

# BIO 10 GENERAL BIOLOGY LECTURE MANUAL

Section 5046

Fall 2011



Instructor- Dr. Jeffery R. Hughey

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Section 5046, Fall 2011

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Front cover image is a scanned leaf of the California Sycamore, *Platanus racemosa* Nutt.

# General Biology- Biology 10

## Lecture and Laboratory Schedule- Sections 5046

Dr. Jeffery R. Hughey  
Hartnell College

Fall 2011 Semester  
T/TH- 6:00 PM-8:50 PM, MER 6

Dates	Lecture and Lab Topics	Reading
August 16	Introduction, Properties & Organization of Life	Chapter 1
August 18	Orientation, Safety, Scientific Method	Topic 1
August 23	Chemistry and Molecules of Life	Chapters 2, 3
August 25	Metric System	Topic 2
August 30	Cells and Cellular Respiration	Chapters 4, 5, 7
September 1	Microscopy	Topic 3, App. A
September 6	Mitosis and Meiosis, Cancer	Chapters 8, 9
September 8	Cells	Topic 4
September 13	Cancer and Foundations of Genetics	Chapters 8, 10
September 15	Cell Environment	Topic 5
September 20	DNA, " <i>The Secret of Photo 51</i> "	Chapter 11
September 22	Carbohydrates	Topic 6
<i>September 27</i>	<i>College Closed, Faculty Flex Day</i>	
September 29	Enzymes	Topic 7
<b>October 4</b>	<b>LECTURE EXAMINATION #1</b>	
<b>October 6</b>	<b>LABORATORY MIDTERM</b>	
October 11	Genes and Gene Technology	Chapters 12, 13
October 13	Cell Division	Topic 10
October 18	Genomics, Cell Technology, Cloning	Chapters 12, 13
October 20	DNA Biology	Topic 11
October 25	Evolution, Agents of Evolution, & its Critics	Chapter 14
October 27	Genetics	Topic 12
November 1	Ecology and Ecosystems, Photosynthesis	Chapters 6, 35, 36
November 3	Biotechnology	Topic 13, App. B
<b>November 8</b>	<b>LECTURE EXAMINATION #2</b>	

November 10	Natural Selection	Topic 14
November 15 November 17	Classification and the Prokaryotes Ecology	Chapters 15, 16 Topic 18
November 22 <i>November 24</i>	Virology, Kingdoms Protista and Fungi <i>Thanksgiving Holiday, Campus Closed</i>	Chapters 16-18
November 29 December 1	Kingdoms Plantae and Animalia Senses and Perception	Chapters 19, 32 Topic 17
December 6 <b>December 8</b>	<i>“Journey of Man”</i> and Out of Africa <b>LABORATORY FINAL</b>	Chapter 21
<b>December 13</b>	<b>COMPREHENSIVE LECTURE EXAMINATION (6:00-8:50 PM)</b>	

### COURSE DESCRIPTION

An introduction to the facts and principles of general biology with emphasis on the diversity, morphology, cellular and organismal physiology, heredity, evolution, and ecology of living organisms.

### COURSE OBJECTIVES

1. Develop an appreciation of the need for scientific literacy, learning and communication of ideas.
2. Organize the developmental sequence for the origin of life.
3. Organize the developmental sequence for the origin of cells.
4. Distinguish between cell organelles and their functions.
5. Diagram major physical cell processes, including diffusion, osmosis, dialysis and active transport.
6. Compare and arrange the steps of mitosis and meiosis.
7. Organize and arrange the steps and control mechanisms of the cell cycle.
8. Compare and contrast the structures and functions of biological molecules.
9. Organize and diagram the steps in photosynthesis.
10. Organize and diagram the steps of cellular respiration.
11. Arrange the classification hierarchy and understand placement of organisms within it.
12. Compare and contrast reproductive strategies.
13. Evaluate means of human contraception and STD control.
14. Compare and contrast selected ontogenies.
15. Solve problems in classical genetics.
16. Diagram steps in DNA replication and transcription.
17. Diagram the steps of protein synthesis.
18. Evaluate the benefits and risks of genetic engineering.
19. Compare and contrast concepts of Darwinian and Lamarckian evolution.
20. Apply concepts of natural selection to examples leading to speciation.
21. Examine fossil, molecular, and other evidence for evolution and natural selection.

22. Organize the living and nonliving components of ecosystem structures.
23. Propose biome designations based on ecosystem data.
24. Evaluate impact on ecosystems by direct human actions and population growth.

### INSTRUCTOR INFORMATION

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 Web Address- [http://www.hartnell.cc.ca.us/faculty/jhughey/course\\_doc.htm](http://www.hartnell.cc.ca.us/faculty/jhughey/course_doc.htm)  
 Office Hours- Tuesday 5:00-6:00 PM, Wednesday 1:00-2:00 PM, Thursday 1:00-2:00 PM

### REQUIRED TEXTBOOKS

- Johnson, G. & Losos, J. *The Living World*. 7<sup>th</sup> ed. McGraw Hill, New York, 2011.
- Laboratory Manual: Biology 10. Hartnell College.
- Hughey, J. Bio 10- General Biology Lecture Manual: Section 5046, Fall 2011.

### GRADING

Determination of grades in this course will be based on your performance in the laboratory, which accounts for 33% of your grade, and the lecture, which accounts for 67% of your grade. The following points are available:

Laboratory Midterm	50 pts.
Laboratory Final	50 pts.
Lab Quizzes (best 10 scores)	50 pts.
Lecture Examination #1	100 pts.
Lecture Examination #2	100 pts.
<u>Final Examination</u>	<u>100 pts.</u>
Total	450 pts.

Grade	Total Points Earned (Percentage)	Definition	Grade Points
A	405-450 pts. (90-100%)	Excellent	4
B	360-404 pts. (80-89%)	Good	3
C	315-359 pts. (70-79%)	Satisfactory	2
D	270-314 pts. (60-69%)	Barely Passing	1
F	269 or fewer (59% or less)	Failing	0

### EXAMINATIONS

The lecture portion of the examination will consist of a combination of multiple choice, true or false, matching, short answer, and essay questions. The questions will come mainly from the lecture material, but may also be derived from assigned readings. Supply your own Scantron 882-E form and a number 2 pencil for each examination. No study guides will accompany the course material. Refer to your laboratory syllabus for details on the lab portion of the course.

### MAKE UP EXAMINATION POLICY

If you are unable to attend an examination please notify me by telephone, email, or in person prior to the test. If for an unforeseen reason you are unable to contact me in advance and you

miss the examination, submit a written letter signed by the authority involved (doctor, policeman, judge) that includes their phone number and an explanation. If you have a valid excuse, I will schedule an intellectually comparable oral or essay examination. *No make ups will be granted for the final examination without prior notification and approval from Dr. Hughey.*

### ATTENDANCE POLICY

Regular attendance and consistent study are your responsibility and the two factors that contribute most to a successful college experience. I expect you to attend all of the class sessions. Any lack of attendance, which leads in my judgment to unsatisfactory progress, may result in being dropped from the course. Absence in excess of two weeks (consecutive or non-consecutive) may result in being dropped from the course.

### DROPPING THE COURSE

It is your responsibility to drop the course. If you decide to stop coming to class, do not assume that I will submit the drop for you. Students that do not officially drop the course by November 18<sup>th</sup> will receive a letter grade that is based on their Total Points Earned.

### CLASSROOM VISITORS

No one is permitted to attend this class unless she or he is a registered student.

### CONDUCT

Please show respect for your peers and your instructor. If I observe any student performing or aiding in any of the types of misconduct listed under “Codes of Student Conduct” on page 31 of the Hartnell Catalog, that student will be dropped from the course. Disruptive behavior will not be tolerated (this includes text messaging during class).

### COMMUNICATION WITH YOUR INSTRUCTOR

When communicating by email, phone, or in person, do so in a professional manner. Specifically, when emailing, include your complete name, course name, and use complete sentences. Do not abbreviate words or use slang.

### INSTRUCTIONAL SUGGESTIONS

Course suggestions and requests that you feel will improve comprehension, retention, and cognition are warmly welcomed. Requests for less information, postponement of examinations, or easier examinations are not welcomed.

### SUGGESTIONS FOR DOING WELL IN BIOLOGY 10

1. Read the textbook
2. Review your notes before coming to class
3. Study for exams with a partner or in a group
4. Review the study guides
5. Attend class and take complete notes
6. Participate in classroom exercises
7. Outside of class study at least 6 hrs/week

## Properties of Life- Chapter 1

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### Five Basic Properties

- Life-defining properties must be \_\_\_\_\_ to living things.
  - \_\_\_\_\_ Organization
  - Metabolism
  - \_\_\_\_\_
  - Growth and \_\_\_\_\_
  - \_\_\_\_\_

### Cellular Organization

Example- \_\_\_\_\_.

### Metabolism

Example- \_\_\_\_\_.

### Glycolysis

Example- \_\_\_\_\_.

### Homeostasis

Example- \_\_\_\_\_.

### Growth and Reproduction

Example- \_\_\_\_\_.

### Heredity

Example- \_\_\_\_\_.

## Organization of Life- Chapter 1

### Levels of Organization

- |   |   |
|---|---|
| <input type="checkbox"/> Atoms          | <input type="checkbox"/> Atoms          |
| <input type="checkbox"/> Tissues        | <input type="checkbox"/> Tissues        |
| <input type="checkbox"/> Ecosystem      | <input type="checkbox"/> Ecosystem      |
| <input type="checkbox"/> Molecules      | <input type="checkbox"/> Molecules      |
| <input type="checkbox"/> Organism       | <input type="checkbox"/> Organism       |
| <input type="checkbox"/> Organelles     | <input type="checkbox"/> Organelles     |
| <input type="checkbox"/> Species        | <input type="checkbox"/> Species        |
| <input type="checkbox"/> Organ Systems  | <input type="checkbox"/> Organ Systems  |
| <input type="checkbox"/> Cells          | <input type="checkbox"/> Cells          |
| <input type="checkbox"/> Community      | <input type="checkbox"/> Community      |
| <input type="checkbox"/> Population     | <input type="checkbox"/> Population     |
| <input type="checkbox"/> Organs         | <input type="checkbox"/> Organs         |
| <input type="checkbox"/> Macromolecules | <input type="checkbox"/> Macromolecules |

### **Matching. Match the definitions on the right to the levels of organization on the left.**

- |  |  |
|--|--|
| <input type="checkbox"/> Molecule      | a. all the species in an ecosystem that can interact                           |
| <input type="checkbox"/> Cell          | b. a single organism   |
| <input type="checkbox"/> Organ         | c. a community and its physical environment                                    |
| <input type="checkbox"/> Organ System  | d. group of related organs that have a common function                         |
| <input type="checkbox"/> Organism      | e. all individuals of the same species that occupy a given area                |
| <input type="checkbox"/> Population    | f. two or more different tissues that perform a common function                |
| <input type="checkbox"/> Community     | g. the basic unit of life  |
| <input type="checkbox"/> Ecosystem     | h. group of similar cells that perform a common function                       |
| <input type="checkbox"/> Tissue        | i. combinations of atoms that are bonded together                              |
| <input type="checkbox"/> Atom          | j. a subcellular membrane-bound compartment                                    |
| <input type="checkbox"/> Organelle     | k. the fundamental unit of all matter  |
| <input type="checkbox"/> Macromolecule | l. very large molecules that serve as the building blocks for cells            |
| <input type="checkbox"/> Species       | m. group of organisms capable of interbreeding and producing fertile offspring |

Examples of the above

### Chemistry- Chapter 3

- Elements- a substance that cannot be broken down into any other substance; composed of only one type of atom.

#### Atoms

- Atoms contain a \_\_\_\_\_ and a \_\_\_\_\_ or shells.
- Atoms consist of \_\_\_\_\_ subatomic particles.
  - \_\_\_\_\_ = + charge
  - \_\_\_\_\_ = no charge
  - \_\_\_\_\_ = - charge

#### Atom Stability

- The inner shell can hold \_\_\_\_\_ electrons.
- The outer shell can hold \_\_\_\_\_ electrons.
- Atoms are more stable when their shells are \_\_\_\_\_, \_\_\_\_\_ for the inner and \_\_\_\_\_ electrons for each additional outer shell.

#### Covalent Bond

- Covalent Bond- 2 or more atoms \_\_\_\_\_ electrons in their \_\_\_\_\_ shells.

#### Ionic Bond

- Ionic Bond- atoms \_\_\_\_\_ or \_\_\_\_\_ on an electron to stabilize their outer shells.

### Hydrogen Bond

- Hydrogen Bond- an attraction between a slightly \_\_\_\_\_ charged hydrogen atom and a slightly \_\_\_\_\_ charged atom.

### Isotopes

- Isotopes- atoms that have the \_\_\_\_\_ number of protons, but \_\_\_\_\_ numbers of neutrons in their nucleus.

### C14 is used for Dating Fossils

### Bone Scans

- \_\_\_\_\_ tracer (isotope) is given intravenously.
- Correlation- amount of uptake is \_\_\_\_\_ to the amount of blood flow to bone.
- Hot spots are areas of \_\_\_\_\_ that may indicate cancer, abnormal healing, or growth.

### Water Chemistry

- Essential for Life
- Universal \_\_\_\_\_
- High \_\_\_\_\_ - water molecules are attracted to ions and polar compounds.
- Hydro \_\_\_\_\_ vs. hydro \_\_\_\_\_

## Molecules of Life- Chapter 4

- \_\_\_\_\_ - very large molecules that serve as the building blocks for cells.
  - \_\_\_\_\_
  - \_\_\_\_\_
  - \_\_\_\_\_
  - \_\_\_\_\_

### Macromolecules are Polymers

- \_\_\_\_\_ - a small subunit molecule.
- Polymers- a large molecule formed by long \_\_\_\_\_ of \_\_\_\_\_ subunits.

\_\_\_\_\_-Proteins

a. nucleotides

\_\_\_\_\_-Nucleic Acids

b. sugars

\_\_\_\_\_-Carbohydrates

c. amino acids

\_\_\_\_\_-Lipids

d. fatty acids

### Macromolecule Making and Breaking

### Protein Functions

\_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_  
\_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_

### Proteins 1

### Proteins 2

- Protein \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

## Nucleic Acids

### Nucleic Acids

- Nucleic acids- polymers of nucleotides.
  - Nucleotide- \_\_\_\_\_ group, a five-carbon \_\_\_\_\_, and a \_\_\_\_\_ base.
- There are \_\_\_\_\_ types of nucleic acids.
  - RNA- \_\_\_\_\_ nucleic acid.
  - DNA- \_\_\_\_\_ ribonucleic acid.
  - \_\_\_\_\_, ADP, AMP- \_\_\_\_\_ tri/di/monophosphate.

### DNA Structure

ATP (Adenosine Triphosphate)- a \_\_\_\_\_ .

### Carbohydrates

- \_\_\_\_\_
  - Monosaccharides
  - Disaccharides
- \_\_\_\_\_
  - Polysaccharides

### Complex Carbohydrate- Cellulose

\_\_\_\_\_ , \_\_\_\_\_ , \_\_\_\_\_

## Lipids

### Lipid Types

- \_\_\_\_\_
  - Fats and oils
- \_\_\_\_\_
- \_\_\_\_\_
- Rubber
- \_\_\_\_\_
- Pigments

### Lipid Examples

### Cell Membrane- Phospholipid Bilayer

## Cells- Chapter 5

### Levels of Organization

Robert Hooke (1635-1703)

### Cell Theory

- CELL THEORY- proposed in 1839 by Schleiden and Schwann.

1. All living things are \_\_\_\_\_.
2. The cell is the \_\_\_\_\_ of life.
3. New cells \_\_\_\_\_ only from \_\_\_\_\_ cells.
4. Cells contain \_\_\_\_\_ information which is passed from cell to cell during cell division.
5. All cells are \_\_\_\_\_ in \_\_\_\_\_ composition.
6. All of the \_\_\_\_\_ of life occurs within cells.

### Prokaryotic and Eukaryotic Cells

### Cells and Organelles

Animal Cell

Plant Cell

Origin of Cells

Origin of Eukaryotic Cells

**1-14. Matching. Match the functions on the right with the cytological structure on the left.**

- |                                |  |
|--------------------------------|--|
| _____ 1. Cell Wall             | a. flexible barrier that regulates what comes in and out of the cell           |
| _____ 2. Cytoskeleton          | b. protection; support   |
| _____ 3. Flagella and Cilia    | c. packages proteins and lipids for export from cell; forms secretory vesicles |
| _____ 4. Plasma membrane       | d. metabolism of fatty acids and other metabolites                             |
| _____ 5. Endoplasmic reticulum | e. forms vesicles; protein and lipid synthesis                                 |
| _____ 6. Nucleus               | f. contain genetic information   |
| _____ 7. Golgi complex         | g. assembles ribosomes   |
| _____ 8. Lysosomes             | h. motility  |
| _____ 9. Peroxisomes           | i. site of the majority of ATP synthesis                                       |
| _____ 10. Mitochondria         | j. control center of the cell  |
| _____ 11. Chloroplasts         | k. digest aging organelles and cellular debris                                 |
| _____ 12. Chromosomes          | l. structural support for the cell; intracellular movement                     |
| _____ 13. Nucleolus            | m. site of protein synthesis   |
| _____ 14. Ribosomes            | n. site of photosynthesis  |

## **How Cells Harvest Energy From Food- Chapter 8**

Cellular Respiration- the \_\_\_\_\_ of macromolecules to obtain energy.

Adenosine Triphosphate (\_\_\_\_\_)

1 Glucose Yields 36 ATP

## Glycolysis

- Location- \_\_\_\_\_.
- 1 Glucose yields:
  - 2 \_\_\_\_\_
  - 2 \_\_\_\_\_
  - 2 \_\_\_\_\_

Pyruvate is oxidized to \_\_\_\_\_

## \_\_\_\_\_ Cycle

- Location- matrix of \_\_\_\_\_.
- 2 Acetyl-CoA yield:
  - 2 \_\_\_\_\_
  - 4 \_\_\_\_\_
  - 6 \_\_\_\_\_
  - 2 \_\_\_\_\_

## Electron Transport Chain

- Location- inner mitochondrial membrane.
- NADH and FADH<sub>2</sub> yield:
  - 32 \_\_\_\_\_
  - NAD<sup>+</sup> and FAD

## Lactic Acid Fermentation in Muscles

## Ethanol Fermentation in Yeast

## Mitosis & Meiosis- Chapters 9, 10

Life Cycles Involves

- 1) \_\_\_\_\_
  - **Mitosis**- a nuclear division of a parental cell that produces \_\_\_\_\_ daughter cells with the same chromosome number as the parental cell. ( $2N = \underline{\hspace{2cm}}$ )
- 2) \_\_\_\_\_
  - **Meiosis**- two nuclear divisions of a parental cell that produces \_\_\_\_\_ daughter cells with half the chromosome number as the parental cell. ( $N = \underline{\hspace{2cm}}$ )

Human Life Cycle

*Ulva* (Sea lettuce) Life Cycle

Cell Cycle In Eukaryotes

- Cell cycle consists of:
  - \_\_\_\_\_
  - \_\_\_\_\_ - nuclear division.
  - **Cytokinesis**- \_\_\_\_\_.

G1- \_\_\_\_\_.

S- \_\_\_\_\_.

G2- \_\_\_\_\_.

## Chromosomes

Walther Flemming- 1882

## Mitosis

4 Stages to Mitosis- \_\_\_\_\_.

- \_\_\_\_\_ phase
- \_\_\_\_\_ phase
- \_\_\_\_\_ phase
- \_\_\_\_\_ phase

## Mitosis

## Animal vs. Plant Cytokinesis

Edouard Van Beneden- 1883

## Meiosis

- Meiosis consists of \_\_\_\_\_ successive nuclear divisions.
- Genetic material between homologous chromatids is \_\_\_\_\_.
- The product of meiosis is \_\_\_\_\_ nuclei.

- Homologous chromosomes- chromosomes that associate in pairs in the \_\_\_\_\_ of meiosis (Prophase I).

#### Genetic Exchange

- \_\_\_\_\_ - the pairing of homologous chromosomes.
- Crossing-over- the \_\_\_\_\_ of genetic material between homologous chromatids.

#### Crossing Over- Meiosis I

#### Meiosis I

#### Meiosis II

## Cancer- Chapter 9

### Terminology

- Cancer- \_\_\_\_\_.
- Dysplasia- \_\_\_\_\_.
- Oncology- \_\_\_\_\_.
- Tumor- \_\_\_\_\_.
- \_\_\_\_\_
- \_\_\_\_\_
- Metastasis- \_\_\_\_\_.

Angiogenesis- \_\_\_\_\_.

Hayflick 50

Telomerase

### Cancer

- Regulation of Cell Division
  - Tumor \_\_\_\_\_ Genes
    - **Genes that \_\_\_\_\_ cell division**
  - Proto-\_\_\_\_\_ genes
    - **Genes that \_\_\_\_\_ cell division**

p53 Tumor Suppressor Gene

p53 Tumor Suppressor Gene

p53 Gene

MDM2 Gene- p53 Negative Regulator

Pedigree

- Pedigree- the \_\_\_\_\_ of an individual or family.

Example of a p53 Hereditary Pedigree

Breast Cancer

Leading Sites of New Cancer Cases and Deaths

Prostate Cancer

Colon Cancer

Smoking and Cancer

Skin Cancer

Surgery

Radiation Therapy

Chemotherapy

Angiogenesis Inhibitors

Immunotherapy

Nanotechnology

Genetic Screening

## Foundations of Genetics- Chapter 11

### Mendel's Methods

- \_\_\_\_\_ hybrid crosses- an experimental cross between individuals that differ by a single trait.
- First generation (\_\_\_\_\_).

### Mendel's \_\_\_\_\_ Observations

- One of the traits could be seen in the F<sub>1</sub> generation= \_\_\_\_\_
- One of the traits was hidden in the F<sub>1</sub> generation= \_\_\_\_\_

### Genetic Terminology #1

- Phenotype- an organisms \_\_\_\_\_.
- Genotype- an organisms \_\_\_\_\_ makeup.
- Homozygous- \_\_\_\_\_ alleles for a gene.
- Heterozygous- two \_\_\_\_\_ alleles for a gene.

### Genetic Terminology #2

- \_\_\_\_\_ - a sequence of DNA that codes for a protein.
- \_\_\_\_\_ - one of 2 or more alternative forms of the same gene.

### Mendel's F<sub>2</sub>

#### Observations

- Flower color  
- \_\_\_\_\_:  
705:224  
\_\_\_\_\_  
\_\_\_\_\_:

### Mendel's Dihybrid Cross

- 315:108:101:32  
= \_\_\_\_\_:\_\_\_\_\_:\_\_\_\_\_:\_\_\_\_\_

### Mendel's Work Yielded These Genetic Rules

- Alternative versions of genes ( \_\_\_\_\_ ) account for variations in inherited characters.
- For each character, an organism inherits \_\_\_\_\_, 1 from the mother and 1 from the father.
- If two alleles differ, then one, the \_\_\_\_\_ allele is fully \_\_\_\_\_ in the organism's appearance.
- The two alleles for each trait \_\_\_\_\_ during gamete production.
- Alleles of a gene segregate \_\_\_\_\_ of the alleles of other genes.

### Punnett Square

- Punnett square- a diagram used to predict the result of a genetic cross.

### Complete Dominance

- The \_\_\_\_\_ allele produces a functional protein and the protein's effects are \_\_\_\_\_.
- The \_\_\_\_\_ allele produces a \_\_\_\_\_ functional protein or \_\_\_\_\_ at all and the trait is not apparent.

### Codominance

- Codominance- the effects of \_\_\_\_\_ alleles are apparent.

### Incomplete Dominance

### Incomplete Dominance

- Incomplete dominance- inheritance in which the  $F_1$  is \_\_\_\_\_ in phenotype \_\_\_\_\_ the parents.
- \_\_\_\_\_ allele is dominant.

Continuous Variation is the result of \_\_\_\_\_ Inheritance

- Continuous variation- a \_\_\_\_\_ in phenotype; indicates that a trait is controlled by \_\_\_\_\_ or \_\_\_\_\_ genes.

Continuous Variation

Environmental Effects on Phenotype

## DNA- Chapter 12

### DNA- Deoxyribonucleic Acid

- Johann Friedrich Miescher

- \_\_\_\_\_
- “\_\_\_\_\_”
- White blood cells from \_\_\_\_\_.
- Salmon spermatozoa, nucleus accounts for more than \_\_\_\_\_ % of mass of sperm cells.
  - DNA contains hereditary information.
  - Rejected this idea after analysis of egg cells.

### Phoebus Levene

### Linus Pauling

### Avery, MacLeod, McCarty 1944

### Erwin Chargaff

- Chargaff's Rules- 1947.

- The number of \_\_\_\_\_ = \_\_\_\_\_. A=T
- The number of \_\_\_\_\_ = \_\_\_\_\_. G=C

### The Structure of DNA

- James \_\_\_\_\_ and Francis \_\_\_\_\_ published in \_\_\_\_\_.
- Maurice \_\_\_\_\_ and \_\_\_\_\_.
  - \_\_\_\_\_ pattern

### Nucleic Acids

- Nucleic acids- polymers of \_\_\_\_\_.
  - Nucleotide- \_\_\_\_\_ group, a five-carbon \_\_\_\_\_, and a \_\_\_\_\_ base.

- There are 2 types of nucleic acids.
  - RNA- \_\_\_\_\_ nucleic acid.
    - Sugar is \_\_\_\_\_.
    - \_\_\_\_\_ stranded.
    - Nitrogenous bases- adenine (A), \_\_\_\_\_ (U), guanine (G), cytosine (C).
  - DNA- \_\_\_\_\_ ribonucleic acid.
    - Sugar is \_\_\_\_\_.
    - \_\_\_\_\_ stranded.
    - Nitrogenous bases- adenine (A), \_\_\_\_\_ (T), guanine (G), cytosine (C).

## DNA Structure

*The Secret of Photo 51*

## How Genes Work- Chapter 13

Gene to Protein

Transcription

Translation

Ribosomal RNA- rRNA

Transfer RNA- tRNA

# Translation

## The Genetic Code

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The Genetic Code									
First Letter	Second Letter								
	U	C	A	G	Third Letter				
U	UUU	UCU UCC UCA UCG	UUA UAC UAA UAG	UGU UGC UGA UGG	U				
	UUC				Phenylalanine	Serine	Tyrosine	Cysteine	C
	UUA				Leucine	Stop	Stop	A	
	UUG				Leucine	Stop	Tryptophan	G	
C	CUU	CCU CCC CCA CCG	CAU CAC CAA CAG	CGU CGC CGA CGG	U				
	CUC				Leucine	Histidine	Arginine	C	
	CUA				Leucine	Glutamine	Arginine	A	
	CUG				Leucine	Glutamine	Arginine	G	
A	AUU	ACU ACC ACA ACG	AAU AAC AAA AAG	AGU AGC AGA AGG	U				
	AUC				Isoleucine	Asparagine	Serine	C	
	AUA				Isoleucine	Lysine	Arginine	A	
	AUG				Methionine; Start	Lysine	Arginine	G	
G	GUU	GCU GCC GCA GCG	GAU GAC GAA GAG	GGU GGC GGA GGG	U				
	GUC				Valine	Aspartate	Glycine	C	
	GUA				Valine	Glutamate	Glycine	A	
	GUG				Valine	Glutamate	Glycine	G	

## Gene Technology- Chapter 14

Green Fluorescent Protein

Genetic Engineering

- Genetic Engineering- the technique of \_\_\_\_\_, \_\_\_\_\_, or \_\_\_\_\_ genes to a DNA molecule.

– Improvements in crops

- \_\_\_\_\_
- \_\_\_\_\_ to insects
- Resistance to herbicides

– Improvements in animal \_\_\_\_\_

\_\_\_\_\_, \_\_\_\_\_  
\_\_\_\_\_, \_\_\_\_\_

Genetically Engineered Rice- \_\_\_\_\_.

Crops

Transgenic Plants

- Tomato with BT gene and without. \_\_\_\_\_
- Transgenic tomatoes with and without *etr1-1* gene. \_\_\_\_\_
- Petunia with and without *etr1-1* gene. \_\_\_\_\_
- Tobacco with and without a cytokinin gene. \_\_\_\_\_

EnviroPig

Increased Milk Production

Mouse with Human Growth Hormone

## Genetically Engineered Salmon (The Pros and Cons of Genetically Altered Salmon)

### Flowchart Example for Genetic Engineering

PCR- polymerase chain reaction

Thermal Cycling Temperatures

Transfer of Genes

Restriction Endonucleases

Increased Milk Production

Pronuclei Injection of DNA

## Genomics- Chapter 15

### Genomics

- Genomics- a field of genetics that attempts to understand the \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_ of genetic information in a whole organism.

### Genome

- Genome- all of the genetic information of an organism.

What has genomics taught us thus far?

- Finding 1- more complex organisms tend to have \_\_\_\_\_.
- Finding 2- all mammals have the \_\_\_\_\_ genomes.
- Finding 3- a large number of genes are \_\_\_\_\_ to science.
  - *Aeropyrum pernix*
    - 57% of genome unique
  - *Mycobacterium tuberculosis*
    - About 50% of genome unique
  - *Homo sapiens*
    - Chr. 6= 772 original, 1557 actual
    - Chr. 7= 605 original, 1150 actual
- Finding 4- large differences in genome size sometimes arise through the \_\_\_\_\_ of chromosomes or entire genomes.
- Finding 5- key genes are \_\_\_\_\_.
  - i.e. HOX gene
- Finding 6- \_\_\_\_\_ of evolution \_\_\_\_\_ greatly.
  - i.e. rodents vs. primates.
- Finding 7- genomes of relatives are more \_\_\_\_\_.
- Finding 8- noncoding DNA is \_\_\_\_\_ junk.

### AffyMetrix GeneChip

## **The Revolution in Cell Technology- Chapter 16**

Species that have been cloned to date:

Cloning Protocol

Therapeutic vs. Reproductive Cloning

Red blood cells

Embryonic Stem Cells and Damaged Tissue

Gene Therapy Using Viruses as Vectors

Craig Venter's Synthetic Cell

## Evolution and Agents of Evolution- Chapters 2 and 17

### Origin of Species

- Special creation- each of the different kinds of organisms were \_\_\_\_\_ in their \_\_\_\_\_.
- \_\_\_\_\_ of \_\_\_\_\_ characteristics- the modifications an organism acquires during its lifetime can be passed along to its offspring.

### Charles Darwin- 1831 HMS Beagle

#### Observations by Darwin in the Galápagos

- Two Important Observations
  - 1) Plants and animals on the island were similar to those on the nearby mainland.
  - 2) Phenotypic variation occurred between organisms from island to island.

Darwin repeatedly emphasized two points in his book.

- 1) Species evolve from other species. He termed this " \_\_\_\_\_ with \_\_\_\_\_ " = Evolution
- 2) The mechanism or driving force of evolution is = \_\_\_\_\_

Darwin cited the following in support of Natural Selection:

- \_\_\_\_\_ occurs in every group of plants and animals.
- All organisms have the potential to \_\_\_\_\_ - \_\_\_\_\_.
- Natural resources \_\_\_\_\_ limited.
- Only the most adapted to the local environment survive and \_\_\_\_\_ to the next generation.

### Darwin's own sketches of Galápagos finches.

#### Beak Demo

## Agents of Evolution

Mutation- a \_\_\_\_\_ in the \_\_\_\_\_ sequence.

Migration- the \_\_\_\_\_ of individuals between populations.

Genetic Drift- the \_\_\_\_\_ of allele frequencies.

Nonrandom Mating- individuals with certain genotypes \_\_\_\_\_ another more commonly than would be expected on a random basis.

Natural Selection- the process by which individuals that are \_\_\_\_\_ than others in meeting the challenges of their habitat produce more offspring.

Stabilizing Selection

Disruptive Selection

Directional Selection

## Evolution's Critics- Chapter 17

### Argument #1

- Evolution if not solidly demonstrated.
  - “Evolution is \_\_\_\_\_ a \_\_\_\_\_.”

### Argument #2

- There are \_\_\_\_\_ fossil intermediates.

### Argument #3

- The intelligent design argument.
  - “The organs of living creatures are \_\_\_\_\_ \_\_\_\_\_ for a random process to have produced.”

### Argument #4

- Evolution Violates the \_\_\_\_\_ Law of Thermodynamics.

### Argument #5

- \_\_\_\_\_ are too improbable.

### Argument #6

- Natural Selection does not imply evolution.

### Argument #7

- Life could not have evolved in water.

## Irreducible Complexity- Michael Behe

## Ecology and Ecosystems- Chapters 2, 37, 38

Ecology- the study of the \_\_\_\_\_ between \_\_\_\_\_ and the \_\_\_\_\_.

- Interactions (or factors) determine the \_\_\_\_\_ and \_\_\_\_\_ of organisms.

Ecology Typically Deals with 3 Levels

- \_\_\_\_\_ - a single organism.
- \_\_\_\_\_ - all individuals of the same species that occupy a given area.
- \_\_\_\_\_ - all the species in an ecosystem that can interact.

Commensalism

Parasitism

Mutualism

Food Chains

Food Webs

Rocky Shore Food Web

## Population Growth

## Population Explosions

### Succession

- Succession- the predictable \_\_\_\_\_ after disturbance.
  - \_\_\_\_\_ succession- the initial colonization of barren soil or bedrock by pioneer species (lichens, mosses, ferns, herbaceous plants).
  - \_\_\_\_\_ succession- the changes in the plants and animals that live in a community after the initial colonization.

Ecosystem- a community and its physical environment.

- \_\_\_\_\_
- \_\_\_\_\_
- Freshwater

### Terrestrial Ecosystems

- \_\_\_\_\_ - a terrestrial ecosystem that occurs over a broad area.

### Tropical Rainforest Biome

### Marine Ecosystem

### Freshwater Ecosystem

## Photosynthesis- Chapter 7

### Photosynthesis

- Photosynthesis- the production of \_\_\_\_\_ from \_\_\_\_\_ and \_\_\_\_\_ in the presence of chlorophyll and light energy.

General PSN Equation:

### The Visible Light Spectrum

- \_\_\_\_\_ - proposed the Particle Model of Light Theory in 1905.
  - Light is composed of particles of energy called \_\_\_\_\_.
  - Visible light has different photon \_\_\_\_\_.

What happens to light when it strikes the surface of a leaf?

### Plant Pigments

### Chloroplast

### Thylakoids

### Stroma

Light-Dependent Reactions

Light-Independent Reactions

## Classification of Organisms- Chapter 18

Carol von Linné (1707-1778)

- Swedish naturalist.
- *Systema Naturae*.
  - \_\_\_\_\_ - a two-term system of nomenclature.
    - \_\_\_\_\_ and \_\_\_\_\_ (specific epithet).
    - Example- catnip.
      - *Nepeta cataria L.*
      - “*Nepeta floribus interrupte spicatus pedunculatis*”

Nepeta cataria- Lamiaceae

\_\_\_\_\_ Domains and \_\_\_\_\_ Kingdoms

Taxonomy

- Taxonomy- (gr. *taxis*- arrangement, *nomos*- law) the science of the \_\_\_\_\_ of organisms.
  - Identifying, naming, classifying organisms.
    - **Domain**
    - **Kingdom**
    - **Phylum**
    - **Class**
    - **Order**
    - **Family**
    - **Genus**
    - **Species**

Classifying Living Things

Species Concepts

\_\_\_\_\_ Species Concept

\_\_\_\_\_ Species Concept

## Prokaryotes- Chapter 19

### Prokaryotic Cell Morphology

#### 3 Bacterial Habits

#### Cell Division in Prokaryotes

#### Conjugation in Bacteria

#### Domain and Kingdom Bacteria

- \_\_\_\_\_ in cell wall
- Genetic differences
- \_\_\_\_\_ in plasma membrane
- \_\_\_\_\_ formation

#### Gram Positive and Negative Bacteria

#### Domain and Kingdom Archaea

- \_\_\_\_\_
  - Hydrothermal vents
  - Hypersaline basins
  - Highly acidic habitats
  - Highly alkaline habitats

#### Hydrothermal Vents and Archaea

#### Metabolism

- Heterotrophic
  - \_\_\_\_\_

- \_\_\_\_\_ autotrophic
- \_\_\_\_\_ autotrophic

Bacterial Abundance

Nitrogen Cycle

Phosphorus Cycle

Oil Degrading Bacteria

10X as many bacteria as human cells in the human body

STDs

Chlamydia

Gonorrhea

Pelvic Inflammatory Disease (PID)

Syphilis

Antibiotics

Anthrax- *Bacillus anthracis*

## Virology- Chapter 19

### Virus Structure

#### HIV Infections Progress to AIDS

- June of 1981
- HIV/AIDS is a global epidemic.
  - World Health Organization estimates that AIDS has killed more than \_\_\_\_ million people.
- Most HIV is transmitted through \_\_\_\_\_ contact, \_\_\_\_\_ drug use, or from a \_\_\_\_\_ to her fetus.
- HIV consists of \_\_\_\_\_ and enzymes encased in a \_\_\_\_\_ coat.

HIV \_\_\_\_\_ the cell, rewrites its RNA as \_\_\_\_\_, inserts DNA into the \_\_\_\_\_, and \_\_\_\_\_.

An HIV infection progresses through several stages as helper T cell numbers decline.

#### HIV Treatments

- Treatments for HIV infection are designed to block specific steps in HIV's replication.
- Highly Active Antiretroviral Therapy (\_\_\_\_\_)
  - Cocktail
- Nucleoside analog reverse transcriptase inhibitors (\_\_\_\_\_ or NRTIs)
- \_\_\_\_\_

Epidemiology- incidence, distribution, and control of disease in a population.

Influenza- “the flu”

Viral STDs

Oral and Genital Herpes

Genital Warts

Ebola

Hantavirus

SARS

West Nile Virus

## Kingdom Protista- Chapter 20

### Protista

- \_\_\_\_\_ karyotic
- Unicellular, colonial, and multicellular
- Autotrophic, heterotrophic (saprophytic and phagocytotic), facultative heterotrophs
- Asexual and sexual reproduction
- \_\_\_\_\_ phyla
- ~200,000 species

### Protistans

- \_\_\_\_\_ trophic
  - Protozoans
- \_\_\_\_\_ trophic
  - Microalgae
  - Macroalgae
- \_\_\_\_\_ phytic
  - Water molds
  - Slime molds

### Protozoans- Rhizopoda and Granuloreticulosa

### Protozoans- Polycystina

### Protozoans- Ciliophora

Protozoans/Microalgae- Euglenozoa

Microalgae- Dinophyta

Microalgae- Heterokontophyta

Macroalgae- Heterokontophyta

Macroalgae- Chlorophyta

Macroalgae- Rhodophyta

Nori Mariculture

Water Molds- Oomycota

Cellular Slime Molds- Dictyosteliomycota

Plasmodial Slime Molds- Myxomycota

## **Kingdom Fungi- Chapter 21**

### Characteristics of the Fungi

Phylum Chytridiomycota

Phylum Zygomycota

Phylum Ascomycota

Phylum Basidiomycota

Lichens

## **Kingdom Plantae- Chapters 22-24**

Characteristics of Plants

Four Main Types of Plants

Non-Vascular Plants- Hepatophyta

Non-Vascular Plants- Anthocerophyta

Non-Vascular Plants- Bryophyta

Seedless Vascular Plants- Lycophyta

Seedless Vascular Plants- Pterophyta

Seed Plants Gymnosperms- Coniferophyta

Seed Plants Gymnosperms- Cycadophyta

Seed Plants Gymnosperms- Ginkgophyta

Seed Plants Gymnosperms- Gnetophyta

Seed Plants Flowering Plants Phylum- Anthophyta

Dicots vs. Monocots

Flower Anatomy

Fruits

## **Kingdom Animalia- Chapters 25, 26**

Characteristics of Animals

Phylum Porifera- sponges

Phylum Cnidaria- jellies, anemones, corals

Nematocyst Stings

Phylum Platyhelminthes- flatworms

Phylum Nematoda- roundworms

Acoelomates

Pseudocoelmates

Coelomates

Phylum Mollusca- gastropods, bivalves, cephalopods

Phylum Annelida- segmented worms

Phylum Arthropoda- insects, spiders, crustaceans, milli/centipedes

Echinodermata- sea stars, urchins, cucumbers, lilies, and brittle stars.

Protostomes

Deuterostomes

Phylum Chordata- tunicates, lancelets, fishes, amphibians, reptiles, birds, and mammals

Characteristics of Chordates

**Questions for the “Journey of Man”**

- 1) What is the source for Luca Cavalli-Sforza’s genetic time machine?
- 2) What population represents the oldest lineage of people living today? What country in Africa are they from?
- 3) How long ago did a small group of humans leave Africa?
- 4) What kind of material did the San Bushmen construct their spear tips from?
- 5) What is a genetic marker?
- 6) Why did early humans migrate out of Africa? What caused them to ‘suddenly vanish’ from this continent?
- 7) Where did the first archaeological human remains outside of Africa show up?
- 8) How did the descendants of the Bushmen get to Australia?
- 9) How many primate species are found on Australia?
- 10) Where did the very first people settle in Australia? How long ago did they settle?
- 11) Do Aborigine’s have any evidence in their ‘Song Lines’ of a journey from Africa?
- 12) Do the Aborigine rock paintings from Queensland show any evidence of a journey?
- 13) What route did early humans take to get to Australia?
- 14) Why did Dr. Wells choose to analyze Y-chromosomal DNA?
- 15) Did Spencer find evidence for a human migration through India en route to Australia?
- 16) Where did the second group out of Africa migrate to? How long ago?
- 17) This second wave of people branched and went in two different directions. Where did they go?

- 18) How long did it take humans to get from the Middle East to Europe? Why?
- 19) What was the name of the hominids that arrived in Europe and lived in caves in France?
- 20) What route did humans take to Europe?
- 21) What is so interesting about Niyazov's DNA?
- 22) What country is Niyazov from? Where is this country located?
- 23) Who are the Chukchi? Where do they live?
- 24) Where did the Chukchi's ancestors come from? How long ago did people in Siberia migrate across Beringia?
- 25) What are Bergman's and Allen's rules?
- 26) What do the reindeer eat? What do the Chukchi eat?
- 27) What do the Chukchi live in? Are they nomadic?
- 28) What route did the ancestors of native North and South Americans take? How many made the journey?
- 29) How many years did it take for humans to populate North and South America?
- 30) Who did the Navajo descend from?
- 31) Who are the ancestors of hispanics?

## Out of Africa and Modern Humans- Chapter 27

Mitochondrial DNA

Haplogroup Origins

Europe: [H](#), [T](#), [U](#), [V](#), [X](#), [K](#), [N](#), [I](#), [J](#)

Sub-Saharan African: [L](#), [L1](#), [L2](#), [L3](#), [L3\\*](#)

Asian: [A](#), [B](#), [C](#), [D](#), [E](#), [F](#), [G](#) (note: C, D, E, and G belong to macro-haplogroup [M](#))

Native American: [A](#), [B](#), [C](#), [D](#), and [X](#)

Y Chromosome

Haplogroups and geographic origins of all individuals in the Y Chromosome

Primate Evolutionary Tree

Chimp versus Hominid Skeleton

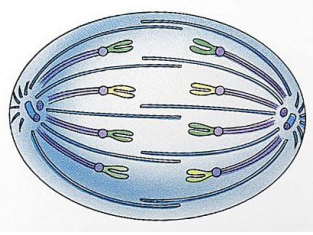
*Homo* Skulls

*Homo sapiens*

**1-39. Multiple Choice. Select the single best possible answer for each question.**

1. Which of the following is one of the properties of life?
  - a. complexity
  - b. movement
  - c. cellular organization
  - d. response to stimulation
  - e. vocalization
  
2. The maintaining of a relatively stable internal physiological environment; a balance, is termed \_\_\_\_\_.
  - a. glycolysis
  - b. homeostasis
  - c. photosynthesis
  - d. hemophilia
  - e. translocation
  
3. \_\_\_\_\_ of cells are composed of the elements Carbon, Hydrogen, Nitrogen, and Oxygen.
  - a. 39%
  - b. 49%
  - c. 59%
  - d. 79%
  - e. 99%
  
4. Isotopes \_\_\_\_\_.
  - a. are useful for dating fossils
  - b. are useful in medicine
  - c. have the same number of protons, but different numbers of neutrons in their nucleus
  - d. occur naturally in the environment
  - e. all of the above
  
5. When two or more atoms share electrons in their outer shells they form a \_\_\_\_\_ bond.
  - a. doric
  - b. ionic
  - c. hydrogen
  - d. covalent
  - e. neutral
  
6. Which of the following is not one of the four macromolecules found in living things?
  - a. hormones
  - b. carbohydrates
  - c. proteins
  - d. nucleic acids
  - e. lipids
  
7. Complex carbohydrates are polymers of \_\_\_\_\_.
  - a. sugars
  - b. nucleotides
  - c. fatty acids
  - d. amino acids
  - e. lipids
  
8. Which of the following is not a function of proteins?
  - a. structural
  - d. storage of energy

- b. transport
  - c. catalysis (enzymes)
  - e. contractile
9. Which of the following is not considered a lipid?
- a. fats and oils
  - b. phospholipids
  - c. monosaccharides
  - d. steroids
  - e. waxes
10. The Englishman Robert Hooke is best known to biologists for \_\_\_\_\_.
- a. determining the structure of DNA
  - b. describing and naming cells (“cellula”)
  - c. inventing the microscope
  - d. proposing the cell theory
  - e. eating pork and muttering in a British accent “damn this stuff is good”
11. Prokaryotic cells \_\_\_\_\_.
- a. include the Bacteria
  - b. are small (usually less than 2  $\mu\text{m}$  in size)
  - c. lack organelles
  - d. include the Archaea
  - e. all of the above
12. Which of the following is not true of the Cell Theory?
- a. all living things are composed of cells
  - b. new cells arise only from preexisting cells
  - c. cells are dissimilar in chemical composition
  - d. cells contain hereditary information which is passed from cell to cell during cell division
  - e. the cell is the basic unit of life
13. Animal cells lack \_\_\_\_\_.
- a. chloroplasts and cell walls
  - b. chloroplasts and golgi bodies
  - c. cell walls and mitochondria
  - d. mitochondria and vacuoles
  - e. vacuoles and endoplasmic reticulum
14. The current scientific hypothesis for the origin of cells states that they \_\_\_\_\_.
- a. popped out of nowhere
  - b. were intelligently designed by a supernatural being (a deity)
  - c. evolved from DNA, which later formed RNA and proteins
  - d. were introduced by extraterrestrial beings (aliens)
  - e. originated by micelles encapsulating RNA, followed by RNA forming proteins and DNA
15. The cell cycle in eukaryotes consists of \_\_\_\_\_.
- a. interphase
  - b. cytokinesis
  - c. mitophase (mitosis)
  - d. G1, S, and G2 periods
  - e. all of the above
16. What phase of mitosis is represented in the picture below?



- a. metaphase  
b. interphase  
c. telophase  
d. anaphase  
e. prophase
17. Homologous chromosomes in meiosis \_\_\_\_\_.
- cross-over
  - associate in pairs in the first stage of Prophase I
  - exchange genetic material
  - synapse/form chiasma
  - all of the above
18. Cancer is traditionally treated with \_\_\_\_\_.
- chemotherapy
  - radiation
  - surgery
  - combinations of chemotherapy, radiation, and surgery
  - all of the above
19. Incomplete dominance \_\_\_\_\_.
- is where the dominant allele produces a functional protein and the protein's effects are apparent
  - is where the effects of both alleles are apparent
  - is inheritance in which the  $F_1$  is intermediate in phenotype between the parents
  - is controlled by two or more genes
  - all of the above
20. p53 and BRCA1 are \_\_\_\_\_.
- lipids
  - proto-oncogenes
  - tumor suppressor genes
  - fatty acids
  - carbohydrates
21. Skin cancers can be identified using the A, B, C, D system. What does A, B, C, D stand for?
- asymmetry, brown, cyst-like, diagnose
  - asymmetry, border, color, diameter
  - avascular, big, callous-like, deep
  - arrangement, black, cell shape, diffuse
  - anything, but, cancer, dude
22. Melanoma \_\_\_\_\_.
- is life-threatening and metastatic
  - is responsible for the majority of skin cancers
  - is not life-threatening
  - is the scientific term for "mole"

- e. none of the above
23. Which of the following is not an example of polygenic inheritance?
- skin color
  - intelligence
  - eye color
  - height
  - attached or unattached earlobes
24. Assuming the freckle (F) form of the gene is dominant over the non freckle (f) form of the gene, what is the probability that a male with the genotype FF and a female with ff will produce a child with freckles?
- no freckles
  - 25% of the time freckles
  - 50% of the time freckles
  - 75% of the time freckles
  - 100% of the time freckles
25. Assuming that the unattached earlobes (E) allele is dominant over attached earlobes (e) allele, what are the resulting genotypes when a heterozygous male and a homozygous recessive female mate?
- 2 Ee, 1 EE, and 1 ee
  - 1 Ee, 2 EE, and 1 ee
  - 2 Ee and 2 ee
  - 2 Ee and 2 EE
  - none of the above, your crazy Hughey
26. During cytokinesis plants form a \_\_\_\_\_.
- cleavage furrow
  - spindle
  - pit connection
  - cell plate
  - blastula
27. Meiosis \_\_\_\_\_.
- consists of two successive nuclear divisions
  - allows for homologous chromatids to exchange genetic material
  - takes place in the gonads (ovaries and testes)
  - produces four haploid nuclei
  - all of the above
28. Which of the following is not a necessary prerequisite to mitosis?
- organelle duplication
  - cytoplasmic synthesis
  - replication or synthesis of DNA
  - synthesis of proteins
  - interphase
29. Which of the following is not true about Gregor Mendel?
- he studied 7 characters (traits)
  - he crossed about 28,000 garden peas
  - he was an Austrian monk

- d. he is considered the Father of Genetics
  - e. he concluded that traits in peas could not be predicted mathematically
30. Mendel learned from his F<sub>1</sub> observations that \_\_\_\_\_.
- a. dominance in flower color does not exist in the pea
  - b. homozygous recessive, in terms of flower color, was always purple
  - c. one of his traits was always dominant and the other was recessive
  - d. 50% were the purple phenotype, 50% were white phenotype
  - e. none of the above
31. The chief energy currency of all cells is \_\_\_\_\_.
- a. ATP
  - b. FADH
  - c. NADH
  - d. PGAL
  - e. RuBP
32. Cellular respiration is defined as the \_\_\_\_\_.
- a. transfer of gases from the lungs to red blood cells
  - b. change in cell shape over time
  - c. process by which plants obtain glucose from trapping sunlight
  - d. oxidation of macromolecules to obtain energy
  - e. none of the above
33. Glycolysis yields \_\_\_\_\_.
- a. 2 ATP
  - b. 2 NADH
  - c. 2 Pyruvates
  - d. all of the above
  - e. none of the above
34. The leading anatomical structures for new cancer cases in men and women are \_\_\_\_\_.
- a. prostate and lung
  - b. prostate and breast
  - c. prostate and colon
  - d. prostate and skin
  - e. prostate and bone
35. Which of the following is not one of the new cancer therapies?
- a. angiogenesis inhibitors
  - b. genetic screening
  - c. immunotherapy
  - d. nanotechnology
  - e. filtration technology
36. Johann Friedrich Miescher was the first person to \_\_\_\_\_.
- a. describe the structure of DNA
  - b. build a microscope to view DNA
  - c. isolate DNA
  - d. isolate proteins
  - e. isolate lipids

37. Chargaff's Rules state that \_\_\_\_\_.
- the # of adenines = # of guanines and # of thymines = # of cytosines
  - the # of adenines = # of thymines and # of guanines = # of cytosines
  - the # of adenines = # of cytosines and # of guanines = # of thymines
  - the # of adenines = # of thymines and # of guanines = # of thymines
  - the # of adenines = # of cytosines and # of guanines = # of cytosines
38. Nucleotides contain \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.
- nitrogenous base, sugar, methionine amino acid
  - nitrogenous base, sugar, 3 fatty acid tails
  - phosphate group, nitrogenous base, methionine amino acid
  - phosphate group, nitrogenous base, sugar
  - sugar, 3 fatty acid tails, methionine amino acid
39. Which of the following did not have a role in determining the structure of DNA?
- James Watson
  - Francis Crick
  - Rosalind Franklin
  - Maurice Wilkins
  - Kary Mullis

**40-59. True or False. Mark A for true and B for false.**

- Heredity is defined as the transmission of traits (characteristics) from parent to offspring.
- Metabolism is the sum total of all chemical reactions that occur in an organism.
- Atoms consist of four subatomic particles: protons, neutrons, electrons, and thereons.
- Macromolecules are very large molecules that serve as the building blocks for cells.
- Macromolecules are formed through a process termed hydrolysis.
- Chloroplasts and mitochondria evolved through the endosymbiosis of bacteria.
- Mitosis involves two nuclear divisions of a parental cell and produces four haploid daughter cells.
- The process of cytokinesis is identical in plants and animals.
- Cancer is a group of diseases characterized by uncontrolled or abnormal cell proliferation.
- The phenotype of an organism refers to its traits (appearance).
- The cell membrane consists of a phospholipid bilayer, proteins, and steroids.
- Meiosis is a process that increases the chromosome number from N (haploid) to 2N (diploid).
- Eukaryotic cells contain a nucleus.
- Walther Flemming described mitosis in 1660.
- A Punnett square is a diagram used to predict the result of a genetic cross.
- Carcinogens are any agents that cause cancer.
- Cancer arises through environmental carcinogens and genetic mutations.
- An example of a molecule that forms an ionic bond is methane (CH<sub>4</sub>).
- Lactic acid fermentation is an aerobic process.
- Cancer cells do not follow the rules of Hayflick 50.

**60-64. Match the definitions on the right to the correct level of organization on the left.**

- |                |  |
|----------------|--|
| 60. Molecules  | a. the basic unit of life  |
| 61. Cells      | b. all individuals of the same species that occupy a given area                |
| 62. Organelle  | c. combinations of atoms that are held together by energy                      |
| 63. Population | d. a subcellular membrane-bound compartment                                    |
| 64. Species    | e. group of organisms capable of interbreeding and producing fertile offspring |

**65-69. Match the functions on the right to the correct cell structure on the left.**

- |                  |  |
|------------------|--|
| 65. Cytoskeleton | a. motility  |
| 66. Flagella     | b. structural support for the cell; intracellular movement |
| 67. Nucleus      | c. site of photosynthesis                                  |
| 68. Chloroplast  | d. control center of the cell                              |
| 69. Mitochondria | e. site of the majority of ATP synthesis                   |

**70-74. Match the cancer definitions on the right to their correct term on the left.**

- |                     |   |
|---------------------|---|
| 70. Dysplasia       | a. life-threatening; spreads                          |
| 71. Benign tumor    | b. spreads  |
| 72. Malignant tumor | c. non life-threatening; does not spread              |
| 73. Metastasis      | d. formation of blood vessels connections with tumors |
| 74. Angiogenesis    | e. change in size, shape, and organization of cells   |

**75-79. Match cell cycle function on the right to the period of the cell cycle on the left.**

- |                 |  |
|-----------------|--|
| 75. Mitosis     | a. nuclear division                                |
| 76. G1          | b. protein synthesis, cell growth                  |
| 77. S           | c. organelles double, cell growth                  |
| 78. G2          | d. DNA replication occurs as chromosomes duplicate |
| 79. Cytokinesis | e. splitting of 1 cell into 2 cells                |

**80-84. Match the definition on the right to the physiological response on the left.**

- |                  |  |
|------------------|--|
| 80. Heterozygous | a. two different alleles for a gene                    |
| 81. Homozygous   | b. an organisms traits                                 |
| 82. Allele       | c. identical alleles for a gene                        |
| 83. Genotype     | d. one of 2 or more alternative forms of the same gene |
| 84. Phenotype    | e. an organisms genetic makeup                         |

**85-89. Match the terms on the right to the cellular energy terms on the left.**

- |                              |   |
|------------------------------|---|
| 85. Glycolysis               | a. breakdown of fatty acids                       |
| 86. Krebs's cycle            | b. matrix of mitochondrion; 2 ATP generated       |
| 87. Electron Transport Chain | c. cytoplasm; 2 ATP generated                     |
| 88. Beta Oxidation           | d. breakdown of amino acids                       |
| 89. Deamination              | e. inner mitochondrial membrane; 32 ATP generated |

**90-97. Match the mode of inheritance on the right to the trait on the left. Use some of the terms on the right more than once.**

- |                                      |                          |
|--------------------------------------|--------------------------|
| 90. Hitchhiker's thumb               | a. Complete dominance    |
| 91. Blood type                       | b. Incomplete dominance  |
| 92. Corn length (ear length)         | c. Codominance           |
| 93. PTC paper                        | d. Polygenic inheritance |
| 94. Pink flowers in snapdragon       |                          |
| 95. Purple flowers in the garden pea |                          |
| 96. Skin color in humans             |                          |
| 97. Widow's peak                     |                          |

**98-102. Match the terms on the right to the correct term on the left.**

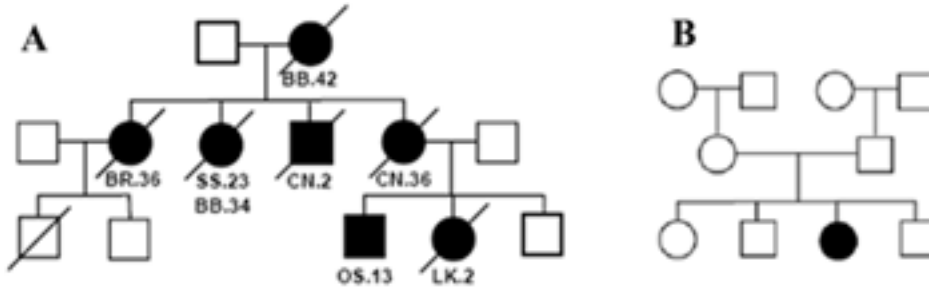
- |                 |                                      |
|-----------------|--------------------------------------|
| 98. Hydrophobic | a. water loving; soluble in water    |
| 99. Hydrophilic | b. water fearing; insoluble in water |
| 100. Lipids     | c. nucleotides                       |

- 101. DNA and RNA
- 102. Proteins

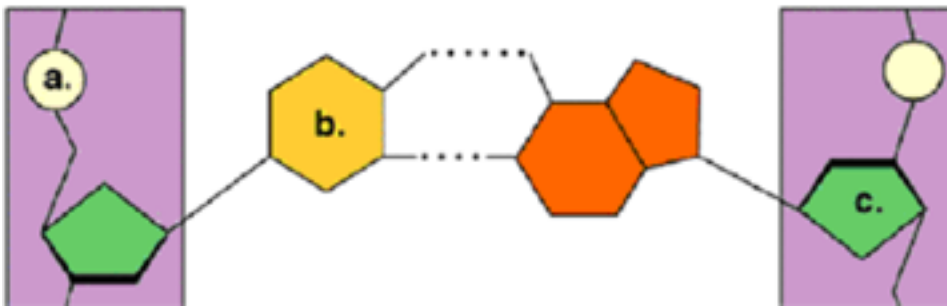
- d. glycerol and 3 fatty acids
- e. amino acids

**103-104. Below are two pedigrees. Match the letter with the type of cancer.**

- 103. Environmentally induced (carcinogen induced)
- 104. Genetic (inherited from parents)



**105-107. Match the letter on the diagram to the correct subunit below.**



- 105. Sugar
- 106. Phosphate group
- 107. Nitrogenous base

**108-111. Match the nucleic acid on the right to its characteristic on the left.**

- 108. A, T, G, C
  - 109. A, U, G, C
  - 110. Ribose
  - 111. Double stranded
- a. deoxyribonucleic acid
  - b. ribonucleic acid

**1-33. Multiple Choice. Select the single best possible answer for each question.**

1. Transcribe the following DNA template into mRNA: AATCGGCGGTAATGC.
  - a. TTAGCCGCCATTACG
  - b. GCATTACCGCCGATT
  - c. GCAUUAGGCGGCUAA
  - d. UUAGCCGCCAUUACG
  - e. GCATTACCGCCGACC
  
2. Which one of the following is a false statement about protein synthesis?
  - a. it involves rRNA
  - b. it involves tRNA
  - c. it involves mRNA
  - d. it takes place in the nucleus
  - e. it involves the formation of peptide bonds between amino acids
  
3. Genetic engineering can improve \_\_\_\_\_.
  - a. crop longevity
  - b. the resistance of crops to insects
  - c. the resistance of crops to herbicides
  - d. animal yields
  - e. all of the above
  
4. Transgenic rice now includes \_\_\_\_\_.
  - a. insecticide genes that were originally isolated from mold
  - b. beta-carotene genes that come from the daffodil plant
  - c. hormone producing genes from mice
  - d. bacterial genes that speed up growth rates
  - e. none of the above
  
5. Milk production is improved by \_\_\_\_\_.
  - a. injecting cows with somatotropin that is genetically engineered into bacteria
  - b. cloning cows that produce four times the amount of milk
  - c. adding foreign genes from humans that stimulate growth
  - d. forcing cows to drink their own milk
  - e. massaging the cow's ears while milking them
  
6. Biolistics is a technique in which genes are transferred into plants with a \_\_\_\_\_.
  - a. pipette
  - b. microscope
  - c. syringe
  - d. plasmid
  - e. gene gun
  
7. Genes from other organisms can be inserted into plasmids using \_\_\_\_\_.
  - a. a PCR machine
  - b. restriction enzymes (endonucleases)
  - c. RNA polymerase
  - d. a buffer
  - e. a salty solution
  
8. Which of the following is not a concern of Michael Hansen (he currently opposes the sale of genetically engineered salmon in the U.S.)?

- a. the immune response (allergenicity)
  - b. the labeling on the package
  - c. the salmon's ability to grow twice as fast as native salmon
  - d. the escaping of fish that will mix with native populations
  - e. the thoroughness of the studies that *AquaBounty* carried out
9. Genomics \_\_\_\_\_.
- a. is a field of genetics
  - b. attempts to understand the content of genetic information in an organism
  - c. attempts to understand the organization of genetic information in an organism
  - d. attempts to understand the function of genetic information in an organism
  - e. all of the above
10. Genomics has led to several interesting findings. Which of the following is not one of these findings?
- a. more complex organisms tend to have more genes
  - b. a large number of genes are new to science
  - c. large differences in genome size can arise through the duplication of chromosomes
  - d. organisms and their genes are easy to genetically engineer
  - e. rates of evolution vary greatly
11. Based on genomic studies of mammals, we've learned that \_\_\_\_\_.
- a. mammal genome size varies between mammals
  - b. mammals have about the same size genomes
  - c. the genome of an elephant is more similar to humans than the human genome is to primates
  - d. junk DNA has no function, it's junk
  - e. all of the above
12. As far as we know, which of the following organisms has not been cloned?
- a. sheep
  - b. dog
  - c. horse
  - d. cat
  - e. human
13. Which of the following is not involved in Somatic Cell Nuclear Transfer?
- a. somatic cell enucleation
  - b. nuclear injection with a micropipette
  - c. ligation of DNA to a plasmid
  - d. implantation of blastocyst into surrogate mother
  - e. electric shock to trigger cell division
14. Craig Venter is famous for recently leading a team of scientist that \_\_\_\_\_.
- a. confirmed the structure of DNA
  - b. sequenced the genome of a rat
  - c. developed the first self-replicating synthetic cell
  - d. reverse translated protein into mRNA
  - e. genetically engineered the *EnviroPig*
15. Embryonic stem cells \_\_\_\_\_.
- a. are found in the outer layer of the blastocyst (ball of cells)

- b. are pluripotent
  - c. are found in the base of the epidermis of humans
  - d. are found in the bone marrow of humans
  - e. all of the above
16. Inheritance of acquired characteristics suggests that new species \_\_\_\_\_.
- a. were created in their present form
  - b. arise from the modifications an organism acquires during its lifetime
  - c. evolve from other species
  - d. are brought about by natural selection
  - e. none of the above
17. Which of the following was not cited by Darwin in support of natural selection?
- a. variation occurs in every group of plants and animals
  - b. all organisms have the potential to over-reproduce
  - c. natural resources are limited
  - d. organisms travel great distances over time
  - e. only the most adapted to the local environment survive and pass along traits to the next generation
18. Disruptive natural selection is best characterized by \_\_\_\_\_.
- a. the loss of intermediate phenotype; 2 different sized bird beaks remain
  - b. the loss of the smaller beak phenotype; 1 large bird beak remains
  - c. the loss of the larger beak phenotype; 1 small bird beak remains
  - d. the loss of the larger and smaller beak phenotypes; the intermediate beak size remains
  - e. the loss of all beak sizes; beakless birds remain
19. Which of the following is not a statement/argument that is typically raised by the critic's of evolution?
- a. there are no fossil intermediates
  - b. variation does not occur in all plants and animals
  - c. the organs of living creatures are too complex for a random process to have produced
  - d. proteins are too improbable
  - e. natural Selection does not imply evolution
20. Michael Behe \_\_\_\_\_.
- a. proposed that intelligent design as an alternative to the theory of evolution
  - b. proposed that at the biochemical level, systems were irreducibly complex
  - c. proposed that the bacterial flagellum supports his "irreducible complexity" hypothesis
  - d. testified at the *Kitzmiller v. Dover Area School District* case in favor of intelligent design
  - e. all of the above
21. The study of the interactions between organisms and the environment is termed \_\_\_\_\_.
- a. haptology
  - b. phycology
  - c. ecology
  - d. environmental science
  - e. population blooms
22. Which of the following is not typically studied by ecologists?
- a. individuals

- b. populations
  - c. communities
  - d. biospheres
23. Parasitism is a type of relationship in which \_\_\_\_\_.
- a. one organism benefits and the other (host) does not benefit and is not harmed
  - b. both organisms benefit
  - c. one organism benefits and the other (host) is harmed
  - d. both organisms are harmed
  - e. none of the above
24. A food web \_\_\_\_\_.
- a. depicts the energy flow of nutrients in a community/ecosystems
  - b. includes primary producers
  - c. includes primary consumers
  - d. includes secondary consumers
  - e. all of the above
25. Based on the food chain on the right of this page, who is the primary consumer?
- a. hawk
  - b. snake
  - c. mouse
  - d. cricket
  - e. plant
26. Biological populations show a \_\_\_\_\_ type of growth.
- a. parabolic
  - b. exponential
  - c. logistic
  - d. hyperbolic
  - e. euclidean
27. The predictable process of recovery that occurs after a disturbance is termed \_\_\_\_\_.
- a. dispersal
  - b. colonization
  - c. regression
  - d. succession
  - e. pythagorean
28. A community and its physical environment is termed \_\_\_\_\_.
- a. biosphere
  - b. environment
  - c. habitat
  - d. community
  - e. ecosystem
29. Photosynthesis \_\_\_\_\_.
- a. occurs in the mitochondrion of the cell
  - b. produces carbon dioxide that animals use for respiration (to breathe)
  - c. produces oxygen and carbohydrates from carbon dioxide and water
  - d. was first discovered by Albert Einstein in 1905
  - e. all of the above
30. The light reaction in photosynthesis \_\_\_\_\_.
- a. is also called the z-scheme

- b. is light dependent
  - c. creates ATP and NADPH which are used in the Calvin cycle
  - d. requires water as a source of electrons
  - e. all of the above
31. Light energy that passes through a leaf is \_\_\_\_\_.
- a. reflected
  - b. transmitted
  - c. absorbed
  - d. absorbed by chlorophyll molecules
  - e. all of the above
32. Which of the following is not true of photosystems?
- a. they are responsible for capturing light energy
  - b. they are composed of antennae molecules and a reaction center that receives energy
  - c. they consist of about 300 pigment molecules
  - d. there are three types of photosystems involved in photosynthesis: PSI, PSII, and PSIII
  - e. they are embedded in the thylakoid membrane
33. Which of the following is not true about the Calvin Cycle?
- a. after six revolutions carbohydrates (sugars) are generated
  - b. it is light independent
  - c. it takes place in the cytoplasm of the cell
  - d. it requires molecules of Rubp (ribulose biphosphate) to keep the cycle revolving
  - e. it is the site of carbon fixation

**34-43. True or False. Mark T if the statement is true, Mark F if it is false.**

- 34. Genetic engineering is the technique of removing, modifying, or adding genes to a DNA molecule.
- 35. GMO is an acronym for "Genetically Modified Organism".
- 36. Transgenic tomatoes with the *etr1-1* gene decompose at a faster rate than unmodified tomatoes.
- 37. Pronuclear injection is a technique that is commonly used to add desirable genes to animals.
- 38. Genetically engineered salmon are currently being sold at the grocery stores.
- 39. The genome of an organism includes all of its genetic information.
- 40. About 100 prokaryotic and 30 eukaryotic genomes have been determined to date.
- 41. Therapeutic cloning is a technique that uses cloning methods to cure disease.
- 42. Adult stem cells can be stimulated to form any cell type of the human body.
- 43. The Polymerase Chain Reaction is a technique used to make billions of copies of any DNA target.

**44-48. Match the definitions on the right to the correct agent of evolution on the left.**

- |                      |   |
|----------------------|---|
| 44. Mutation         | a. the random change of allele frequencies  |
| 45. Migration        | b. individuals with certain genotypes mate with one another more commonly than would be expected on a random basis.   |
| 46. Genetic Drift    | c. the movement of individuals between populations  |
| 47. Nonrandom Mating | d. a change in the DNA sequence   |
| 48. Selection        | e. individuals that are better adapted than others in meeting the challenges of their habitat produce more offspring. |

**49-51. Match the type of symbiosis on the right to the correct organisms on the left.**

- |                         |                 |
|-------------------------|-----------------|
| 49. Ants and aphids     | a. commensalism |
| 50. Tapeworm and human  | b. parasitism   |
| 51. Whale and barnacles | c. mutualism    |

**52-55.** In 1956 Dr. Crick illustrated the “Central Dogma of Molecular Biology”. In the space provided below, label and illustrate (draw) this process. Include in your answer the following terms: translation, transcription, DNA, mRNA, protein, nucleus, cytoplasm. Also in your answer, show arrows indicating all known directions of information flow.

**1-17. Multiple Choice. Select the single best possible answer for each question.**

1. Carol von Linné \_\_\_\_\_.
  - a. proposed the binomial system of classification
  - b. was a german born plant physiologist
  - c. proposed the polynomial system of classification
  - d. proposed the theory of inheritance
  - e. proposed the Calvin Cycle
  
2. Identifying, naming, and classifying organisms is the field of \_\_\_\_\_.
  - a. regnumology
  - b. phylogenetics
  - c. taxonomy
  - d. astrology
  - e. fluviology
  
3. The current system of classification recognizes \_\_\_\_\_ domains and \_\_\_\_\_ kingdoms.
  - a. 2, 3
  - b. 3, 2
  - c. 3, 5
  - d. 2, 6
  - e. 3, 6
  
4. The biological species concept states that individuals of the same species \_\_\_\_\_.
  - a. cluster together on a phylogenetic tree in well defined clades
  - b. are able to breed with each other but are unable to produce fertile offspring
  - c. are unable to breed with each other
  - d. can breed with one another and able to produce fertile offspring
  - e. prefer to breed with individuals of other species
  
5. Domains Bacteria and Archaea are distinguished by \_\_\_\_\_.
  - a. the presence or absence of endospores
  - b. DNA analysis
  - c. lipid chemistry and structure
  - d. the presence or absence of peptidoglycan in the cell wall
  - e. all of the above
  
6. Exchange of plasmid DNA by bacteria is termed \_\_\_\_\_.
  - a. synapsis
  - b. pilifusing
  - c. conjugation
  - d. fertilization
  - e. phosphorylation
  
7. Bacterial cell division is termed \_\_\_\_\_.
  - a. mitosis
  - b. anastomosis
  - c. binnary fission
  - d. blastulation
  - e. splitting
  
8. Archaea are given the name “extremophiles” because they \_\_\_\_\_.
  - a. populate hydrothermal vents
  - b. live in highly acidic environments

- c. live in extremely high temperature environments
  - d. can withstand high salt concentrations
  - e. all of the above
9. Gram positive bacteria \_\_\_\_\_.
- a. stain pink
  - b. stain purple
  - c. do not stain
  - d. stain red
  - e. are optimistic and upbeat, and weigh about 1 gram, hence the name... lame
10. \_\_\_\_\_ is currently the most common bacterial STD in the United States.
- a. Syphilis
  - b. Hepatitis
  - c. Gonorrhea
  - d. Chlamydia
  - e. Herpes
11. Which of the following is not true about viruses?
- a. they are chemical parasites
  - b. they contain only DNA, no RNA
  - c. they require a host cell to reproduce
  - d. they have a protein layer (sheath) that surrounds the nucleic acids
  - e. they can incorporate their genetic material into the host's cells DNA
12. Which of the following is not part of the HIV life cycle?
- a. HIV enters the cell
  - b. HIV inserts its DNA into the host chromosome
  - c. HIV rewrites its RNA into DNA using reverse transcriptase
  - d. HIV proteins are reverse translated into RNA and then into host DNA
  - e. HIV replicates and exits the cells
13. HIV in human populations is currently treated with \_\_\_\_\_.
- a. nucleoside analog reverse transcriptase and protease inhibitors
  - b. antibiotics
  - c. antihistamines
  - d. penicillin
  - e. three hail marys and a stiff drink
14. Gonorrhea \_\_\_\_\_.
- a. can be cured with antibiotics
  - b. results in a rash
  - c. results in a chancre
  - d. results in a lesion
  - e. all of the above
15. Genital and oral herpes \_\_\_\_\_.
- a. can be cured with antibiotics
  - b. leads to "wasting"
  - c. are caused by the herpes simplex 1 and 2 viruses (HSV 1 and 2)
  - d. are characterized by painful urination and a white/yellow discharge
  - e. are caused by the human papillomavirus (HPV)

16. The Ebola and Hanta viruses \_\_\_\_\_.
- are transmitted to humans by the ingestion of uncooked meats
  - are common throughout the United States
  - are carried and transmitted to humans through contact with pigs and ducks
  - are carried and transmitted to humans through contact with crows
  - are filiviruses that cause hemorrhaging and typically result in death
17. Select the arrangement below that correctly lists the taxonomic units from largest to smallest.
- phylum, domain, family, class, order, genus, species, kingdom
  - phylum, domain, order, genus, species, kingdom, family, class
  - domain, class, kingdom, phylum, order, family, genus, species
  - domain, kingdom, phylum, class, order, family, genus, species
  - domain, class, genus, species, kingdom, phylum, order, family

**18-21. Match the characteristics on the right to the correct taxonomic group on the left.**

- |                       |   |
|-----------------------|---|
| 18. Euglenozoa        | a. protein pellicle, parasitic, heterotrophic, and some autotrophic with Chlorophylls A, B, many with 2 flagella for locomotion |
| 19. Rhizopoda         | b. silica (glass) shell, pseudopodia used for feeding, live in the pelagic (planktonic), ornamented                             |
| 20. Granuloreticulosa | c. amoebas, pseudopodia for movement, phagocytosis of bacteria  |
| 21. Polycystina       | d. forams, calcium carbonate shell, pseudopodia used for feeding, benthic, good indicators of past environmental conditions     |

**22-25. Match the characteristics on the right to the correct taxonomic group on the left.**

- |                      |  |
|----------------------|--|
| 22. Heterokontophyta | a. chlorophylls A, C, peridinin, 2 flagella, red tides, whirl, some parasitic, some autotrophic, unicellular and colonial  |
| 23. Chlorophyta      | b. chlorophylls A, C, fucoxanthin, whiplash and tinsel flagella, alginate and silica (glass) in some, unicellular and multicellular  |
| 24. Rhodophyta       | c. chlorophylls A, D, phycobilins, no flagella, agar/carrageenan, multicellular only and 99% marine  |
| 25. Dinophyta        | d. chlorophylls A, B, carotenoids, many types of whiplish flagella, predominantly freshwater, but also marine species, unicellular and multicellular, gave rise to Kingdom Plantae |

**26-29. Match the characteristics on the right to the correct taxonomic group on the left.**

- |                        |  |
|------------------------|--|
| 26. Oomycota           | a. hyphae aseptate, cell wall chitin, club-shaped spore structure, no flagella, mushrooms, rusts and smuts |
| 27. Zygomycota         | b. hyphae septate, cell wall chitin, no flagella   |
| 28. Basidiomycota      | c. cell wall cellulose, individuals form slugs to relocate to find yeast and bacteria to feed upon         |
| 29. Dictyosteliomycota | d. cell wall cellulose, whiplash and tinsel flagella, sudden oak death and Irish Potato Famine             |

**30-34. Match the characteristics on the right to the correct taxonomic group on the left.**

- |                   |  |
|-------------------|--|
| 30. Hepatophyta   | a. seedless vascular plants, sporophyte dominates  |
| 31. Gnethophyta   | b. most primitive plants, no vascular tissue, require water for fertilization, gametophyte dominates |
| 32. Coniferophyta | c. seeds, vessel elements present, insect and wind pollinated, double fertilization                  |
| 33. Pterophyta    | d. seeds, most advanced plants, fruits, monocots and dicots,   |
| 34. Anthophyta    |  |

- pollination by insect, bird, or wind, sporophyte dominant, double fertilization
- e. seeds, no vessel elements, no double fertilization, sporophyte dominant, female and male cones, wind pollinated

**35-43. Match the KEY evolutionary innovations on the right to the correct taxonomic animal group on the left. Use the letters only once.**

- |                     |   |
|---------------------|---|
| 35. Porifera        | a. bilateral symmetry (acoelomate type) |
| 36. Cnidaria        | b. body cavity (pseudocoelomate type)   |
| 37. Platyhelminthes | c. multicellularity                     |
| 38. Nematoda        | d. jointed appendages and exoskeleton   |
| 39. Mollusca        | e. symmetry and tissues                 |
| 40. Annelida        | f. notochord                            |
| 41. Arthropoda      | g. true body cavity (coelomate type)    |
| 42. Echinodermata   | h. segmentation                         |
| 43. Chordata        | i. deuterostome and endoskeleton        |

**44-52. Match the animals on the right to the correct taxonomic group on the left.**

- |                     |   |
|---------------------|---|
| 44. Porifera        | a. flatworms  |
| 45. Cnidaria        | b. insects, spiders, crustaceans, milli/centipedes                  |
| 46. Platyhelminthes | c. gastropods, bivalves, cephalopods                                |
| 47. Nematoda        | d. jellies, anemones, corals  |
| 48. Mollusca        | e. tunicates, lancelets, fish, amphibians, reptiles, birds, mammals |
| 49. Annelida        | f. roundworms   |
| 50. Arthropoda      | g. sponges  |
| 51. Echinodermata   | h. segmented worms  |
| 52. Chordata        | i. sea stars, urchins, cucumbers, lilies, and brittle stars         |

**52-63. Based on information from the movie “Journey of Man”, answer the following questions:**

52. What was the source for Luca Cavalli-Sforza’s genetic time machine?
53. What population represents the oldest lineage of people living today? What country in Africa are they from?
54. How long ago did a small group of humans leave Africa?
55. Why did early humans migrate out of Africa?
56. Did Spencer find evidence for a human migration through India en route to Australia?
57. Where did the second group out of Africa migrate to? How long ago?
58. The second wave of people out of Africa branched and went in two different directions. Where did they go?
59. How long did it take humans to get from the Middle East to Europe? Why?
60. What is so interesting about Niyazov’s DNA?
61. Where did the Chukchi’s ancestors come from?
62. What route did the ancestors of native North and South Americans take? How many made the journey?
63. Who are the ancestors of latinos?