has 8 RNA segments (new vaccine needed each year)

Viruses have limited host ranges – due to the need for specific receptors on host cells; TMV vs. rabies

Some viruses only infect certain cells within host – HIV infects T_H lymphocyte in causing AIDS

A. How Viruses Replicate

Viruses 'take over' host cell

Cytopathic effect – changes seen in host cells

Effects due to the virus lysing the host cell, causing apoptosis in the host cell, or budding out of the host cell

1. Steps of Virus Infections

a. attachment – specific due to the need for specific receptor; species/organism or even cells within an organism

b. entry – virus taken into host cell by endocytosis

c. synthesis of

nucleic acid
proteins

d. assembly – proteins and nucleic acid come together as new virions

e. release – viruses are released through lysis of host cell or budding out of host cell

B. Viruses and Disease

Overview of different types of viral infections

1. Vaccines for Prevention

Categories
- Active – vaccine contains antigen which triggers the production of antibodies
- Passive – vaccine contains pre-formed antibodies

Types
- Live – attenuated or weakened strain of pathogen
  Reversion – pathogen can revert back to virulent form
- Killed – pathogen cannot reproduce
- Subunit – antigenic parts of the pathogen are used (cannot cause disease)

The polio vaccine has both a killed and live version

New vaccines needed each year for some viruses – some viruses mutate so rapidly that new vaccines preparations are needed each year (influenza)

2. Vaccines and Antiviral Drugs for Treatment

Passive vaccines – can be used to boost immune system after exposure to pathogen (rabies/Ebola); contain antibodies for immediate protection

Antiviral drugs – very few good ones
Generally work by targeting processes/molecules that are unique to viruses (selective toxicity)
Some target specific viruses; others target multiple viruses

Ex.:
Tamiflu – influenza; take early in infection; minimizes severity and length of infection

Acyclovir – genital herpes
Ribavirin – respiratory syncytial virus
HAART – highly active anti-retroviral treatment; drug cocktail for treatment of AIDS; multiple drugs with different mechanisms of action which averts resistance (reverse transcriptase inhibitor/protease inhibitor/fusion inhibitors/integrase inhibitors)

17.2 Innate Immunity

Definition – immunity you are born with; also called species or non-specific immunity

Works against a variety of different pathogens – no previous exposure to pathogen needed

1st line of defense – intact skin and mucous membranes (barriers)

2nd line of defense – chemicals; cells; proteins

- Chemicals

  a. lysozyme in tears

  b. acidic sweat and sebum

  c. stomach acid

- Cells

  a. phagocytes – macrophages and neutrophils

  b. natural killer cells

- Proteins

  a. complement

  b. interferon

A. External and Chemical Barriers

1st line of defense – intact skin and mucous membranes

Physical barriers – keratin in skin; mucous in internal membranes; cilia

Protective chemicals – sweat is acidic; lysozyme in saliva, mucous, and tears; stomach acid

Normal flora – microorganisms that live on us and in us are protective

B. Internal Defenses

2nd line of defense – comes into action when 1st line is breached

Processes and cells involved

Inflammation – non-specific response to tissue damage

Phagocytosis – cells engulf pathogen

Natural killer cells – type of lymphocyte

Mast cells – release inflammatory chemicals

Cytokines – chemicals made by immune cel

1. The Inflammatory Response and Phagocytes

Inflammation – a non-specific response to tissue damage (chemicals are released from damaged cells)

Signs/symptoms – redness, heat, swelling, pain

Redness and heat due to increased vasodilation (more blood comes to area)
Swelling and pain due to increased in vasopermeability (blood vessels become leaky)

White blood cells involved – phagocytes; neutrophils arrive first and then macrophages to ‘clean up’

Pyrogens – cytokines which reset hypothalamus causing fever

2. Natural Killer Cells

Lymphocyte that targets
a. virally infected cells
b. cancer cells

Mechanism of action – cells that are infected with a virus or have mutated into a cancer cell display unusual molecules on their surface which NK cells recognize. They release chemicals that induce apoptosis in that cell.

Immune surveillance – phagocytes and NK cells are constantly scouring the body looking for any transformed (virally infected/cancer) cell

3. Complement

Twenty serum proteins – that complement immune responses

Complement proteins are made in their inactive forms and found at all times in the blood

Three possible outcomes once it is activated
a. enhancement of inflammation
b. enhancement of phagocytosis
c. formation of a membrane attack complex (MAC); lysis of target cell

17.3 Adaptive Immunity

Occurs only after exposure to antigen

Antigen – molecule that triggers an immune response

Two types of immune responses
a. CMI – cell-mediated due to T cells
b. AMI – antibody-mediated due to B cells

Three characteristics of the adaptive immune response
a. specific
b. memory
c. ability to recognize self vs. non-self

A. B and T Cells

B cells – made and mature in bone marrow

T cells – made in bone marrow; mature in thymus

Only cells that do not respond to self survive fetal development; once mature both types of cell migrate to spleen and lymph nodes

B. Humoral Immune Response

B cell receptor – antibody molecule on surface of B cell

B cell activation – antigen binds to a specific B cell with a specific receptor

Plasma cell – an activated B cell that is producing antibodies

Actions of antibodies
a. neutralization
b. opsonization
c. activation of complement

Active immunity – organism is producing antibodies

Passive immunity – organism is giving pre-formed antibodies

C. Cell-Mediated Immunity

Involves direct cell to cell attacks

T cell activation – T cells are activated only after a specific antigen that is recognized is presented to them

Three antigen presenting cells (APCs)
a. macrophages
b. dendritic cells
c. B cells

Antigen processing and presentation – antigen is engulfed, broken down and pieces of it (in MHC molecules) are put back on the surface of the presenting cell

T_H cells – help to activate B cells and T_C cells

T_C cells – directly attack virally infected cells and cancer cells

D. Immunological Memory

Primary response – first encounter with antigen; clonal selection and proliferation; immune system is primed to recognize this antigen in the future; some cells become active at this time to clear invader; other cells become memory cells

Secondary response – faster due to memory cells; antigen is often cleared without the knowledge of exposure/infection

Memory cells – clones (T or B) which have not yet been activated; may circulate in system for years and provide protection

E. The Lymphatic System

Filters antigens from blood

Lymph – fluid that leaves blood vessels and enters lymph vessel; no RBCs

Lymph fluid is filtered in nodes full of B and T cells before returning to blood circulation

Lymph system – a system of vessels, ducts and nodes/organs

Lymph organs
a. tonsils
b. adenoids
c. thymus (T cells mature here)
d. spleen

F. Mucosal Immune System

Mucosal lymphatic tissue is associated with the skin and mucosa throughout the body

SALT – skin associated lymphoid tissue

MALT – mucosal associated lymphoid tissue

G. Immune Tolerance

T_{reg} – a population of T cells that suppress immune responses to self tissue and the immune response after pathogen is cleared to minimize damage to host

One property of the adaptive immune response is the ability to recognize self vs. non-self

Major histocompatibility complex antigens (MHC) – self antigens

17.4 Disruptions in the Immune System

Mechanisms pathogens use to escape phagocytosis
a. capsules – hinders phagocytosis
b. leukicidins – chemicals that kill protective leukocytes

HIV attacks T_H cells (CD_4) and suppresses immune system

A. Immunodeficiency

Definition – lack of an immune response

Primary – congenital
Ex.: Severe combined immunodeficiency (SCID – born without B and T cells)

Secondary – acquired
Ex.: HIV
chemotherapy
malnutrition
stress

B. Hypersensitivities

Definition – Excessive response to otherwise harmless substance or self-molecule

1. Allergies

a. Immediate – occurs immediately after exposure to allergen

Mechanism – Allergen (antigen) stimulates the production of antibody which binds to mast cells; subsequent exposures cause mast cells to release inflammatory chemicals

local – hives, hayfever

systemic – anaphylactic shock

b. Delayed – occurs anywhere from 24-72 hours following exposure to allergen

Mechanism – T cells are involved which accounts for the delay in a response

Ex.: contact dermatitis to nickel, cosmetics, poison ivy/oak
tuberculin skin test

2. Autoimmunity

Definition – response to self-tissue

Can be antibody mediated, cell mediated or both

Antibody mediated autoimmune responses: myasthenia gravis (MG), systemic lupus erythramatosus (SLE – make antibodies to their own DNA), rheumatic fever, Type I diabetes

Cell mediated autoimmune response: rheumatoid arthritis

Chapter 17 Student's Outline

Introduction

Variolation -

17.1 Viruses

Viruses are NOT cells –

They infect host cell and hijack metabolic machinery to make copies of themselves

They do replicate (reproduce) –

Do not know a lot about origin and evolution

1886 – Tobacco mosaic virus
1892 – Ivanowski

Size –
Virion –

Parts of virus

Nucleocapsid made of:

a. Capsid

b. Nucleic acid

RNA or DNA

May or may not have:

a. Envelope

b. Protein spikes

DNA viruses:

RNA viruses:

Various replication schemes:

Retroviruses –

RNA viruses mutate quickly –

Viruses have limited host ranges –

Some viruses only infect certain cells within host –

A. How Viruses Replicate

Viruses ‘take over’ host cell

Cytopathic effect –

1. Steps of Virus Infections

a. attachment –

b. entry –

c. synthesis
nucleic acid
proteins

d. assembly

e. release

B. Viruses and Disease

Overview of different types of viral infections

1. Vaccines for Prevention

Categories

- Active –
- Passive –

Types

- Live

  Reversion -

- Killed
- Subunit

New vaccines needed each year for some viruses –

2. Vaccines and Antiviral Drugs for Treatment

Passive vaccines –

Antiviral drugs –

Examples:

a.

b.

c.

d.

17.2 Innate Immunity

Definition –

Works against a variety of different pathogens –

1st line of defense

2nd line of defense –

- Chemicals
  a.
  b.
  c.
- Cells
  a.
  b.
- Proteins
  a.
  b.

A. External and Chemical Barriers

1st line of defense –

Physical barriers –

Protective chemicals –

Normal flora –

B. Internal Defenses

2nd line of defense

Processes and cells involved

Inflammation –

Phagocytosis –

Natural killer cells –

Mast cells –

Cytokines –

1. The Inflammatory Response and Phagocytes

   Inflammation –

      Signs/symptoms –

      White blood cells involved –

      Pyrogens –

2. Natural Killer Cells

   Lymphocyte that targets

      a.

      b.

   Mechanism of action –

   Immune surveillance –

3. Complement

Twenty serum proteins –

Three possible outcomes once it is activated

a.

b.

c.

17.3 Adaptive Immunity

Occurs only after exposure to antigen

Antigen –

Two types

a. CMI –

b. AMI –

Three characteristics

a.

b.

c.

A. B and T Cells

B cells –

T cells –

Only cells that do not respond to self survive fetal development; once mature both types of cell migrate to spleen and lymph nodes

B. Humoral Immune Response

B cell receptor –

B cell activation –

Plasma cell –

Actions of antibodies

a.

b.

c.

Active immunity –

Passive immunity –

C. Cell-Mediated Immunity

T cells activation –

Three antigen presenting cells (APCs)

a.

b.

c.

Antigen processing and presentation –

T_H cells –

T_C cells –

D. Immunological Memory

Primary response –

Secondary response –

Memory cells –

E. The Lymphatic System

Filters antigens from blood

Lymph –

Lymph system –

Lymph organs

a.

b.

c.

d.

F. Mucosal Immune System

MALT –

SALT –

G. Immune Tolerance

T_{reg} –

Major histocompatibility complex antigens –

17.4 Disruptions in the Immune System

Mechanisms pathogens use to escape phagocytosis

a.

b.

HIV attacks T cells (CD_4) and suppresses immune system

A. Immunodeficiency

Definition –

Primary –

Example:

Secondary –

Examples:

a.

b.

c.

d.

B. Hypersensitivities

Definition –

1. Allergies

a. Immediate –

Mechanism –

local –

systemic –

b. Delayed –

Mechanism –

Examples:

2. Autoimmunity

Definition –

Can be antibody mediated, cell mediated or both

Antibody mediated autoimmune responses:

Cell mediated autoimmune response:

Chapter 17 Study Guide

17.1 Viruses

1. Why are viruses known as intracellular parasites?
2. Draw and label a typical virion using the following:
    a. capsid
    b. nucleic acid
    c. envelope
    d. protein spikes
5. How do viruses damage host cells?
6. What is the cytopathic effect?
7. What are the steps of a viral infection?
8. Name 10 viral diseases and the systems/organs they effect.
9. Why do RNA viruses mutate more quickly than DNA virues?
10. Why can certain viruses only affect a specific organism or a specific type of cell?
11. What is a retrovirus (why are they called that)? Give an example of one.
12. What are three types of vaccines?
13. What is an attenuated vaccine?
14. Why is the rabies vaccine called an ‘active’ vaccine?
15. How do different antiviral drugs work?
16. Name several antiviral drugs and what they treat.
17. What is HAART?

17.2 Innate Immunity

1. What is innate immunity?
2. List several external and chemical barriers.
3. What is the function of interferon?
4. What are the four classic signs and symptoms of inflammation?
5. What two types of white blood cells respond during the process of inflammation?
6. What are the two targets of NK (natural killer) cells?
7. What is complement? What are two outcomes of activation?

17.3 Adaptive Imunity

1. What is an antigen?
2. What are the two types of adaptive immune responses?
3. Where do B and T cells mature?
4. Differentiate between AMI and CMI.
5. What do B cells do once they are activated?
6. What is the general shape of an antibody molecule?

7. What is the function of each type of T cell:
    a. T_H
    b. T_C
    c. T_{reg}
8. What two types of cells do T_C attack?
9. What is meant by ‘antigen presentation’? What types of cells can perform this function?
10. What are memory cells?
11. Name three lymph organs.
12. What is the function of the spleen?
13. What type of cell is responsible for ‘immune tolerance’?

17.4 Disruptions in the Immune System

1. What are two ways that pathogens escape phagocytosis?
2. What type of cell does the HIV attack?
3. What is an immunodeficiency? What are several causes?
4. What is a hypersensitivity?
5. Contrast an immediate vs. a delayed allergy. List examples of each?
6. What is an autoimmune response? List several examples.

18

Animal Reproduction and Development

Chapter 18 Outline

Introduction

18.1 How Animals Reproduce

- A. Asexual Reproduction
  - 1. Fission
  - 2. Budding
  - 3. Fragmentation
  - 4. Parthenogenesis
- B. Sexual Reproduction
  - 1. Hermaphroditism
- C. Sex Determination
- D. Fertilization
  - 1. External Fertilization
  - 2. Internal Fertilization

18.2 Development and Organogenesis

- A. Early Embryonic Development
  - 1. Organogenesis

18.3 Human Reproduction

- A. Human Reproductive Anatomy
  - 1. Male Reproductive Anatomy
  - 2. Female Reproductive Anatomy
- B. Gametogenesis
  - 1. Spermatogenesis

2. Oogenesis

C. Hormonal Control of Reproduction

1. Male Hormones

2. Female Hormones

a. The Ovarian Cycle

b. The Menstrual Cycle

D. Gestation

Chapter 18 Instructor's Outline

Introduction

External fertilization in seahorses

18.1 How Animals Reproduce

Asexual reproduction – One parent; no genetic diversity
Sexual reproduction – Two parents; genetic variation

There are advantages and disadvantages to each

A. Asexual Reproduction
1. Fission – cell/organism splits in two
2. Budding – the outgrowth of a body part (bud) until it separates from the organism
3. Fragmentation – the breaking of an organism into parts followed by regeneration
4. Parthenogenesis – an egg develops without being fertilized

B. Sexual Reproduction
1. Hermaphroditism – an organism has both male and female reproductive structures

C. Sex Determination
Variations
a. humans – X and Y
b. birds – Z and W; ZZ = male, ZW = female
c. swordfish – three chromosomes
d. environment – temperature affects sex in alligators and turtles
e. some species change sexes

D. Fertilization
Definition – fusion of egg and sperm nuclei

1. External Fertilization – occurs outside of female body
Spawning – eggs and sperm released into water (frogs)

2. Internal Fertilization – occurs inside the female body
Usually sperm deposited into female system
Variations
a. oviparity – fertilized eggs laid outside body and develop there
b. ovoviparity – fertilized eggs retained in female body and hatch there or they are laid before hatching; embryo is nourished from yolk
c. viviparity – young are born alive and nourished by placenta

18.2 Development and Organogenesis

A. Early Embryonic Development

Fertilization – egg (N) and sperm (N) nuclei unite forming zygote (2N)
- Acrosomal enzymes from sperm head allow penetration of zona pellucida, a layer around the egg
- Only one sperm enters egg (monospermy); any other sperm are prevented from entering due to changes in zona pellucida

Development
- Zygote undergoes rapid cell division (cleavage), forming a hollow ball of cells called a blastula.
- Cells in the blastula arrange themselves into two layers:
  - the inner cell mass – becomes the embryo
  - the trophoblast – secretes enzymes that facilitate implantation of blastocyst (embryo) into endometrium of the uterus; will form placenta

The cells that make up the inner cell mass (future embryo) will undergo gastrulation and form three layers of cells called germ layers:
- the endoderm – will form gut and many internal organs
- the mesoderm – will form muscle and connective tissue
- the ectoderm – will form nervous system and epidermis

1. Organogenesis

Organogenesis – the formation of organs
- The three germ layers undergo differentiation and form organs
- Differentiation is the movement of a cell from an unspecialized state (stem cell) to a more specialized state with a specific function
- Since all cells have the same genetic material (DNA), differentiation is a result of these embryonic stem cells expressing different sets of genes that will determine their ultimate cell type; in other words,different genes are switched off or on.

18.3 Human Reproduction

A. Human Reproductive Anatomy

Sex determination about seventh week of gestation
- Low amounts of testosterone from gonads of fetus result in development of male sex organs

Low amounts of estrogen from gonads of fetus result in development of female sex organs

Common tissue in embryo develop differently under influence of testosterone or estrogen

1. Male Reproductive Anatomy

Sperm need lower temperature (@ 2°C) than body temperature to develop

External structures
a. scrotum – contains testicles with seminiferous tubules
b. penis – deposits sperm into female; three columns of erectile tissue; reproductive and excretory function

Internal structures
a. semen – sperm and fluid from accessory organs
b. testes – makes sperm and hormones
1. seminiferous tubules – where sperm is made
2. Sertoli cells – protect and nourish sperm; produce inhibin
3. interstitial cells of Leydig – make testosterone
c. epididymis – site of sperm maturation and storage
d. vas deferens – tube through which sperm leaves testicles; becomes the ejaculatory duct after fluid from seminal vesicles is added
e. urethra – tube through which sperm (and urine) moves out of the body

Vasectomy – method of birth control that involves the cutting of the vas deferens

Accessory glands – contribute fluids to semen
Fluids contain
a. nutrients
b. electrolytes
c. pH buffers
d. coagulation factors
e. anti-coagulation factors

Three accessory glands
a. seminal vesicles – paired
b. bulbourethral glands (Cowper's) – paired
c. prostate – single structure

2. Female Reproductive Anatomy

External structures

a. breasts – contain mammary glands

b. vulva – external genitalia

1. clitoris – erectile tissue; sensory function
2. labia majora – external folds of tissue
3. labia minora – folds of tissue within the labia majora
4. vestibular glands – lubrication

Internal structures

a. ovaries

1. produces egg
2. corpus luteum (remnants of ruptured follicle after release of egg) makes hormones

b. oviducts/uterine tubes/fallopian tubes

1. tubes through which egg moves on its way to uterus; site of fertilization
2. at the ends of oviducts are extensions called fimbriae
   - gently caress ovary
   - become active due to high levels of luteinizing hormone (LH)
   - movement draws egg into oviducts
3. uterus – houses developing embryo/fetus

   Parts
   - endometrium – lining of the uterus; thickens for implantation of embryo; lost if no fertilization occurs
   - cervix – lower part of uterus
4. vagina – receptacle for penis; birth canal

Cilia in oviducts sweep egg toward uterus; takes about one week

Tubal ligation – form of birth control that involves the cutting of the oviducts

B. Gametogenesis

Formation of gametes via meiosis; results in haploid cells

1. Spermatogenesis

Meiosis occurs in wall of seminiferous tubules; results in four haploid sperm

Begins at puberty

2. Oogenesis

Meiosis occurs in outer layers (surface) of ovary

Females are born with 1 – 2,000,000 primary oocytes (develop into eggs)

Beginning at puberty, follicle stimulating hormone (FSH) initiates the development of a few follicles each month
Usually one follicle makes it to maturity
During the process of meiosis polar bodies are formed; they will generally degenerate and are a mechanism to eliminate excess genetic material
The process of egg maturation is usually alternated between the ovaries monthly
In females, meiosis is halted two times:
a. before birth, the process is stopped in prophase I
b. after first polar body is formed, the process stops again in metaphase II
After the egg is fertilized, meiosis continues with the formation of the second polar body
The result of oogenesis is one mature egg (ovum)

After the union of the sperm (N = 23 chromosomes) and egg (N) nuclei, a zygote (2N = 46 chromosomes) is formed

C. Hormonal Control of Reproduction

Both sexes make the following hormones; they have different functions based on sex
- Gonadotropin-releasing hormone (GnRH) from the hypothalamus
- FSH
- LH

1. Male Hormones
At the time of puberty, the following hormones are made
a. hypothalamus – GnRH

b. anterior pituitary
- FSH – initiates sperm formation
- LH – initiates testosterone production; testosterone enhances production of FSH and is responsible for secondary sexual characteristics (deep voice, increased muscle mass)

With sufficient amounts of testosterone, a negative feedback mechanism results in the inhibition of the hypothalamus and anterior pituitary

With sufficient amounts of sperm, a negative feedback mechanism results in the production of inhibin (by Sertoli cells) that inhibits the production of FSH by the anterior pituitary

2. Female Hormones

Estrogen and progesterone – control ovarian and menstrual cycles; responsible for secondary sexual characteristics (breast development, wider hips, etc.)

Both the ovarian and the uterine cycles occur simultaneously

a. The Ovarian Cycle
Includes all events occurring in the ovaries:

1. Follicular phase
   - days 1–13 of cycle
   - FSH and LH are release and follicle begins to develop
   - low levels of estrogen (from follicle)
     a. inhibits hypothalamus and anterior pituitary
     b. repairs uterine lining and causes it to thicken

2. Ovulation
   - day 14 of cycle
   - a surge of LH causes ovulation (release of egg from follicle)
   - remnants of follicle, called the corpus luteum, produces large amounts of estrogen and cause increased thickening of the endometrium

3. Luteal phase – due to hormones from corpus luteum
   - days 15–28 of cycle
   - large amounts of estrogen and progesterone
     a. cause further thickening of uterine lining
     b. inhibit FSH and LH
        - if fertilization occurs, the corpus luteum is maintained by human chorionic gonadotropin (HCG) from embryo
        - if no fertilization occurs, the corpus luteum degenerates and the lining of the uterus sloughs off (menstruation)

HCG – made by chorionic cells of embryo; maintains the corpus luteum which produces progesterone that maintains the lining of the uterus until the placenta starts to make estrogen and progesterone

b. The Menstrual (Uterine) Cycle
Includes all events occurring in the uterus
- Menstrual cycle –
- Proliferative phase –
- Secretory phase –

D. Gestation

Gestation – pregnancy; events which occur from fertilization to birth
Lasts approximately 266 days; 9 calendar months or 10 lunar months
Fertilization results in formation of zygote that undergoes cleavage (mitosis)
Many rounds of cell division result in the formation of a blastocyst that will develop into the embryo
Implantation – blastocyst (embryo) embeds into the thickened endometrium about seven days after fertilization
- outer layer of blastocyst release enzymes to facilitate implantation
- other cells (chorion), of the blastocyst, release HCG which maintains the corpus luteum which, in turn, maintains the lining of the uterus (pregnancy)

Importance of HCG – detected in pregnancy tests

Three trimesters of about three months each

1. First trimester
   - after 4 weeks – placenta well-formed
   - after 5 weeks – limb buds form, along with eyes, heart and liver
   - after 8 weeks – called a fetus at this point; liver not functioning so any chemicals can build up with dangerous consequences (alcohol, drugs, smoking)

2. Second trimester
   - increased growth of fetus
   - placenta now makes estrogen and progesterone to maintain pregnancy; HCG levels drop; corpus luteum degenerates

3. Third trimester
   - period of most rapid growth
   - average weight: 6–8 pounds
   - average length: 19–20 inches

Labor – expulsion of fetus and placenta

Events that occur at the end of the third trimester

1. oxytocin receptors develop in uterus
2. baby turns head down
3. stretching of cervix causes release of oxytocin – positive feedback cycle begins; more stretching, more oxytocin released

Three stages

1. dilation – around 10 cm.
2. delivery of baby
3. expulsion of placenta

Chapter 18 Student's Outline

Introduction

18.1 How Animals Reproduce

Asexual reproduction –

Sexual reproduction –

There are advantages and disadvantages to each

A. Asexual Reproduction

1. Fission –

2. Budding –

3. Fragmentation –

4. Parthenogenesis –

B. Sexual Reproduction

1. Hermaphroditism –

C. Sex Determination

Variations

a. humans –

b. birds –

c. swordfish –

d. environment –

e. some species change sexes

D. Fertilization

Definition –

1. External Fertilization –

Spawning –

2. Internal Fertilization –

Usually sperm deposited into female system

Variations

a. oviparity –

b. ovoviparity –

c. viviparity –

18.2 Development and Organogenesis

A. Early Embryonic Development

Fertilization –

Acrosomal enzymes from sperm –

zona pellucida

Monospermy –

Development

Cleavage –

Blastula –

Cells in the blastula arrange themselves into two layers:

- the inner cell mass –
- the trophoblast –

The cells that make up the inner cell mass (future embryo) will undergo gastrulation and form three layers of cells called germ layers:

- the endoderm –
- the mesoderm –
- the ectoderm –

1. Organogenesis

Organogenesis –

The three germ layers undergo differentiation and form organs

Differentiation –

Stem cells –

Differentiation of stem cells is due to –

18.3 Human Reproduction

A. Human Reproductive Anatomy

Sex determination about seventh week of gestation

Low amounts of testosterone from gonads –

Low amounts of estrogen from gonads –

Common tissue in embryo develop differently under influence of testosterone or estrogen

1. Male Reproductive Anatomy

Sperm need lower temperature (@ 2C) than body temperature to develop

External structures

a. scrotum –

b. penis –

Internal structures

a. semen –

b. testes –

1. seminiferous tubules –

2. Sertoli cells –

3. interstitial cells of Leydig –

c. epididymis –

d. vas deferens –

e. urethra –

Vasectomy –

Accessory glands –

Fluids contain

a.

b.

c.

d.

e.

Three accessory glands

a. seminal vesicles –

b. bulbourethral glands (Cowper's) –

c. prostate –

2. Female Reproductive Anatomy

External structures

a. breasts –

b. vulva –

1. clitoris –

2. labia majora –

3. labia minora –

4. vestibular glands –

Internal structures

a. ovaries

1. produces eggs

2. corpus luteum –

b. oviducts/uterine tubes/fallopian tubes

1. tubes through which egg moves on its way to uterus

2. at the ends of oviducts are extensions called fimbriae
    -
    -
    -
3. uterus –

    Parts
    - endometrium –
    - cervix –
4. vagina –

Cilia in oviducts sweep egg toward uterus

Tubal ligation –

B. Gametogenesis

Formation of gametes via meiosis; results in haploid cells

1. Spermatogenesis –

    Type of cell division involved –

    Result –

    Begins –
2. Oogenesis –

    Meiosis occurs in outer layers (surface) of ovary

    Number of eggs females are born with –

    Begins –

    FSH function –

Usually one follicle makes it to maturity

Polar bodies –

The process of egg maturation is usually alternated between the ovaries monthly

In females, meiosis is halted two times

After the egg is fertilized, meiosis continues with the formation of the second polar body

Result –

After the union of the sperm (N = 23 chromosomes) and egg (N) nuclei, a zygote (2N = 46 chromosomes) is formed

C. Hormonal Control of Reproduction

Both sexes make the following hormones; they have different functions based on sex

- Gonadotropin releasing hormone (GnRH) from the hypothalamus
- FSH
- LH

1. Male Hormones

At the time of puberty, the following hormones are made

a. hypothalamus –

b. anterior pituitary

- FSH –
- LH –

With sufficient amounts of testosterone –

With sufficient amounts of sperm –

2. Female Hormones

Estrogen and progesterone – control ovarian and menstrual cycles; responsible for secondary sexual characteristics (breast development, wider hips, etc.)

Both the ovarian and the uterine cycles occur simultaneously

a. The Ovarian Cycle

Includes all events occurring in the ovaries:

1. Follicular phase

- days –
-
- low levels of estrogen (from follicle)

a.

b.

2. Ovulation

- day 14 of cycle
- a surge of LH –
- corpus luteum –

3. Luteal phase –

- days –
- large amounts of estrogen and progesterone

a.

b.

- if fertilization occurs –
- if no fertilization occurs –

HCG –

b. The Menstrual (Uterine) Cycle

Includes all events occurring in the uterus

- Menstrual cycle –

- Proliferative phase –

- Secretory phase –

D. Gestation

Gestation –

Lasts approximately 266 days

Fertilization results in formation of -

Many rounds of cell division result in –

Blastocyst –

Implantation –

- outer layers of blastocyst release –
- other cells (chorion) of the blastocyst release –

Importance of HCG –

Three trimesters of about three months each

1. First trimester
    - after 4 weeks –
    - after 5 weeks –
    - after 8 weeks –
2. Second trimester
    - growth
    - placenta makes –
3. Third trimester
    - period of most rapid growth
    - average weight: 6–8 pounds
    - average length: 19–20 inches

Labor –

Events that occur at the end of the third trimester

1.
2.
3.

Three stages

1. dilation –
2. delivery –
3. expulsion –

Chapter 18 Study Guide

18.1 How Animals Reproduce

1. Contrast and compare sexual and asexual reproduction.
2. Define/discuss the various forms of asexual reproduction.
3. What is a hermaphrodite?
4. What are two variations on the normal X and Y chromosomes for sex determination:
5. What is fertilization?
6. Contrast internal and external fertilization.
7. Define the following:
    a. oviparity
    b. ovoviparity
    c. viviparity

18.2 Development and Organogenesis

1. What is the zona pellucida?
2. What is the acrosome?
3. Why does only one sperm (usually) penetrate the egg?
4. What is a zygote? How many chromosomes would a human zygote contain? What is cleavage?
5. What two layers form within the blastula/blastocyst and what is the function of each?
6. What happens during gastrulation?
7. What are the three germ layers and give an example of the type of tissue that they will form?
8. Define organogenesis.
9. What is differentiation?

18.3 Human Reproduction

1. How is sex determined in utero?
2. Know all of the parts of the male reproductive anatomy and their functions. Refer to figure 18.12 and table 18.1.
3. What is semen?
4. What are the three accessory glands and what is their contribution to semen?
5. What is a vasectomy?
6. Know all of the parts of the female reproductive anatomy and their functions. Refer to figure 18.3 and table 18.2.
7. What is gametogenesis?
8. Contrast and compare oogenesis and spermatogenesis.
9. What are polar bodies?
10. With how many ova (egg cells) are females typically born.

11. FSH (follicle stimulating hormone) and LH (luteinizing hormone) are made by both females and male, but have different functions in both. What are these varying functions?
12. In general, how are hormone amounts (any hormone) controlled?
13. In males, where are sperm made? What produces testosterone?
14. What are the three phases of the female cycle (28 days)?
15. Contrast the events occurring in the ovaries and uterus during each of the three phases above.
16. What is the corpus luteum?
17. What is HCG (human chorionic gonadotropin)? What is its function?
18. What occurs during implantation?
19. What is a trimester? Briefly what are some changes in the embryo/fetus during each?
20. What is an embryo? What is a fetus?
21. What are the three stages of labor?
22. For each of the following hormones, tell where they are produced and their function

    Males:

    a. FSH
    b. LH
    c. testosterone
    d. inhibin

    Females:

    a. FSH
    b. LH
    c. estrogen
    d. progesterone
    e. HCG

19

Population and Community Ecology

Chapter 19 Outline

Introduction

19.1 Population Demographics and Dynamics

A. Population Size and Density

1. Estimating Population Size

B. Species Distribution

C. Demography

1. Life Tables

2. Survivorship Curves

19.2 Population Growth and Regulation

A. Population Growth

1. Exponential Growth

2. Logistic Growth

a. Carrying Capacity and the Logistic Model

b. Role of Intraspecific Competition

c. Examples of Logistic Growth

C. Population Dynamics and Regulation

D. Density-dependent Regulation

E. Density-independent Regulation and Interaction with Density-dependent Factors

F. Demographic-Based Population Models

19.3 The Human Population

A. Overcoming Density-dependent Regulation

B. Age Structure, Population Growth, and Economic Development

C. Long-term Consequences of Exponential Human Population Growth

19.4 Community Ecology

A. Predation and Herbivory

1. Defense Mechanisms Against Predation and Herbivory

B. Competitive Exclusion Principle

C. Symbiosis

1. Commensalism

2. Mutualism

3. Parasitism

D. Characteristics of Communities

1. Biodiversity

2. Foundation Species

3. Keystone Species

E. Community Dynamics

1. Primary Succession and Pioneer Species

2. Secondary Succession

Chapter 19 Instructor's Guide

Introduction

Types of invasive species – Asian carp, kudzu, snakehead fish, zebra mussel

19.1 Population Demographics and Dynamics

Populations are dynamic – size and composition fluctuate

Demography – statistical study of populations such as life tables developed by insurance companies

A. Population Size and Density

Population Size – total number of members

Population Density – number of individuals/unit area

1. Estimating Population Size

a. count – count each organism in population

b. use quadrant – count and extrapolate

c. mark and recapture – capture organisms, mark them and then recapture the same amount and see what percentage are marked

(# marked 1st catch x total # 2nd catch) / (# marked 2nd catch) = N

B. Species Distribution

Species distribution pattern – distribution of individuals with in habitat

a. random – no pattern

b. clumped – groups of organisms

c. uniform – pattern

C. Demography

Definition – statistical study of population changes over time: birth rates, death rates, life expectancies

1. Life Tables – show life history and life expectancy

   mortality rate = (# individuals dying / # individuals surviving) x 1,000

2. Survivorship Curves – a graph of the number of individuals surviving at each age

   interval vs. time

19.2 Population Growth and Regulation

A. Population Growth – two models: exponential and logistic

1. Exponential Growth – Population size increases at a greater rate; no limits on growth
   Ex. bacterial growth

   Results in a J-shaped curve

   Death rate – number of individuals that die during an interval

   Birth rate – number of individuals that are born during an interval

   Zero population growth – population size is unchanging

2. Logistic Growth – Population grows until resources become limited

   Results in S-shaped curve

   a. Carrying Capacity and the Logistic Model

      Carrying capacity – maximum population size that particular environment can sustain

   b. Role of Intraspecific Competition

      Intraspecific competition – competition for resources among population members of the same species

   c. Examples of Logistic Growth

B. Population Dynamics and Regulation

1. Density-dependent Regulation – biological in nature; predation, inter/intra species competition, parasites

2. Density-independent Regulation and Interaction with Density-dependent Factors – physical in nature; weather, natural disasters, pollution

C. Demographic-Based Population Models

1. k-selected species – species which tend to have larger, but fewer, offspring; contribute large amounts of resources to each offspring; tend to exist closer to their carrying capacity; adapted to stable, predictable environments

2. r-selected species – species which have large numbers of offspring; do not provide a lot of resources or parental care to offspring; adapted to unstable, unpredictable environments

19.3 The Human Population

The human population is growing exponentially; time between billions being added to population is decreasing

A. Overcoming Density-dependent Regulation

B. Age Structure, Population Growth, and Economic Development

C. Long-term Consequences of Exponential Human Population Growth
- Famine
- Disease
- Large-scale death
- Social consequences of crowding such as increased crime
- Degradation of environment

19.4 Community Ecology

Diversity – number of species occupying the same habitat and their relative abundance

A. Predation and Herbivory

Predation – members of one population kills and consumes members of another population

Herbivory – consumption of plants

1. Defense Mechanisms Against Predation and Herbivory

a. mechanical – armor, thorns

b. chemical – poisons (foxglove – digitalis; mushrooms)

c. physical – body shape (walking stick); coloration (mimicry helps protect some species)

d. behavioral – avoid predator (dig, run fast)

B. Competitive Exclusion Principle

Definition – two species cannot occupy the same niche in a habitat; one species will outcompete the other for resources

Niche – unique set of resources used by a species

C. Symbiosis

Definition – a relationship in which organisms live together

1. Commensalism – one organism benefits and the other is neither helped nor harmed

2. Mutualism – both organisms benefit

3. Parasitism – one organism benefits and the other is harmed

D. Characteristics of Communities

Communities are characterized by structure and dynamics

1. Biodiversity – number of different species in an area and their relative abundance

Species richness – number of species living in a habitat

Island biogeography – relationship between species richness, island size and distance from mainland; there is always great species richness on isolated islands

Relative species abundance – number of individuals of a species compared to the total number of individuals within the system

2. Foundation Species – 'base' of community and has greatest influence on structure; often are primary producers and abundant

Forms the major structural portion of habitat

3. Keystone Species – presence is necessary to maintain biodiversity in an ecosystem and upholding an ecological community's structure

E. Community Dynamics

Definition – changes in community structure and composition over time usually following environmental disturbances

Types of environmental disturbances – volcanic eruptions, earthquakes, storms, fire, climate change

Community equilibrium – relative constant number of species

Succession – sequential appearance and disappearance of species in a community after a severe disturbance

Primary succession – new or newly exposed rock is colonize

Secondary succession – part of an ecosystem is disturbed, but part of previous community remains

1. Primary Succession and Pioneer Species

New land is formed (i.e. after a volcanic eruption)

First species that can grow (lichens/plants) are known as pioneer species

a. pioneer species – first species that appear after major ecosystem disturbance; break up rock further so that other species can become established

2. Secondary Succession

Follows a disruption (i.e. fire), but there is already a soil ecosystem

a. pioneer species – annual plants, grasses, ferns, perennials

b. intermediate species – shrubs, pines, oaks

c. climax community – mature trees in forest

Could take up to 150 years to reach a climax community again

Chapter 19 Student's Outline

Introduction

Types of invasive species

19.1 Population Demographics and Dynamics

Populations are dynamic

Demography –

A. Population Size and Density

Population Size –

Population Density –

1. Estimating Population Size

a. count –

b. use quadrant –

c. mark and recapture –

B. Species Distribution

Species distribution pattern –

a. random –

b. clumped –

c. uniform –

C. Demography

Definition –

1. Life Tables –

2. Survivorship Curves –

19.2 Population Growth and Regulation

A. Population Growth – two models

1. Exponential Growth –

Results in a J-shaped curve

Death rate –

Birth rate –

Zero population growth –

2. Logistic Growth

Results in S-shaped curve

a. Carrying Capacity and the Logistic Model

Carrying capacity –

b. Role of Intraspecific Competition

Intraspecific competition –

c. Examples of Logistic Growth

B. Population Dynamics and Regulation

1. Density-dependent Regulation –

2. Density-independent Regulation and Interaction with Density-dependent Factors

C. Demographic-Based Population Models

1. k-selected species –

2. r-selected species –

19.3 The Human Population

Present growth of human population –

A. Overcoming Density-dependent Regulation

B. Age Structure, Population Growth, and Economic Development

C. Long-term Consequences of Exponential Human Population Growth

-
-
-
-
-

19.4 Community Ecology

Diversity –

A. Predation and Herbivory

Predation –

Herbivory –

1. Defense Mechanisms Against Predation and Herbivory

a. mechanical –

b. chemical –

c. physical –

d. behavioral –

B. Competitive Exclusion Principle

Definition –

Niche –

C. Symbiosis

Definition –

1. Commensalism –

2. Mutualism –

3. Parasitism –

D. Characteristics of Communities

1. Biodiversity –

Species richness –

Island biogeography –

Relative species abundance –

2. Foundation Species –

3. Keystone Species –

E. Community Dynamics

Definition –

Types of environmental disturbances –

Community equilibrium –

Succession –

1. Primary Succession and Pioneer Species

a. pioneer species –

2. Secondary Succession

a. pioneer species –

b. intermediate species –

c. climax community –

Chapter 19 Study Guide

19.1 Population Demographics and Dynamics

1. Name four invasive species.
2. Define demography.
3. What is population size? What is population density?
4. Explain the three ways to estimate population size.
5. Explain the three types of species distribution patterns.
6. What do life tables show?
7. Who first came up with life tables?
8. What does a survivorship curve show?

19.2 Population Growth and Regulation

1. Contrast the two models of population growth.
2. What is the carrying capacity?
3. What is intraspecific competition?
4. Contrast (and give examples) of density-dependent and density-independent factors that regulate population growth.
5. Contrast k-selected and r-selected species.

19.3 The Human Population

1. What is the present population of the Earth estimated to be?
2. By what model is the human population growing?
3. What are several long-term consequences of exponential growth for the human population?

19.4 Community Ecology

1. What is diversity?
2. Differentiate between predation and herbivory.
3. List and give examples of four different defense mechanisms against predation and herbivory.
4. What is the competitive exclusion principle?
5. What is a niche?
6. What is symbiosis?
7. Define each of the three types of symbiotic relationships.
8. What is biodiversity?
9. What is species richness?
10. What is meant by relative species richness?

11. Differentiate between a foundation species and a keystone species.
12. What are several types of environmental disturbances?
13. What is succession?
14. Contrast primary and secondary succession.
15. What is a pioneer species?
16. What are the three stages of secondary succession and describe the vegetation that represents each stage.

20

Ecosystems and the Biosphere

Chapter 20 Outline

Introduction

20.1 Energy Flow Through Ecosystems

A. Ecology of Ecosystems

1. Ecosystems and Disturbance

B. Food Chains and Food Webs

C. How Organisms Acquire Energy in a Food Web

D. Consequences of Food Webs: Biological Magnification

20.2 Biogeochemical Cycles

A. The Water Cycle

B. The Carbon Cycle

1. The Biological Carbon Cycle

2. The Biogeochemical Carbon Cycle

C. The Nitrogen Cycle

D. The Phosphorus Cycle

E. The Sulfur Cycle

20.3 Terrestrial Biomes

A. Tropical Forest

B. Savannas

C. Deserts

D. Chaparral

E. Temperate Grasslands

F. Temperate Forests

G. Boreal Forests

H. Artic Tundra

20.4 Aquatic and Marine Biomes

A. Marine Biomes

1. Ocean

2. Coral Reefs

3. Estuaries: Where the Ocean Meets Fresh Water

B. Freshwater Biomes

1. Lakes and Ponds

2. Rivers and Streams

C. Wetlands

Chapter 20 Instructor's Outline

Introduction

Ecosystem ecology – ecology of organisms, populations and communities
Ecosystem biologists study how nutrients and energy are stored and cycles among organisms and atmosphere, soil and water

20.1 Energy Flow through Ecosystems

Ecosystem – community of living organisms and their abiotic environment in a particular geographic area
Three categories of ecosystems – freshwater, marine and terrestrial

A. Ecology of Ecosystems

Organisms compete for food, water, sunlight and space

Freshwater – 1.8% of Earth's surface; includes lakes, rivers, streams, and springs

Marine – 75% of Earth's surface

Three types:
a. shallow ocean – includes the coral reef ecosystem
b. deep ocean water
c. deep ocean bottom

40% of all photosynthesis on Earth is performed by phytoplankton

Terrestrial – ecosystems found on land

Biome – large community of organisms

Defined by plant types, geographic region, climate
Ex.: tropical rainforests, savannas, deserts, grasslands, temperate forests, tundra

1. Ecosystems and Disturbance

Ecosystems are complex with many interacting parts
Types of disturbances – fires, earthquakes, volcanic eruptions, floods, hurricanes, drought
Also includes human activities – agriculture, air pollution, deforestation, acid rain, oil spills

Equilibrium – even though there are changes in species numbers and occurrence, biodiversity remains almost constant

Resistance – ability of an ecosystem to maintain equilibrium even with disturbances
Resilience – the speed at which an ecosystem recovers equilibrium following a disturbance

B. Food Chains and Food Webs

Food chain – a linear sequence of organisms that nutrients and energy pass through as one organism eats another

Energy is lost at each trophic level as heat

Trophic level – an energy level in a food chain

Producers – organisms that carry on photosynthesis
Primary consumers – eat producers directly
Secondary consumers – eat primary consumers
Tertiary consumers – eat secondary consumers
Apex consumers – top-level predator

Food Web – interconnected food chains; interactions between organisms across trophic levels (secondary consumer may eat primary consumer and producer)

Grazing food web – photosynthesizers --- herbivores --- carnivores
Detrital food web – base organisms (decomposers) feed on dead organisms
Ex.: bacteria, fungi and invertebrates such as worms

C. How Organisms Acquire Energy in a Food Web

Autotrophs – 'self-feeder'; make their own food

Photoautotrophs – carry on photosynthesis (Sun is source of energy)
Ex.: plants, algae, bacteria

Gross primary productivity – rate at which photosynthesizers trap energy from the Sun

Net primary productivity – energy that remains in producers after accounting for their respiration and heat loss; energy that is available to primary consumers

Chemoautotrophs – inorganic molecules are source of energy
Ex.: Bacteria and Archaea

D. Consequences of Food Webs

Biological Magnification – the tendency of toxins to become concentrated as they pass through a food chain

Ex.:
- DDT affected the shells of bald eagle (apex predator); Rachel Carson wrote about this in 1960s book Silent Spring
- PCBs
- Heavy metals such as lead and mercury

20.2 Biogeochemical Cycles

A. The Water Cycle – driven by the energy of the sun; water evaporates, condenses and falls back to Earth as precipitation

B. The Carbon Cycle – component of all organic molecules

1. The Biological Carbon Cycle – carbon cycles through living organisms
2. The Biogeochemical Carbon Cycle – carbon cycles through land, water and air; fossil fuels are a non-renewable resource

C. The Nitrogen Cycle – 78% of air; nitrogen becomes available to living organism due to the actions of N_2-fixing and denitrifying bacteria

D. The Phosphorus Cycle – phosphorus cycles very slowly (hundreds to thousands of years);

Dead zone – area with depleted of natural flora and fauna near the mouth of a river due to the run-off of phosphorus and nitrogen

Causes:
- Eutrophication
- Oil spills
- Dumping toxins

E. The Sulfur Cycle – fallout from atmosphere; acid rain (weak H_2SO_4)

20.3 Terrestrial Biomes

A. Tropical Forest

Near equator
Most diverse, but under threat
Nature's pharmacy
Evergreen trees with large leaves that form canopy
Temperature range: 68ºF – 93ºF
Rainfall: 8–15 inches per year
Very high net primary productivity

B. Savannas

Grasslands with scattered trees
Grasses and herbaceous plants
Long dry season with frequent fires
Temperature: 75ºF – 84ºF
Rainfall: 51–127 inches per year

C. Deserts

Very dry; high rate of evaporation
Low species diversity – plants are annuals; animals are generally nocturnal
Temperature range: 140ºF (day) – 32ºF (night)
Rainfall: less than 12 inches per year
Cold deserts – freezing temperatures in winter; precipitation as snowfall

D. Chaparral

Scrub forest
Summers are very dry
Main type of vegetation – shrubs, some with seeds that only germinate after fire
Rainfall: 25–30 inches per year

E. Temperate Grasslands

Called prairies in North America; steppes in Eurasia
Hot summers and cold winters
Plant growth occurs during spring, summer, and fall
Dominant vegetation – grasses; trees along rivers and stream
Fertile soil
Maintained by fire
Rainfall: 10–35 inches per year

F. Temperate Forests

Main type of vegetation – deciduous trees (lose leaves)
Trees do leaf out and shade ground, but trees are not as tall as in rainforest
Soils are rich in organic matter
Temperature range: -22°F – 86°F
Rainfall: 30–59 inches

G. Boreal Forests

Taiga; coniferous forest
Cold dry winters and short, cool, wet summers
Main type of vegetation – cold tolerant cone-bearing plants (evergreen coniferous trees)
Lower species diversity than in other forests
Rainfall: 16–39 inches

H. Arctic Tundra

Arctic areas; very cold
Permafrost – soil is frozen almost year round; melts some in summer creating soggy soil
Short growing season: 50–60 days; 24 hours of sunlight during growing season
Low shrubs, grasses, lichens and small flowering plants
Low species diversity and low net primary productivity
Average temperature: -29.2°F

20.4 Aquatic and Marine Biomes

Influenced by abiotic factors such as light, temperature, flow and dissolved solids

A. Marine Biomes – includes the oceans with coral reefs and estuaries

1. Ocean

Zones based on depth

Pelagic – open water
Benthic – from surface to deepest parts of the ocean floor
Photic – from surface to the limit where photosynthesis can occur
Aphotic – depths greater than light can penetrate
Abyssal – deepest part of ocean; very cold; high pressure

Deepest point in ocean is Challenger Deep in the Mariana Trench in the Pacific Ocean – 6.8 miles deep; average ocean depth is 14,000 feet

Zones based on distance from land

Intertidal – closest to land
Neritic – from margin of intertidal zone to edge of intertidal zone; highest productivity and biodiversity of entire ocean
Oceanic – open ocean

2. Coral Reefs

Formed by marine invertebrates; corals secrete calcium carbonate skeleton forming reef
One of most diverse biomes; 4,000 species of fish alone
Threatened by pollution and rising ocean temperatures

3. Estuaries: Where the Ocean Meets Fresh Water

Diluted (brackish) salt water
Once or twice daily, tides bring in salt water
Plants and animals have adapted to the salty environment

B. Freshwater Biomes

Ecosystem services – human benefits from ecosystems
Ex.: drinking water, crop irrigation, sanitation, etc.

1. Lakes and Ponds

Temperature is important factor affecting life in lakes and ponds
Deep lakes show thermal stratification in summer; warmer layers on top contain photosynthesizers
Cooler temperatures and winds in the fall cause the layers to mix
Nitrogen and phosphorus are limiting nutrients

Eutrophication – high levels of N and P due to runoff (fertilizer/sewage) leads to an algal bloom which cuts off light; algae and other photosynthesizers die; depleted oxygen levels lead to massive fish die offs

2. Rivers and Streams

Continuously moving bodies of water
Empty into lake or ocean
Source water – point of origin of a stream; cold, low in nutrients, and clear
Channel – width of the river or stream
Headwater stream – the beginning of a stream; main organisms in the fast-moving water are algae growing on rocks and invertebrates (worms, predatory fish)
As river or stream flows away from its source, the channel widens and the current slows; organisms found here include phytoplankton, worms, insects, frogs, and fish
As river approaches the ocean, it slows and any silt present will settle out

C. Wetlands

Environment in which soil is either permanently or periodically saturated with water
Emergent vegetation – wetlands plants that are rooted in soil, but have portions of leaves, stems and flowers above the water's surface

Includes marshes (fresh and saltwater), swamps, bogs, mudflats
Marshes and swamps – slow and steady water flow

Bogs – no water flow of water; clay bottom with poor percolation (the movement of water through pores in soil or rock); stagnant water leads to low oxygen and pH levels; no nitrogen is available to plants so carnivorous plants (Pitcher plants, bladderworts, sundews) consume insects for a source of nitrogen

Chapter 20 Student's Outline

Introduction

Ecosystem ecology –

Ecosystem biology –

20.1 Energy Flow through Ecosystems

Ecosystem –

Three categories of ecosystems –

A. Ecology of Ecosystems

Freshwater –

Marine –

Three types:

a.

b.

c.

Terrestrial –

Biome –

1. Ecosystems and Disturbance

Ecosystems are complex

Types of disturbances –

Human activities

Equilibrium –

Resistance –

Resilience –

B. Food Chains and Food Webs

Food chain

Trophic level –

Producers –

Primary consumers –

Secondary consumers –

Tertiary consumers –

Apex consumers –

Food Web –

Grazing food web –

Detrital food web –

C. How Organisms Acquire Energy in a Food Web

Autotrophs

Photoautotrophs –

Gross primary productivity –

Net primary productivity –

Chemoautotrophs –

D. Consequences of Food Webs

Biological Magnification –

Examples –

20.2 Biogeochemical Cycles

A. The Water Cycle

B. The Carbon Cycle

1. The Biological Carbon Cycle

2. The Biogeochemical Carbon Cycle

C. The Nitrogen Cycle

D. The Phosphorus Cycle

Dead zone –

Causes:

-
-
-

E. The Sulfur Cycle

20.3 Terrestrial Biomes

A. Tropical Forest

B. Savannas

C. Deserts

D. Chaparral

E. Temperate Grasslands

F. Temperate Forests

G. Boreal Forests

H. Arctic Tundra

20.4 Aquatic and Marine Biomes

A. Marine Biomes

1. Ocean

Zones based on depth

Pelagic –

Benthic –

Photic –

Aphotic –

Abyssal –

Zones based on distance from land

Intertidal –

Neritic –

Oceanic –

2. Coral Reefs

3. Estuaries: Where the Ocean Meets Fresh Water

B. Freshwater Biomes

1. Lakes and Ponds

Eutrophication –

2. Rivers and Streams

C. Wetlands

Emergent vegetation –

Marshes and swamps –

Bogs –

Chapter 20 Study Guide

20.1 Energy Flow through Ecosystems

1. Ecosystem ecology involves the study of what three things?
2. What is an ecosystem?
3. What are the three categories of ecosystems? What are several characteristics and examples of each?
4. What is a biome? Give examples of terrestrial biomes.
5. What are several types of disturbances (natural and man-made) of ecosystems?
6. What is the equilibrium of an ecosystem?
7. What is resistance? What is resilience?
8. What is a food chain?
9. What is a trophic level?
10. List and discuss each of the five different trophic levels of a food chain.
11. What is a food web?
12. Contrast a grazing food web with a detrital food web.
13. What is an autotroph? What are the two types? Which one has more of an impact on the planet and why? Give examples of the two types.
14. What is gross primary productivity?
15. What is net primary productivity?
16. What is biomagnification? Give several examples.

20.2 Biogeochemical Cycles

1. What are 5 compounds/elements that are constantly recycled?

20.3 Terrestrial Biomes

20.4 Marine and Aquatic Biomes

1. Know each of the terrestrial and aquatic biomes as to location, climate, flora and fauna, etc.

21

Conservation and Biodiversity

Chapter 21 Outline

Introduction

21.1 Importance of Biodiversity

A. Types of Biodiversity

1. Genetic and Chemical Biodiversity

2. Ecosystems Diversity

3. Current Species Diversity

B. Patterns of Biodiversity

C. Importance of Biodiversity

1. Human Health

2. Agriculture

3. Wild Food Sources

21.2 Threats to Biodiversity

A. Habitat Loss

B. Overharvesting

C. Exotic Species

D. Climate Change

21.3 Preserving Biodiversity

A. Change in Biodiversity Through Time

B. Recent and Current Extinction Rates

C. Estimates of Present-day Extinction Rates

D. Conservation of Biodiversity

1. Changing Human Behavior

2. Conservation in Preserves

3. Habitat Restoration

4. The Role of Zoos and Captive Breeding

Chapter 21 Instructor's Outline

Introduction

Species extinction – currently 500-1,000 times the rates seen before; will lead to a decrease in biodiversity
Occurring most rapidly in rainforest due to deforestation; from 1970-2011, 20% of the Amazon rainforest was lost
Rainforests are the most diverse ecosystems on the planet
'Invisible' species become extinct; we are not even aware that they are gone
Endangered species – at great risk of extinction

21.1 Importance of Biodiversity

Definition – biological variety; number of species and number of individuals in each species

Effect of species loss – collapse of ecosystems; increased costs of food, to maintain clean air and water, and to improve health (important, possibly life-saving chemicals are lost)

A. Types of Biodiversity

Common measure –

Alternate measures of biodiversity:

1. Genetic and Chemical Biodiversity

a. genetic diversity – variation in genes in population
b. chemical diversity – variation in chemicals made within cells; may be useful to humans as medicines

2. Ecosystems Diversity

Definition – number of different ecosystems on Earth
Example of largely extinct ecosystem: prairies in central North America

3. Current Species Diversity (Table 21.1)

8.7 million eukaryotic species today (estimate)
@ 1.5 million have been described/named
Extinction – total loss of a species
17,000-20,000 new species described each year
Extinction is removing species faster than they can be characterized

B. Patterns of Biodiversity

Biodiversity is not evenly distributed on Earth; biodiversity ‘hot spots’ exist
Endemic species – found only in one location; particularly vulnerable to extinction
Habitat heterogeneity – number of different ecological niches

Biodiversity increases closer to the equator:
- Greater age of ecosystems
- Greater energy input
- Greater habitat heterogeneity

Potential for loss of biodiversity is high

C. Importance of Biodiversity

1. Human Health

Secondary plant compounds (venoms, poisons, toxins) could be potential medicines

Ex.:
- Aspirin
- Codeine
- Digoxin
- Atropine
- Vincristine

Antibiotics come mainly from Bacteria and Fungi

Biophilia – love and need for nature (biodiversity)

2. Agriculture

We must continually breed new varieties of crops in order to avoid any being ‘wiped out’ due to disease or pests

Svalbard Global Seed Vault (Norway) stores seeds from around the world

Ecosystem services:
- Organisms which cycle nutrients and breakdown organic matter
- Plant pollination
- Natural pest control

3. Wild Food Sources

Fish are generally not being managed sustainably
Probably will not be fished to extinction, but will affect marine/aquatic ecosystems

21.2 Threats to Biodiversity

A. Habitat Loss

Due to human population growth and use of resources

B. Overharvesting

Due to human population growth and use of resources such as:
- Fisheries – for food
- Coral reef – for aquariums
- Bush meat – for food

C. Exotic Species

Due to increase in mobility and trade
Species reset ecological conditions in their new environment
Ex.:
- Nile perch in Lake Victoria
- Brown tree snake in Guam
- Zebra mussel in Great Lakes
- European green crab in San Francisco Bay

Pathogens can also be brought into an ecosystem
- White nose syndrome (fungus) affects North American bats

D. Climate Change

Human cause; may become significant during this century
Is shifting ranges of organisms causing contact between organisms that otherwise would not have come in contact; sometimes these organisms breed (affects gene pool)
Will cause rise in ocean levels

21.3 Preserving Biodiversity

A. Change in Biodiversity Through Time

Five mass extinctions
Most recent @ 65 mya; dinosaurs lost probably due to asteroid impact on Yucatan Peninsula

B. Recent and Current Extinction Rates

Sixth mass extinction occurring now due to human impact
International Union for Conservation of Nature (IUCN) keeps lists of endangered and extinct species – the 'Red List'

C. Estimates of Present-day Extinction Rates

Background rate – 10 of 1,000,000 species become extinct every year = 1E/MSY
MSY – million species years

Present day rate – 100 E/MSY

End of century – 1,500 E/MSY

D. Conservation of Biodiversity

1. Changing Human Behavio

Through legislation:

- 1918 – Migratory Bird Treaty Act (MBTA) between U.S. and Canada
- 1973 – Endangered Species Act
- 1975 – Conservation on International Trade and Endangered Species (CITES) treaty
- Nature Conservancy – purchases land and sets aside

2. Conservation in Preserves

Preserve – area of land set aside to protect organisms
Preserves perform better when protected by buffer zones (area around preserve)
Limitations of preserves:

- Enforcement of protections
- Migration of species due to climate change

Biodiversity ‘hot spots’ need to be saved first

3. Habitat Restoration

Restore keystone species like the wolves in Yellowstone Park
Removal of dams
Planting trees
Developing parks

4. The Role of Zoos and Captive Breeding

Have brought back many species
Not as much success reintroducing species back into wild

Chapter 21 Student's Outline

Introduction

Species extinction –

Occurring more rapidly in –

Most diverse ecosystems –

Endangered species –

21.1 Importance of Biodiversity

Definition –

Effect of species loss –

A. Types of Biodiversity

1. Genetic and Chemical Biodiversity

   a. genetic diversity –

   b. chemical diversity –

2. Ecosystems Diversity

   Definition –

   Example of largely extinct ecosystem –

3. Current Species Diversity (Table 21.1)

   Number of species –

Extinction –

B. Patterns of Biodiversity

Biodiversity not evenly distributed –

Endemic species –

Habitat heterogeneity –

Biodiversity increases closer to the equator:

-
-
-

Potential for loss of biodiversity is high

C. Importance of Biodiversity

1. Human Health

Secondary plant compounds –

Examples:

-
-
-
-
-

Source of antibiotics –

Biophilia –

2. Agriculture

Need for new varieties of crops –

Svalbard Global Seed Vault (Norway) –

Ecosystem services:

-
-
-

3. Wild Food Sources

21.2 Threats to Biodiversity

A. Habitat Loss

Due to –

B. Overharvesting

Due to human population growth and use of resources such as:

-
-
-

C. Exotic Species

Due to –

How these species affect environment –

Examples:

-
-
-

Pathogens can also be brought into an ecosystem:

-

D. Climate Change

Human cause

Results of shifting ranges –

Will see rise in ocean levels

21.3 Preserving Biodiversity

A. Change in Biodiversity through Time

Five mass extinctions

Most recent –

B. Recent and Current Extinction Rates

Sixth mass extinction occurring now

IUCN –

C. Estimates of Present-day Extinction Rates

Background rate –

Present day rate –

End of century –

D. Conservation of Biodiversity

1. Changing Human Behavior

Through legislation:

-
-
-

2. Conservation in Preserves

Preserve –

Buffer zone –

Limitations of preserves:

-
-

Biodiversity ‘hot spots’ –

3. Habitat Restoration

-
-
-

4. The Role of Zoos and Captive Breeding

-

Chapter 21 Study Guide

21.1 Importance of Biodiversity

1. What is the present extinction rate? In which biome is extinction occurring most rapidly?
2. What is biodiversity?
3. What are several effects of biodiversity/species loss?
4. What is genetic diversity?
5. What is chemical diversity? Why is it so important for humans?
6. What is ecosystem diversity?
7. How many new species are described each year?
8. What is extinction?
9. What is an endemic species?
10. Discuss each of the three reasons that biodiversity is so important.
11. What is biophilia?

21.2 Threats to Biodiversity

1. Discuss each of the four threats to biodiversity.

21.3 Preserving Biodiversity

1. What is the estimated present-day rate of extinction?
2. What is the difference between and threatened and endangered species?
3. What is a biodiversity ‘hot spot’?
4. Discuss each of the three main efforts to preserve biodiversity

Appendices

Appendix A: Web Resources and Teaching Tips

Chapter 12: Diversity of Life

Tree of Life Web Project (ToL) – Provides information about biodiversity, the characteristics of different groups of organisms, and their evolutionary history (phylogeny). © 1995-2004 Tree of Life Project. All rights reserved. ToL Policies refer to Fair Use Guidelines for Educational Multimedia.

Have students produce a phylogenetic tree for an organism.

Chapter 13: Diversity of Microbes, Fungi, and Protists

Microbe World – This site is affiliated with The American Society for Microbiology and provides information about all types of microbes, fungi and protists. © 2014 American Society for Microbiology. See the site's Terms of Use to determine fair use status of information.

Microbiology Online – This site is affiliated with the Society for General Microbiology and also contains a wealth of information about the different types of microbes, fungi and protists. © 2015 Society for General Microbiology.

Using one of the various word search makers that can be found online, create a word search with topics from the chapter.

Chapter 14: Diversity of Plants

Natural Resources Conservation Service Plants Database – This site is affiliated with the U.S. Department of Agriculture and "provides standardized information about the vascular plants, mosses, liverworts, hornworts and lichens of the U.S. and its territories." Most information on the USDA Web site is considered to be in the public domain.

Have students explore your campus (or their own environment) for an example of specific plants (moss, fern, gymnosperm, angiosperm, etc.) and take photos to share with classmates. You could produce a slide show from the photos they provide.

Chapter 15: Diversity of Animals

Encyclopedia of Life on Earth (eol) – This website provides "Global access to knowledge about life on Earth." There is information about all of the major phyla of animals. There is also information about plants, fungi, bacteria, archaea and viruses. Most of the information at eol is openly reusable by virtue of licensing through Creative Commons.

The Encyclopedia of Earth (eoearth) – On this website one can find "Expert-reviewed information about the Earth. For everyone." The 'Encyclopedia' includes twenty-one topics covering biodiversity, biology, ecology, environmental and Earth science, and society and the environment. Most of the content at eoearth is available under the terms of the Creative Commons Attribution-Share Alike license.

Create a crossword puzzle about the different animal phyla for students to complete. A number of crossword puzzle generators are available online. Make sure your hints sufficiently test students' knowledge.

Chapter 16: The Body's Systems

Innerbody - This website allows one to "Explore the human body like never before!" It contains "hundreds of interactive anatomy pictures" with descriptions of the functions of organs and structures that comprise each of the body systems. There is also a short tutorial which shows how to "get the most out of InnerBody." © 1999-2015 Howtomedia, Inc. All rights reserved.

Have students research various pathologies of particular body systems.

Create a Jeopardy™ game using an online game generator.

Chapter 17: The Immune System and Disease

Centers for Disease Control, US Government - This is the official website of the Centers for Disease Control and Prevention. It covers diseases and conditions from A – Z. Most information is in public domain.

Have students go to the CDC website. Using the "CDC A-Z Index" drop down, assign diseases for research. (I told students to choose a disease using the first letter of their last name.)

Chapter 18: Animal Reproduction and Development

One can find a plethora of websites with excellent activities for teaching human reproduction by searching 'teaching tips for human reproduction.'

Chapter 19: Population and Community Ecology

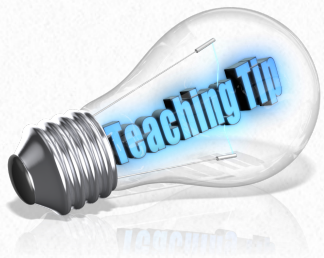
Nature - the "Scitable by Nature Education" part of the website "is a free science library and personal learning tool brought to you by Nature Publishing Group, the world's leading publisher of science." Upon reaching the 'Scitable' site, the Library link brings up Topic Rooms, eBooks, Spotlights, Blogs and Forums, Multimedia and the Knowledge Project. Although the 'Knowledge Project' is no longer active, articles are archived there and available for educational and non-commercial use. Some of the topics covered include population and community ecology, ecosystem ecology, and conservation and restoration.

Have students visit a cemetery to gather data for creating a survivorship curve.

Chapter 20: Ecosystems and the Biosphere

Missouri Botanical Garden - This website contains information about each of the biomes of the world, freshwater ecosystems, and marine ecosystems.

Assign groups of students a particular biome to research and present to the class.



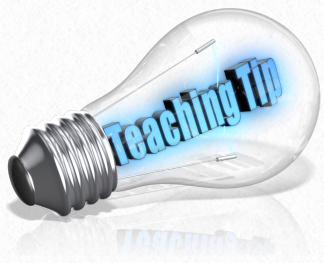
Have students calculate their carbon footprint using one of several online calculators.

Chapter 21: Conservation and Biodiversity

E. O. Wilson Biodiversity Foundation - This website has information about biodiversity from one of the most important conservationists of our time, E. O. Wilson. Also, an iBook and iTunesU course, both titled “Biology: Life on Earth,” are available. © 2013 E. O. Wilson Biodiversity Foundation.

International Union for Conservation of Nature and Natural Resources Red List - This website provides information about threatened or endangered species. Downloading and remixing are allowed under certain conditions. © International Union for Conservation of Nature and Natural Resources

World Wildlife Fund - This website provides information about conservation efforts involving species around the world. Use of information is defined by the Site Terms. © 2015 World Wildlife Fund.



Have groups of students research the different threats to biodiversity.

Have students choose and research a threatened or endangered species.

Additional Teaching Tips: These will be useful for any topic.

Create inquiry based lessons or find ready-made ones using the resources found at Webquest.

Have students create a digital portfolio of all activities done throughout the course using a tool like Educlipper or Dropr.

Assign a topic and have students create sharable bookmark collections using Symbaloo or Papaly.

Assign a topic and have students create a website using a tool such as Weebly or Silk.

Appendix B: Sample Calendar for Introductory Biology II

This calendar is designed for a class that meets 75 minutes twice per week for lecture and 110 minutes once per week for lab over a fifteen-week semester.

Week 1:	Lecture	Review syllabus and demonstrate how to access text; Chapter 12: Diversity of Life; 12.1, Classification; 12.2, Evolutionary Relationships
	Lab	Pre-test
Week 2:	Lecture	Chapter 13: Diversity of Microbes, Fungi and Protists; 13.1, Prokaryotes
	Lab	Review of Lab Safety Procedures
Week 3:	Lecture	13.2, Eukaryotic Origins; 13.3, Protists; 13.4, Fungi; Exam 1
	Lab	Exploring Bacteria, Protists and Fungi
Week 4:	Lecture	Chapter 14: Diversity of Plants; 14.1, Plant Kingdom; 14.2, Seedless Plants; 14.3, Gymnosperms; 14.4, Angiosperms
	Lab	Plant Diversity
Week 5:	Lecture	Exam 2; Chapter 15: Diversity of Animals; 15.1, Features of Animal Kingdom; 15.2, Sponges and Cnidarians
	Lab	Flowers and Fruit
Week 6:	Lecture	15.3, Flatworms, Nematodes and Arthropods; 15.4, Mollusks and Annelids; 15.5, Echinoderms and Chordates; 15.6, Vertebrates: Fish and Amphibians
	Lab	Animal Diversity
Week 7:	Lecture	15.6, Vertebrates: Reptiles, Birds, and Mammals; Exam 3
	Lab	Animal Diversity; Virtual Tour of the Okefenokee Swamp

Week 8:	Lecture	Chapter 16: The Body's Systems; 16.1, Homeostasis and Osmoregulation, Excretory System; 16.2, Digestive System
	Lab	Lab Mid-term Exam; Diversity of Plants and Animals
Week 9:	Lecture	16.3, Circulatory and Respiratory Systems; 16.4, Endocrine System; 16.5, Musculoskeletal System
	Lab	Kidneys and Digestive System
Week 10:	Lecture	16.6, Nervous System; Exam 4
	Lab	The Heart, Respiratory System, Bones and Muscles
Week 11:	Lecture	Chapter 17: The Immune System; 17.1, Viruses; 17.2, Innate Immunity; 17.3, Adaptive Immunity; 17.4, Disruptions in Immune System; Chapter 18: Animal Reproduction and Development; 18.1, How Animals Reproduce; 18.2, Development and Oogenesis
	Lab	Immune System
Week 12:	Lecture	18.3, Human Reproduction; Exam 5
	Lab	Reproductive System
Week 13:	Lecture	Chapter 19: Population and Community Ecology; 19.1, Population Demographics; 19.2, Population Growth and Regulation; 19.3, The Human Population; 19.4, Community Ecology; Chapter 20: Ecosystems and the Biosphere; 20.1, Energy Flow; 20.2, Biogeochemical Cycles
	Lab	Cemetery Demographics
Week 14:	Lecture	20.3, Terrestrial Biomes; 20.4, Marine Biomes; Chapter 21: Conservation and Biodiversity; 21.1, The Importance of Biodiversity; 21.2, Threats to Biodiversity; 21.3, Preserving Biodiversity
	Lab	Ecology Lab
Week 15:	Lecture	Exam 6; Review for Final Exam
	Lab	Lab Final

Appendix C: A Virtual Tour of the Okefenokee Swamp

The Okefenokee Swamp is the largest blackwater swamp in North America, covering 438,000 acres in southern Georgia and northern Florida. It is home to many species of plants, birds, amphibians, and reptiles. The majority of the images in the "Virtual Tour of the Okefenokee Swamp" were taken (with an iPhone!) at the private Okefenokee Swamp Park near Waycross, Georgia, though some were taken at the Okefenokee National Wildlife Refuge, at the Suwannee Canal entrance on the eastern side near Folkston, Georgia, and at the Stephen C. Foster State Park on the western side near Fargo, Georgia.

Movie Appendices.1 Virtual Tour of the Okefenokee

A closed captioned version of the tour is available at YouTube. *The captions contain the common name and the scientific name for each organism depicted. The video could be shown without the captions for quiz purposes; students could check their answers by viewing the video with the captions enabled.*