



**Course** With relevance to students' lives, Introductory Biology II will provide exploration into the diversity, classification, ecology, and evolution of the natural world and the importance of photosynthesis and other cellular processes. Different types of organisms, such as bacteria, protists, fungi, plants and animals, will be studied to compare structure and function. Several field trips may be taken but hours will most likely not extend beyond weekly contact hours for laboratory. Students may also be required to attend one committee/council meeting from a list of designated environmental groups from the Muskegon area.

This course is four credits with seven contact hours per week for 15 weeks (3 hours for lecture and 4 hours for laboratory) and is an option for the Science/math elective for General Education. No prerequisites are needed, although lecture and lab are co-requisites.

**E-mail** *All email Communication originating from MCC to students will be via their email account. CHECK YOUR MCC EMAIL FREQUENTLY. When emailing, **put BIOL 104 in the subject area and subject of email.** Currently, please don't use postings on the Blackboard discussion site to correspond with instructors.*

- Expect emails to be answered between M – F (no weekends), approximately 8am to 3pm but not during lab and lecture periods. Expect about a two day response time (exempting weekends).

**Required Texts/programs:**

- Starr, Evers, Starr. 2011. Biology: Concepts and Applications. 8th ed. Thomson Brooks/Cole.
  - In the bookstore, it is a custom package with selected chapters from the entire book. ISBN 13 978-1 285 041049
  - OR the entire textbook can be purchased used from your favorite on-line bookstore. ISBN 13 978-1-4390-4673 9 , ISBN 10 4390 4673 5 (*Has many on-line resources and mp3 downloads*)
  - Or you can purchase e-chapters on line from Thomson Brooks/Cole.
- Perry, Morton, & Perry. 2012. Laboratory Manual for General Biology. 5th ed. Thomson Brooks/Cole. ISBN 978 0 495-46657-3
- Supplement pages will be provided via Blackboard for downloading and printing. **You must print these off before coming to lab or lecture.** No extra copies will be provided.
- Goggles and 6 pairs of gloves for laboratory work (dissections and mixing chemicals). Available through the bookstore.

**Optional/Recommended for Biology majors or visual learners:**

- Van De Graaff and Crawley. 2009. A Photographic Atlas for Biology. 6<sup>th</sup> ed. Morton Publishing. ISBN 978-0-89582-803-3

**Required for On-line Students and recommended for on campus students:**

Internet, BlackBoard access, PowerPoint Viewer (free), Microsoft Word (or free software from internet "Open Office), media player. Recommended: High speed Internet access, speakers, QuickTime

**Fees** Course fee of \$14.00. If student opts not to carpool in the school's van for the field trips, then they will need to provide their own transportation (no gas costs or mileage will be paid to students and carpooling is highly recommended).

**Objectives** The objectives serve as a basis for the lectures, laboratories, and exams. The student is responsible for an objective, whether it is covered in the laboratory only, lecture only, reading only, or a combination of these. Tests will be derived from these objectives, labs, lectures, and the textbook readings. Use the objectives as study guides for the exams.

**Assessment Overview**

Students will be assessed through exams, assignments, labs and lab practicals.

Final letter grades will be based upon points earned:			
		+	-
A		800-736	735-720
B	719-704	703-656	655-640
C	639-624	623-576	575-560
D	559-544	543-496	495-480
E	Below 479		

**Exams (50%) 400** Note: all exams will be held on campus.  
 (Four 75pt exams, 1 final 75pt comprehensive exam, 25 pts lecture quizzes or in class participation, see below for missed exams)

**Assignments (25%) 200** (see detailed assignments below)

**Labs (25%) 200** (worksheets, weekly quizzes, case studies, two lab practicals\*)

**TOTAL 800**

\* Lab practicals canNOT be missed and no make up lab practicals will be given.

*NOTE: Grades will be posted on Blackboard (current points) and Web Advisor (final grades). Except for web advisor's final grade, the instructor's gradebook file is the master document for all points/grade. After a grade is issued, you have one year to contest the grade. Graded papers and exams will be returned to you for temporary viewing within a week's time of the assignment. Exams must be returned to instructor. I suggest that you save all other graded papers.*

**On-line students:** Exam schedule (on campus) and optional orientation.

**Attendance and Absences**

**For lecture:**

- **When in lecture or laboratory, all cell phones must be turned off.**
- See Blackboard site for PowerPoint lectures and assignments.
- Print off supplemental pages before coming to lecture.
- Completed assignment and exam points will be posted on Blackboard.
- Assignments must be submitted as instructed, either through Safe Assign e-mail attachment, or hard copy.
- All papers, presentations, and creativity assignments must be submitted to Safe Assign **before the deadline or 10 pts will be deducted from grade** – no excuses (*learn how to use Safe Assign prior to deadline*).
- When assigned, surveys and timed quizzes must be taken via Blackboard within scheduled times.
- Exams will be taken in person and on campus (see student handbook for more information). **NOTE:** Make up exams may be all essay questions and only ONE exam can be made up. Students must contact the instructor with a valid excuse and then the student must call the Testing Center at 777-0394 (Room 134) to make an appointment to take the exam.

### **For laboratory:**

- When in lecture or laboratory, all cell phones must be turned off.
- Students must concurrently register for a laboratory consisting of an on campus, two 2-hour session times per week. For most of the semester, all time for lab will be utilized.
- The course grade incorporates both lecture and laboratory points.
- See Blackboard site for additional information about laboratories.
- Print off supplemental pages before coming to lab.
- Laboratory points will be posted on BlackBoard.
- Students are required to attend all laboratory sessions. If a lab is not attended, **10pts for each lab time absence will be deducted** from the lab grade (except with valid excuse with proof and instructor has been contacted and **the lab MUST be made up within the week of that lab**). **Only one lab can be made up except for the following:** *No labs can be made up during the lab practical weeks, photosynthesis lab, respiration lab, or soil lab.*
- Prior to attending the laboratory, read the lab manual including worksheet pages that pertain to the week's topic so that procedures/activities are understood.
- **Complete all pre-lab questions and turn in as you come into each laboratory session.**
- **Be prepared for random lab quizzes.** Weekly Lab Quizzes are each worth 5 points. It may consist as a pre-lab quiz on the first lab day of the lab week, a post-lab quiz on the second day, dissection quiz, or some given assignment. ***SO BE PREPARED.***
- Lab worksheets should be filled out neatly and completely; otherwise points will be deducted if it is illegible.
- **All post lab questions from the previous week will be due on the first lab day of the week.**
- **No late post lab questions will be accepted except for a make-up lab.**
- Lab questions may be discussed with your lab group but absolutely no copying of others' work will be allowed. You must write your own responses unless instructed to do otherwise for group projects.
- Some labs are required field trips (about two) or outside work (about three). Participation is required for lab points. NOTICE: The dune field trip is 3 hours so please sign up and make modifications to your schedules. *If you are physically unable to walk on dunes, please notify the instructor as soon as possible, so that you may complete an alternative dune laboratory.* DRESS APPROPRIATELY FOR THE WEATHER.
- Sign up for field trips when instructed.
- Two Lab Practicals will be given. Arrive early to lab and bring two pencils. You will be moving from station to station answering questions during timed periods. You will **NOT** be able to go back to any previous station.

## Withdrawal

See catalog, internet, and schedule book for more details on Withdrawals. *To receive a W in this course, **students must initiate action** according to the student handbook otherwise an E will be given at the end of the semester.*

## Studying

- About 2-3 hours of studying time for each hour in class are recommended.
- Reading the text before a lecture is helpful in understanding the lecture.
- The end of each chapter contains a summary, questions and web sites for additional learning aids.
- Some students find making note cards, recording lectures, studying with a group, and quizzing yourself are good preparation techniques for exams.

## Have a Back up Plan *(if your computer crashes, no wi-fi, or a flat tire...)*

- Complete assignments early and submit work early. DON'T WAIT TO THE LAST MINUTE!
- Have access to a friend's computer in order to complete assignments.
- Recruit a friend or two that you can call if your car breaks down and you need a ride to campus. Ride the bus.
- Use our computer labs. Know their locations and open hours.
- Campus closure days: If in question, check BlackBoard, email, TV news, or radio. **If you do not have access to email at home, please let me know at the beginning of class and I will call the phone number that you give me ☺**

## Other assistance

- Campus Computer Technical problem contact number 24/7: 1-866-718-5170. <http://www.muskegoncc.edu/pages/2648.asp>
- Biology Computers with learning programs (room 249). Bring your own headset for audio listening.
- Additional exam review sessions (outside of regular class time) upon request.
- If you have special learning needs, please inform instructor and contact Janice Alexander at 777-0309. <http://www.muskegoncc.edu/pages/516.asp>
- FREE tutoring is available. 777-0393. <http://www.muskegoncc.edu/pages/646.asp>
- The Writing Center for help with grammar and writing. 777-0474. <http://www.muskegoncc.edu/pages/500.asp>
- On-line students: Read the *Students' Guide to Distance Education at MCC* which is located on your class's Blackboard site.

## Student Assessment and Accreditation

Muskegon Community College is fully accredited by the Higher Learning Commission located in Chicago (<http://ncahlc.org/>). The Higher Learning Commission accredits degree granting postsecondary educational institutions in the North Central Region. Accreditation helps ensure students that they are receiving a quality education and can transfer to other colleges and universities with ease and confidence. MCC is committed to an essential part of the accreditation process: assessing student learning. You will likely be asked to participate in assessment activities as part of MCC's assessment of programs and general education.

## **Student Behavior**

Muskegon Community College is a community of scholars whose members include administrators, faculty, staff, and students. Mutual respect and civility are expected in the classroom or other college academic settings, as well as, in any communication. MCC has the duty of providing students with privileges, opportunities, and protections that best promote learning;

- Students have the right to a non-threatening learning environment;
- Students have the responsibility to refrain from infringing on the right of others to learn or the right of teachers to teach; and
- Any student whose behavior disrupts learning may be subject to disciplinary action as outlined in the Muskegon Community College Student Handbook/Planner.

## **Academic Integrity Policy**

Muskegon Community College expects that all faculty and students will adhere to high standards of personal and academic honesty. This means that all academic work will be done by the student to whom it is assigned without unauthorized aid of any kind. Faculty members, for their part, will exercise care in the planning and supervision of academic work so that honest effort will be positively encouraged. Academic dishonesty consists of, but is not limited to:

- Cheating. Cheating is defined as using or attempting to use, giving or attempting to give, and obtaining or attempting to obtain, materials or information, including computer material pertaining to a quiz, examination, or other work that a student is expected to do alone.
- Plagiarism. Plagiarism is defined as the use of another's words or ideas without acknowledgement.
- Penalties for violation of these standards of conduct may result in sanctions of up to and including suspension or expulsion from MCC.

## **Dispute Resolution Process**

Should a student not agree with a faculty member's decision or actions as they may relate to this policy, the following steps shall be followed:

1. A student suspected of academic dishonesty shall be notified in writing within two school days of the time the violation is discovered. Copies of the written notification shall also be filed with the department chair and Vice President of Student Services.
2. The student should try to reach resolution of the matter through direct discussion with the involved faculty member within three (3) school days of the written notification.
3. If the matter is not resolved in Step 2, the student shall bring the matter to the attention of the department chairperson of the involved faculty member.
4. If the matter is not resolved at the department chairperson level, the student shall bring

the matter to the attention of the Vice President for Academic Affairs who shall render a decision within five school days of the receipt of the dispute information.

5. If a satisfactory solution is not reached at the Step 4 level, the student may file a written request with the Vice President of Student Services for a hearing before the disciplinary board. This meeting shall be held not more than 20 days following the written request. A student may request a hearing before the disciplinary board. The disciplinary and judicial procedures are outlined in the Muskegon Community College Student Handbook/Planner.

## INTRODUCTORY BIOLOGY II (BIOL 104 L & L): DETAILED ASSIGNMENTS

*Below are some required assignments and some optional assignments that you may choose for the **200 assignment points**.*

	Assignment	Possible Points	√ Required or Your Choice	Hard copies Due On	Submit to Safe Assign
<b>REQUIRED</b>	Newspaper articles	5 pts	√ Required		No
	Where is her office?	5 pts	√ Required		No
	Learning Styles	10 pts	√ Required		No
	Weekly Reading Questions (12 of 14 are required)	60 pts (5 pts each week)	√ Required		No
	Local Environmental Meeting	50 pts	√ Required		YES,
<b>CHOOSE One</b>	Paper on an Edible Plant, Fungi, or algae	35pts	Optional		YES,
	Website Research on Genetic Engineering in Plants	35pts	Optional		YES,
<b>Choose one</b>	Presentation	35pts	Optional	Variable, set date with Instructor	YES
	Creativity:	35pts	Optional	Variable, set date with instructor	YES
	<b>TOTAL POSSIBLE POINTS MUST ADD TO 200</b>				

*Fill in below, keep one copy for yourself and give the other to instructor at "The Office Appointment"*

Name: \_\_\_\_\_ Lecture time \_\_\_\_\_ Lab time \_\_\_\_\_ Date of Appointment \_\_\_\_\_

These are my chosen Optional Assignments (2 of the 4, please fill in the appropriate spaces):

Assignment		Yes/No	Due Date	Topic	Partner's Name
Edible P, F, A	<b>Choose one</b>				
Genetic Eng.					
Presentation	<b>Choose one</b>				
Creativity					

## My Reminder Table

These are my chosen Optional Assignments (please fill in the appropriate spaces):

Assignment	Yes/No	Due Date	Topic	Partner's Name
Edible P, F, A				
Genetic Eng.				
Presentation				
Creativity				

**BRIEF ASSIGNMENT INSTRUCTIONS:** *more details with grading rubrics (don't loose) will be given to you during your "Where is the Prof's office" assignment.*

### **Newspaper Article (5pts)**

Bring two newspaper articles: one newspaper article that includes **ECOLOGICAL** science information and one newspaper article that includes non-science information. For full points, must have titles of articles on the board with your initials **before the beginning of lecture class.** **On line students: submit title to discussion board with web link.**

### **Where is the Prof's office? (5pts)**

Meet with your instructor in her/his office **before** \_\_\_\_\_ (no more than 3 people). Sign up for a ten minute appointment. Bring your syllabus and any questions about the course and assignments. *Before coming to the meeting, contemplate on what optional assignments you would like to complete and complete as much of the above table as possible.* Rubrics for your optional assignments will be given to you. **Required for on- campus and on-line students.**

### **Learning Styles (10pts)**

Visit this website from North Carolina State University [www.ncsu.edu/felder-public/ILSpage.html](http://www.ncsu.edu/felder-public/ILSpage.html) Explore and read this website. Complete the ILS questionnaire by completing the 44 questions (takes about 15 minutes). Submit your answers and you will immediately receive your scored results on-line. To receive full points, complete and turn in the following on :

- Print off your results page.
- After seeing your results, discover more about your learning styles by reading the website.
- Answer this question, what are *two specific actions* (from the website) can you do to improve your studies so as to monopolize on your strongest abilities?
- **On line students:** submit as attachments via the assignment.

### **Weekly Reading Questions (60pts)**

**Due on each second lecture day of the week (Wednesday) or [Thursday].** Each week's assignment is worth 5 pts and is graded on your explanation, thoroughness, and accuracy. By the end of the semester, you should have completed 12 of the 14 weekly assignments by each due date. On-line students: submit as a Blackboard assignment according to the following dates.



**Weekly Reading Critical Thinking Questions – Due every second lecture day of week  
Are from Textbook except where noted**

CT Week		DUE DATE (MW) [T TH]
1	Questions (science) CT 3 & 4 pg 21	
2	Explain biomagnification of mercury within an aquatic food web, CT 2 pg 721	
3	Questions (protists) CT 2 pg 73, CT 1 & 3 pg 323	
4	Questions (animals) CT 1 pg 375, CT 1 395	
5	Explain how a dune ecosystem is unique among ecosystems	
6	Summarize "The Endosymbiotic Hypothesis" and its supporting evidence	
7	Construct/diagram a <i>generalized fungi life cycle</i> by comparing life cycles of basidiomycetes, zygomycetes, and ascomycetes for similarities	
8	Construct/diagram the Concept map/web (see BlackBoard)	
9	Compare and Contrast gymnosperms and angiosperms	
10	Questions (photosynthesis) CT 1, 2, 3 pg 105, (ferns) CT 1 341	
11	Questions (plants) CT 3 pg 341, CT 1 & 2 pg 413	
12	Questions (plants) CT 1 & 2 pg 447, CT 2 pg 745	
13	Questions (plants) CT 1 & 2 pg 427, (nat. selection) CT 1 & 2 pg 707	
14	Questions (evolution) CT 2 pg 255, CT 1 pg 281, CT 2 pg 689	

**Local Environmental Meeting (50pts)- see rubric for more information**

Attend one local environmental meeting (a list of organizations is on Blackboard) and be sure to get a signature from one of the board members. DO NOT wait until the end of the semester to attend a meeting as many groups meet only once a month. Write a typed concise one page paper about the group's mission, summary of the meeting, its relevance to you AND attach the signature with date of meeting. During the last two weeks of the semester you will give a 5 – 10 minute informal talk about your paper in lab. For citation style, use APA. 45 pts for paper and 5 pts for presentation. **All students: submit paper to SafeAssign. All students must turn in a hard copy on your lab day – see your schedule.**

**Edible Plant, Fungi, or Algae Paper (35pts)- see rubric for more information**

One-two page typed paper on one *edible non-agricultural organism (algae, plant, fungi)* that you would find here in one of **Michigan's ecosystems**. Use and cite all scientific resources (not Wikipedia) including picture citations. Include a picture & cite resources. Include where to specifically find the organism, which part is edible, any warnings, and how to prepare it. For citation style, use APA. **All students: submit to SafeAssign. All students must turn in a hard copy to instructor in lecture.**

## **Plant Genetic Engineering Paper (35pts) – see rubric for more information**

Use only scientific research sites (not newspapers, Wikipedia, or general magazine websites, although they may lead you to research centers). Print off the first page of the website, be sure it has the website address identified. In one typed page, describe the research, its usefulness for society, and your opinion on the matter. For citation style, use APA. **All students: Submit to SafeAssign. All students must turn in a hard copy in class.**

## **Presentations (35pts)**

About a ten minute presentation either in lecture or in laboratory with or without a partner. Must coordinate topic and due date with instructor during the office appointment. Look at course objectives for topics ideas. Each partner must do his/her share of the preparation and presentation. Each student will be graded individually. **A detailed typed outline** must be provided to the instructor in advance of presentation. Conclude the presentation with 3 questions to ask your peers (each from a different level of thinking, such as: recall, definitions, compare and contrast). Use college biology terms and appropriate SCIENTIFIC resources. Cite all your resources in your outline and presentation. You may use posters, overheads, whiteboard, and/or powerpoint projector. If powerpoint presentation, save your presentation on a UBS flashdrive and copy it to the digital dropbox on our class' Blackboard site. PRESENTATION HINT: use the 7 x 7 rule. No more than 7 bullets/slide and no more than 7 words/bullet. DO NOT PRINT OFF ALL YOUR POWERPOINT SLIDES AND MAKE COPIES FOR YOUR PEERS – INSTEAD and if desired make a single fill in the blank handout. For citation style, use APA. If you would like to make copies for the class, get the master to the instructor about one week in advance. Also submit to SafeAssign. Due date will be coordinated with instructor.

## **Creative Alternative (35pts)**

Write and/or perform a skit, song, game, structure model, painting, video, or other about one of the many topics we will be covering. Topic will be discussed and decided upon during the office meeting with your instructor. Prior to your creativity presentation in lab or lecture, give your instructor a detailed typed outline/script of the project. Include references and citations. Due date will be coordinated with instructor.

## **APA Format Websites**

- <http://flash1r.apa.org/apastyle/basics/index.htm>
- <http://www.liu.edu/CWIS/CWP/library/workshop/citapa.htm>

APA format means that you must list your citations/resources in proper form at the end of your paper AND also put short citations embedded in your main text whenever that you make a quote or paraphrase or use an idea from your resource.

**BIOL 104 L & L, Introductory Biology II and Laboratory  
TENTATIVE SYLLABUS SCHEDULE**

**Common studying concepts for all biome units**

- o Diversity of individuals in populations and communities
- o Taxonomy
- o Food webs
- o Reproduction and life cycles
- o Genetic adaptations and biological evolution
- o Anthropogenetic effects, Exotic species

**Dune Trip Requirements:**

- Must be able to physically walk 1 mile and up 2 flights of stairs.
- Must be able to walk thru sand.
- If unable to do above, you must see instructor immediately for an alternative lab.

MAJOR LECTURE CONCEPTS	LABORATORY ACTIVITIES
<p><b>What is Science, Why Bother with Biology</b>            Scientific process            Biology, ecology, zoology            Nomenclature, Taxonomy,            Cladogram, Tree of Life            Overview of Biomes            Hydrological cycle  <b>Freshwater biome &amp; ecosystems, local watersheds</b>            Protists            Platyhelminthes &amp; Rotifers            Porifera            Cnidarians            Echinoderms            Invertebrates Chordates            Wetlands &amp; Riparian Areas  <b>Upland Forest</b>            Annelids            Mollusks            Dune Ecosystem, Succession,  <b>Rainforests</b>            Exam 1. Units 1-3.            Decomposers            Bacteria            Types of cells            Cellular Respiration            Biogeochemical Cycle: Carbon            Fungi &amp; Lichens            Nematodes            Life cycles            Nuclear Divisions, Animal embryology  <b>Taiga</b>            Photosynthesis            Variations of Photosynthesis            Food webs &amp; energy            Gymnosperms            Angiosperms,  <b>Tundra</b></p>	<p>Lab safety            Scientific method            Measurement            Microscopy            Aquatic lab            Protists            Echinoderms, Invertebrates Chordates            Segmented worms &amp; mollusks            Segmented worm behavior            Kasey Hartz Natural Area  <b>DUNE FIELD TRIP WEEK</b>            Structure of living cells            Bacteria            Respiration            Fungi            Roundworms &amp; jointed legged animals            Lab practical            Seed plants            Photosynthesis            Bryophytes            Seedless vascular plants            Fern Chemotaxis            Plant hormone s            Taxonomy            Vertebrates            Animal Case Studies            Plant Organization            Supermarket Botany            Plant case studies            Soil and organisms            Population Case studies            Evidences of Evolution,            Natural selection  <b>ENVIRONMENTAL MEETING            PRESENTATIONS,            Lab Practical II</b></p>

<p>Bryophytes Ferns &amp; allies Biogeochemical cycles, Nitrogen cycle and Phosphorus cycle, <b>Grasslands</b> Fire and grazing, adaptations Exam 2. Units 4 &amp; 6. Plant Behavior &amp; hormones Plant development &amp; growth Arthropods Chordates <b>Shrublands &amp; chaparrals</b> Plant leaf and stem structure and function Plant root structure and function <b>Deserts</b> Exam 3: Units 7-8. Water conservation plants and animals Transportation of nutrients and water in plts, soils Population &amp; communities Evolution &amp; Natural selection EXAM 4 and FINAL EXAM</p>	
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## **BIOL 104 OBJECTIVES**

### **Overall General Objectives:**

- A. Understand the nature of science and be able to critically assess media reports concerning science, pseudoscience, and non-science.
- B. Explore the diversity and biological evolution of life by studying and observing common structures, functions, and development of bacteria, protists, animals, plants, and fungi.
- C. Recognize different ecological environments around us, the relevance of these ecosystems as well as all the living organisms within them, and how we as a society alter them.
- D. Explore and explain biological evolution by understanding the genetic basis of living organisms and how environments and humans influence populations.
- E. Explain the function and structure of populations and communities by exploring some of our Muskegon ecosystems: dunes, aquatic, and upland forest.

### **Specific Objectives:**

#### **Science, Biology, and Classification.**

1. Explain the nature of science and scientific method / process.
2. Evaluate media reports and critical thinking problems for science and non-science issues.
3. Differentiate and understand major characteristics between prokaryotic and eukaryotic life forms.
4. Define the following: binomial nomenclature, biology, botany, zoology, taxonomy.
5. Understand how and why living organisms are classified into levels: kingdom, phylum, class, order, family, genus and species.
6. Compare and contrast organisms that are classified as bacteria, protists, animals, plants, and fungi. (all units)

#### **Biomes (all units)**

7. Define the term biome and list major terrestrial biomes of the world.
8. Identify the location/distribution of seven (7) major terrestrial biomes on a map of North America.
9. Briefly describe each of the major terrestrial biomes: deserts, tundra, coniferous forest (taiga), shrub lands, grasslands (including savanna & prairie), temperate deciduous forest, rain forests (tropical & temperate).
10. Arrange the major terrestrial biomes of North America according to decreasing temperature and rainfall.
11. Name the sequence of biomes you would encounter going from the base of the Rocky Mountains to their summit.

#### **Ecology, Aquatic ecosystems**

12. Define ecology, biotic, and abiotic.
13. Define and understand what is meant by the terms: biosphere, ecosystem, species, populations, habitat and community.
14. Explain the hydrological cycle and its effect on aquatic ecosystems.
15. Define and identify on a lake cross-section the following general habitat regions and the biotic and abiotic factors in each: littoral zone, profundal zone, and limnetic zone, and benthic zone.
16. Describe with examples the littoral zone plant groups: emergent plants, floating-leaf plants, and submersed plants.
17. Explain why it is possible that the greatest diversity of organisms within pond occurs in the littoral zone.
18. Define and identify specific examples of the following: plankton, phytoplankton, and zooplankton.
19. Describe sequential events that constitute pond or lake "aging" or succession.
20. Explain cultural eutrophication and describe sources of ground water and surface water pollution.
21. Construct an aquatic food chain and web.
22. Explain biological magnification.

#### **Biogeochemical cycles and Anthropogenic Changes (several units)**

23. Diagram and summarize the following biogeochemical cycles: carbon, nitrogen, and phosphorus.
24. Diagram and describe how respiration and photosynthesis are involved in the cycling of oxygen ( $O_2$ ), carbon dioxide ( $CO_2$ ) and water ( $H_2O$ ).

25. Provide examples of how humans have modified the biogeochemical cycles through air pollution, smog, acid rain, fertilizers, mining, and etc.
26. Discuss the effects of acid rain, chlorofluorocarbons, global warming, and ozone depletion.

### **Photosynthesis**

27. Write the overall formula for photosynthesis and identify both the input and output elements contained in the overall formula.
28. Explain how carbon dioxide and water reach the chloroplast-containing cells of green plants.
29. Distinguish between the light and dark reactions of photosynthesis.
30. Explain the following about photosynthesis:
  - a. The wavelengths of light most effective in photosynthesis.
  - b. The role of chlorophyll in photosynthesis.
  - c. The source of oxygen liberated during photosynthesis.
  - d. The role of water in photosynthesis.
  - e. The source of carbon contained in PGAL or Glucose.
  - f. The role of carbon dioxide in photosynthesis.
  - g. The relationship between PGAL and Glucose
31. Explain the significance of the photosynthetic demonstrations and experiments performed in the laboratory.
32. Identify the plant pigments that were separated in the laboratory by chromatographic techniques.
33. Discuss the correlation between the distribution of leaf pigments and the occurrence of photosynthesis, e.g., chlorophyll and anthocyanin.
34. Compare and contrast the overall processes of aerobic respiration and photosynthesis as to inputs (reactants) and outputs (products).
35. Explain the differences between autotrophic and heterotrophic organisms.
36. Explain photorespiration and some other variations of photosynthesis.

### **Protists**

37. List the characteristics of the Phylum Protista and identify at least three features that are unique to the phylum.
38. Cite the features that serve to distinguish the classes of the Phylum Protista.
39. Distinguish between flagella, cilia and pseudopodia.
40. Distinguish and classify the following: Foraminifera, *Radiolaria*, *Euglena*, *Paramecium*, *Plasmodium* and *Entamoeba*.
41. Briefly describe the life cycle of *Paramecium* and the following structures: nuclei, "mouth", food vacuole, cilia, contractile vacuole, anal pore, and trichocyst.
42. Briefly discuss the parasitic nature of the genus *Plasmodium*.
43. List major characteristics of algae.
44. Summarize the major characteristics of each of six divisions/phyla of algae.
45. Compare and contrast a generalized cyanobacterium and green algal cell.
46. Identify the following algae as to major characteristics, common name, genus, and division: *Chlamydomonas*, *Spirogyra*, kelp, *Oedogonium*, *Diatoms*, *Volvox*, *Protococcus*, *Fucus*, *Euglena*, *Dinoflagellates*, *Sargassum*, red algae.
47. Discuss the importance of kelp, diatoms, dinoflagellates, and red algae to humans.
48. Discuss the source and use of agar, algin, and carrageenan.
49. Diagram and explain the life cycle patterns of *Chlamydomonas*, *Spirogyra*, and *Oedogonium*.
50. Define and explain the following terms to the life cycle patterns of algae: asexual reproduction, sexual reproduction, fragmentation, diploid generation, haploid generation, gametes, eggs, sperms, zygote, mitosis, meiosis, fertilization, oogonium, antheridium, zoospore, conjugation.
51. Describe the plant-like and animal-like characteristics of the member of the genus *Euglena*.

### **Animals (all units)**

52. Define the following characteristics for each animal phylum: body plan, symmetry, embryology, type of coelom, level of organization, nervous system, digestive system, circulatory, excretory, and reproduction.

## Animal Invertebrates

53. List and briefly describe the features of the Phylum Porifera, including level of organization. Identify at least three features that are unique to this phylum.
54. Identify from prepared slides, diagrams, or descriptions of sponges, the name and function of the following: epidermis, spongocoel, collar cells, osculum, incurrent pores, central cavity, amoebocytes, scleroblasts, spicules and spongin.
55. Discuss regeneration and asexual reproduction in sponges.
56. List and briefly describe the major features of the Phylum Cnidaria, including level of organization. Cite at least three features that are unique to this phylum.
57. Identify from prepared slides, diagrams, or illustrations, the name and function of each of the following structures/regions associated with members of the Phylum Cnidaria: gastrovascular cavity, tentacles, "mouth-anus," basal disk, bud, nerve net, gastrodermis, epidermis, cnidoblast and nematocyst, polyp and medusa.
58. Diagram and discuss the life cycle of *Obelia*, include both the polyp and medusa stages in the life cycle and note the function of each of the two stages.
59. Identify the following members of the Phylum Cnidaria from preserved material, diagrams, or prepared slides as to name and class: *Hydra*, *Obelia*, Portuguese Man-of-War, Sea Anemone and Corals.
60. Differentiate organismal movement between sponges and cnidarians.
61. List and briefly describe the major features of the Phylum Platyhelminthes. Indicate at least three features that are unique to the phylum.
62. Briefly characterize and note the features that distinguish three classes of Platyhelminthes: Turbellaria, Trematoda and Cestoda.
63. Identify the following from diagrams, prepared slides, or preserved material as to common name, class and phylum: *Planaria*, broad fish tapeworm, *Taenia* (pork/beef tapeworms), *Nereis*, *Hirudo*, *Lumbricus*, *Ascaris* and *Necator*.
64. Define the following and include examples when appropriate: ectoparasite, endoparasite, phytoparasite, free-living, hermaphroditic, definitive (primary) host, secondary (intermediate) host,
65. Identify proglottids, scolex, suckers, and reproductive systems.
66. Diagram and summarize a generalized life cycle of a tapeworm.
67. List and briefly discuss the major features of the Phylum Echinodermata. Indicate at least three features that are unique to this phylum.
68. On the basis of the nature of tube feet, body form, and position of the oral surface, distinguish between the following classes of Echinoderms and be able to identify organisms in each class: Holothuroidea, Asteroidea, and Echinoidea.
69. List and briefly describe the major features of the Phylum Annelida, including level of organization. Note at least three features that are unique to this phylum.
70. Summarize the distinguishing features of these classes of the Phylum Annelida: Polychaeta, Oligochaeta and Hirudinea.
71. Identify and state the functions of the following structures associated with members of the Phylum Annelida: clitellum, setae, "brain", seminal vesicles, aortic arches ("hearts"), ovaries, cocoon, crop, gizzard, typhlosole, intestine, nephridia, coelom and ventral nerve cord.
72. List and briefly discuss the major features of the Phylum Mollusca. Indicate at least three features that are unique to this phylum.
73. On the basis of structure and function distinguish between these classes of mollusks and be able to identify organisms from each class: cephalopods, gastropods, and bivalves.

## Animal Chordates

74. List and briefly describe the major features of the Phylum Chordata. Indicate at least three features that are unique to this phylum.
75. Distinguish between Urochordates, Cephalochordates, and Vertebrates and be able to identify organisms belonging to each group.

## Genetic expressions, Dune ecosystem, Succession

76. Briefly discuss the geological origin of the sand dunes of Lake Michigan.
77. List in sequence the seral communities that comprise Lake Michigan sand dune succession: beach, foredune, trough, backdune.
78. Identify and list the common plant and animals that occur in each of the sand dunes communities in the Muskegon area.
79. Discuss the special adaptations of selected plant and animal species typical of the Lake Michigan sand dunes communities. Discuss how such adaptations of an organism arise.
80. Discuss the abiotic trends that characterize dune biota succession, e.g., relative humidity, soil quality, light, wind, soil temperature, air temperature, and the complexity of the plant-animal interrelationships.

### **Succession**

81. Explain how living organisms' genetic traits arise from their genes (genotype) and are expressed in phenotypic traits.
82. Explain ecological succession with ecosystem examples.
83. Using examples compare and contrast primary and secondary succession.
84. Relate shade tolerant and shade intolerant species to ecological succession.
85. Define and provide examples of pioneer organisms.

### **Food Webs and Energy**

86. Define and provide examples of the following terms: autotrophs, ecosystem, heterotrophs, herbivores, carnivores, omnivores, scavengers, parasites, decomposers, trophic level, inorganic nutrient pool.
87. Define and illustrate grazing and detritus food chains and food webs.
88. Why is a food web a more accurate way to depict niches/ feeding relationships in a community than a food chain?
89. Explain the meaning and significance of the expression, "energy cannot be recycled".
90. Diagram and describe what is illustrated in each of these types of ecological pyramids: biomass, energy, and abundance.
91. Explain the generalized "10% Law" to trophic levels and why each succeeding trophic level receives less energy than the previous trophic level.

### **Non-flowering and Flowering Seed Plants**

92. Recognize the division/phyla to which gymnosperms and angiosperms belong.
93. Compare and contrast the basic characteristics of the gymnosperms and angiosperms.
94. List the basic characteristics of the Monocotyledonae and Dicotyledonae.
95. Cite the differences and similarities between ferns and angiosperms with regard to: dominant generation, relationship between gametophyte and sporophyte generation, nature of the reproductive organs, spore types, vascular tissue, fertilization and external water requirements, relationship of sporophyte embryo to gametophyte tissues.
96. Diagram, label, and discuss the life cycle pattern and structural functions of a generalized angiosperm with: zygote, embryo, microsporangium, microspore mother cell, seed (seed coat/integument, cotyledon, epicotyl, hypocotyls, endosperm, hilum, micropyle), flower (sepals, petals, stamens, microsporophyll, anther, filament), pollen grain (pollen, pollen tube, generative nucleus, tube nucleus, sperm), microspore, microgametophyte, pistil (megasporophyll, ovules, megasporangium, megaspore mother cell, megagametophyte, embryo sac, antipodals, polar nuclei, egg, synergids).
97. Describe the relationship of the following to the life cycle of a generalized angiosperm: changes in chromosome number and the associated structures, spore-producing generation, process of forming microspores, process of forming megaspores, microspore-producing generation, megaspore-producing generation, origin and fate of zygote, dependence or independence of each generation, process of forming gametes, and dominant generation of the life cycle.
98. Differentiate between pollination and fertilization and explain double fertilization.
99. Distinguish between complete, incomplete, perfect and imperfect flowers.
100. Explain the relationships that exist between the ovule, embryo, seed, ovary, and fruit.



101. Label and discuss the origin, function and chromosome number of: embryo, cotyledons, epicotyl, hypocotyls, radical, seed coats and endosperm.
102. Correlate the formation of an apple fruit with the structure of the apple flower.

### **Nonvascular Plants**

103. List the characteristics of the *Bryophyta*.
104. Describe the habitat of the bryophytes and list the special adaptive features of the bryophytes for living on land.
105. Explain why the bryophytes are usually limited to moist and shady habitats.
106. Label and discuss the generalized life cycle of moss: change in chromosome number, meiosis, mitosis, spores, spore-producing generation, gametes, gamete-producing generation, gametophytic structures, sporophytic structures, dependent generation, independent generation, first cell of gametophyte generation, first cell of sporophyte generation.
107. Explain alternation of generation life cycle.
108. Recognize the common names of gametophyte generation of liverworts, true mosses, and sphagnum moss.
109. Define and explain the following terms as they relate to bryophytes: thallus, zygote, embryo, antheridium, sperm, archegonium, egg, rhizoid, protonema, foot, stalk, capsule, spore mother cell, gemmae, "leafy" moss plant.
110. Discuss the comparisons between the algae and the bryophytes.
111. Discuss the origin of peat.

### **Seedless Vascular Plants**

112. List and describe the diagnostic features of ferns.
113. Recognize and identify to common name examples of each of the following: *Psilotum*, *Equisetum*, and *Lycopodium*.
114. Label and diagram life cycle of a fern: meiosis, mitosis, spores, spore-producing generation, gametes, gamete-producing generation, gametophytic structures, sporophytic structures, dominant generation, first cell of gametophyte generation, first cell of sporophyte generation, zygote, frond, rhizome, root, sporangium, spore mother cell, sori, gametophyte generation, spore, prothallium/prothallus, archegonium, egg, antheridium, sperm.
115. Compare the gametophyte and sporophyte generations with respect to relative size and independence/dependence.
116. Compare the life cycle of the moss to the life cycle of a fern.
117. Discuss some important advances and adaptations in the fern life cycle.
118. Name the moss structure that is equivalent to the fern prothallus, to the fern plant with roots.
119. Name the moss structure that is equivalent to the fern plant with roots.

### **Plant Behavior and Hormones**

120. Define the term geotropism/gravitropism and generally discuss the role of auxin in the response of roots to gravity.
121. Define the term hormone and list five major classes of growth-regulatory hormones.
122. Explain auxin production and its effects on plants.
123. Discuss the current hypotheses that explain how plants respond to the stimuli of light and gravity.
124. Explain with examples the practical application of auxin in agriculture, i.e., leaf fall, fruit fall, initiation of flowering, parthenocarpic fruit formation, and selective weed removal.
125. Discuss the origin and application of gibberellic acid in agriculture.
126. Name several effects produced by cytokinins in plants.
127. Define the term photoperiodism and distinguish between long-day, short-day, and day-neutral plants, and give examples of each type.
128. Describe an experiment that illustrates that the dark period, not the light period, is responsible for the photoperiodic effect.
129. Explain the role of phytochrome in the flowering process.
130. State the differences between annual and biennial plants and explain the physiological basis for the differences.

### **Bacteria**

131. List the characteristics of the classification group to which bacteria belong.
132. Recognize and diagram the three common shapes of bacterial cells.

133. Diagram, label, and describe the functions of the structural features of a generalized bacterium.
134. Discuss the significance of endospore formation in the bacteria.
135. Discuss obligate anaerobes, obligate aerobes and facultative anaerobes with regard to their degree of dependence on the presence of molecular oxygen.
136. Explain the following with regard to their mode of nutrition: autotrophs (photosynthesizers, chemosynthesizers), heterotrophs (holotrophs, saprotrophs, parasites).
137. Cite examples of the detrimental and beneficial activities of bacteria.
138. Describe the mode of bacterial reproduction.
139. State why cyanobacteria are classified with bacteria and not with plants.
140. Identify the following cyanobacteria as to major characteristics, genus, and division: *Anabaena*, *Oscillatoria*

### **Cell Structure and Function**

141. Differentiate between unicellular, colonial, and multicellular organisms and between prokaryotic and eukaryotic cells.
142. Identify, label, and state the function of the following of a generalized plant cell: cell wall, cytoplasm, nuclear membrane, vacuole, endoplasmic reticulum, nucleolus, plasmodesmata, mitochondria, chloroplasts, cell membrane, nucleus, ribosomes, leucoplasts.
143. Write the overall formula for aerobic respiration and identify both the input and output elements contained in the overall formula.
144. Distinguish between aerobic and anaerobic cellular respiration.
145. Identify the biological process concerned with the formation of ATP, state the source of the energy contained in a molecule of ATP, and indicate several biological processes that require ATP energy.

### **Fungi**

146. List the characteristics of fungi and explain in which domain and kingdom they are classified.
147. List the scientific and common names for four divisions/phyla of fungi.
148. Summarize the major characteristics of each of the four divisions of fungi with emphasis on structure and mode of reproduction.
149. Diagram and discuss the life cycle of *Rhizopus* (Division Zygomycota) including: gametes, fertilization, zygote formation, diploid generation, meiosis, haploid generation, sporangiophores, sporangia, rhizoids, stolons, spore formation, chromosome number of each structure (2n or n). Distinguish between the asexual and sexual phases of the life cycle.
150. Summarize the major features of the Division *Ascomycota* and include: nature of hyphae, asci, ascospores, ascocarps, conidia, and conidiospores.
151. Diagram and discuss asci and ascospore formation in the cup fungi, morels, yeasts, and the powdery mildews.
152. Diagram and discuss the asexual reproduction structures, conidia and conidiospores, in *Aspergillus*, *Penicillium*, and the powdery mildews.
153. Describe asexual reproduction by budding in yeasts and compare the structure of yeast to that of other *Ascomycota*.
154. Summarize the major characteristics of the Division *Basidiomycota*.
155. Identify and explain the functions of hyphae, basidia, basidiospores, basidiocarps, the vegetative hyphae, "fruiting" body, cap, stalk, gill.
156. Distinguish between hyphae (hypha) and mycelia (mycelium); septate and non-septate hyphae and mycelia.
157. Identify the following as to major characteristics, common name, genus, and division: *Rhizopus*, powdery mildews, yeasts, salad mushrooms, *Aspergillus*, puffballs, earthstars, *Penicillium*, smut, rust fungi, *Pezzia*, *Morchella*, *Polyporus*.
158. Discuss the economic importance of *Rhizopus*, powdery mildews, yeasts, *Aspergillus*, *Penicillium*, smut.

### **Animal Invertebrates**

159. List and briefly describe the major features of the Phylum Nematoda. Indicate at least three features that are unique to the phylum.
160. Diagram and summarize a generalized life cycle of a roundworm.

161. Summarize the major features of the Phylum Arthropoda, including level of organization. Indicate at least three features that are unique to this phylum.
162. Distinguish among the following classes of the Phylum Arthropoda and identify organisms belonging to each: Crustacea, Diplopoda, Chilopoda, Insecta and Arachnida.

### **Nuclear Divisions, Life Cycle Patterns, Evolution**

163. Define and explain the function of the two types of nuclear division: mitosis and meiosis.
164. Describe the role of mitosis and meiosis in the sexual and asexual phase of organisms.
165. Relate the change in chromosome number (diploid (2n) and haploid (n)) to the processes of mitosis and meiosis.
166. Explain and assign life cycle patterns (Haplontic, Diplontic, or Alternation of Generation) to the organisms studied in this course.
167. Explain how genetic traits are inherited and how natural selection occurs.
168. Explain biological evolution and the tree of life.

### **Plant Development and Growth**

169. Diagram, label, and discuss the functions of the following structures associated with seeds: embryo, cotyledon, coleoptile, epicotyl, hypocotyl, and radicle.
170. Compare and contrast monocots and dicots with regard to the nature of the embryo, cotyledons, and endosperm. Identify beans, peas, and corn as examples of monocots or dicots.
171. Compare and contrast the two types of seedling development - hypogeous and epigeous. Provide examples of each type of development.
172. With appropriate diagrams and labels, describe the sequence of events that begins with a bean seed, corn seed, or pea seed and results in the development of a bean, corn, or pea seedling.
173. Define and identify apical and lateral meristems in seeds, seedlings, and mature plants.
174. List (and diagram) the three primary tissues that develop from the apical meristems.
175. List the primary adult tissue types that are derived from each of the three primary tissues.
176. List, identify, and state the function of the adult cell types that comprise each of these adult tissues: epidermis, cork, vascular tissue, parenchyma, sclerenchyma, xylem, collenchyma, endodermis, phloem.
177. Identify and distinguish between and define simple and complex tissue types of plants.
178. State the function of the following xylem cell types: parenchyma cells, tracheids, vessel elements, and fibers.
179. State the function of the following phloem cell types: sieve cells, companion cells, parenchyma cells, and fibers.

### **Animal Vertebrates**

180. Describe the major features of each of the classes of the Subphylum Vertebrata and be able to identify organisms that belong to each: Agnatha, Chondrichthyes, Osteichthyes, Amphibians, Reptiles, Aves and Mammals.
181. Define the following structures/features and indicate the vertebrate class or classes with which they are associated: gills slits, vertebrae, jaws, jawless, paired fins/appendages, cartilaginous skeleton, bony skeleton, 2-chambered heart, 3-chambered heart, 4-chambered heart, tadpole stage, gills/lungs, endotherm, feathers, scales, hair, mammary glands, internal fertilization, external fertilization, shelled egg, and aquatic, terrestrial, - or uterine development.
182. Distinguish between the following mammals: Monotremes, Marsupials, and Placentals.

### **Plant Root Structure and Function**

183. Label a diagram or identify on a prepared slide and indicate the function of the following primary structures that comprise a young root (buttercup): epidermis, phloem, cortex, endodermis, xylem, pericycle.
184. Identify and discuss the role of each region: root cap, apical meristem, zone of cell division, zone of elongation, and zone of maturation.
185. Label a diagram or identify on a prepared slide the root tissue produced as a result of secondary growth: secondary xylem, secondary phloem, and cork.
186. Identify the zone of the root with which root hairs are associated.
187. Contrast with examples and be able to recognize tap roots, fibrous roots, adventitious roots, storage roots, primary roots, and second roots.

188. Identify and state the function of the following parts of a carrot root: xylem, vascular cambium, phloem, and corky materials.

### **Structure and Function of Plant Leaf and Stem**

189. Identify the following leaf structures from a prepared slide or diagram and state the function of each: upper epidermis, spongy mesophyll, palisade mesophyll, lower epidermis, vein, stomata, xylem, phloem, guard cells, intercellular spaces, cuticle.
190. List the leaf cell types/tissues that contain chloroplasts.
191. Identify the external features/structures of leaves from a diagram or specimen: types of leaf blade, types of leaf margin, petiole, stipules, and types of venation.
192. Differentiate between simple and compound leaves and identify the following types of compound leaves: palmately compound, pinnately compound, and bi-pinnately compound.
193. Distinguish between microscopic cross sections of sun and shade leaves, and explain how they differ.
194. Explain the differences between mesophytic, hydrophytic, and xerophytic habitats. Identify plants from each of the three habitats.
195. Define the term etiolated and describe the appearance of plants grown in the dark.
196. Label a prepared diagram of a stem tip or identify the following structures from a prepared slide and state the function of each: apical meristem, ground meristem, leaf primordium, nodes, bud primordium, internodes, nodes.
197. Contrast and identify herbaceous and woody stems.
198. Identify the following structures from prepared slides or diagrams of herbaceous monocots or dicots and state the function of each structure: epidermis, vascular bundle, cortex, xylem, pith, phloem, rays, vascular cambium (if present).
199. Identify the following specialized plant parts and state whether or not they are stem, root, or leaf derived: rhizomes, tubers, runners (stolons), bulb, potato, corm.
200. Classify and identify the following specialized stems: quack grass, white potato, *Gladiolus*.
201. Identify the following stem structures from a prepared slide or diagram that are associated with basswood stems and state the function of each structure: epidermis, secondary xylem, cortex, secondary phloem, cork cambium, pith, cork, rays, cork parenchyma, vascular cambium.
202. Distinguish between bark and wood. List the tissues that comprise each.
203. Define, compare, and identify from prepared slides or diagrams: spring wood, heartwood, summer wood, annual ring(s), sapwood.
204. Compare and contrast the origin of primary and secondary tissue in stems.
205. List the cell types that comprise secondary phloem and secondary xylem in woody plants.
206. Distinguish between transverse and tangential sections of a woody stem.
207. Label a prepared diagram or identify the external features of a woody twig. Determine the age of woody twigs from external inspection.
208. Explain how a tree grows both in height and in diameter.
209. Discuss the function of lenticels.

### **Transportation of nutrients, water, carbohydrates in Plants**

210. Describe the manner by which the organic nutrition of autotrophic plants differs from that of most other organisms.
211. List six "macronutrient" elements required in large quantities by plants. State at least one function of each of the six "macronutrients."
212. List the seven "micronutrients" required by plants. State at least one function of each micronutrient.
213. Discuss how you would demonstrate that a given element is essential to a plant.
214. Discuss in detail how nitrogen nutrition is different from that of other mineral elements.
215. Explain what is meant by transpiration and discuss the factors that control its rate.
216. Discuss the role of stomata and guard cells in transpiration.
217. Diagram and discuss the pathway for transport of water, minerals, and carbohydrates in green plants.
218. Explain the mechanisms proposed for: transport of sugars from leaf to root; transport of water from root to leaf in a hundred-foot high tree.

### **Population and Community Ecology**

219. Define and discuss the following terms as they relate to population biology: dispersion, natality, mortality, growth curves, density, biotic potential, carrying capacity.
220. Compare and contrast community and population.
221. Explain and provide examples of the following types of symbiosis: commensalisms, mutualism, parasitism.
222. Contrast a J-shaped growth curve with and S-shaped growth curve.
223. Indicate which part of an S-shaped growth curve represents biotic potential, environmental resistance, and carrying capacity.
224. Demonstrate that for a given population with a constant growth rate, more individuals will be added to the population with each generation. Is it possible that even with a declining growth rate some individuals could be added each generation?
225. Describe at least one population in reference to its growth and carrying capacity of the ecosystem.

### **Biological Evolution**

226. Explain the basis of variation in populations.
227. Explain how natural selection occurs and how that is related to “survival of the fit enough”.
228. Describe speciation using the biological species concept.
229. Explain biological evolution and its main mechanism, natural selection.
230. Differentiate between the scientific explanation of biological evolution and other non-science explanations about biological evolution.