

LAST NAME: *KEY Version #3* _____ FIRST NAME _____ LAST 4 WSU ID #: _____

General Instructions:

- On this question packet, please fill out your name and last 4 WSU ID # above.
- On your Scantron sheet, fill out the name portion and fill in the corresponding marks for each letter of your name and each of the last 4 digits of your WSU student identification number. *PLEASE* put your LAST NAME in the first part of the section. *ONLY* Scantron responses will be used for multiple choice question grading.
- In the "K" column under "Special Codes", fill in the number corresponding to your version of the exam. **Your exam version number is: #3.** Fill in the corresponding mark for this version.
- This exam has 95 possible points using 35 multiple choice questions and 25 possible points from fill-in questions. A bonus question with 1 additional point is available.
- You have 75 minutes to complete the exam.
- Read the *entire* question and all the answers. Select the *best* possible multiple choice answer and mark your Scantron sheet. These scanned sheets will be graded separately from the fill-in answers on your question pages.
- For fill-in and short answer questions, write **legibly** on the question pages. If I cannot read it, you cannot get credit for it. Use only the space available.
- When you complete the exam, place your Scantron sheet inside the exam question sheets. Turn in your Scantron sheet within these question pages. The instructors will sort the exam accordingly for grading.
- **Failure to follow these simple directions will lead to a deduction of 5 points from your exam score. STILL A PROBLEM!**
- Exam grades will be posted on the course's Blackboard Learn site as soon as possible.

I. Multiple Choice: (35 questions worth a total of 70 points). *For multiple choice questions, answer on your Scantron sheet, beginning with #1.*

1. In a fresh water column or in a lake ecology, the greatest number of carbon-fixing microbes are located
 - a. In or below the sediment layer at the very bottom of the water column.
 - b. Any depth below six meters of water, but above the bottom sediment later.
 - c. In the middle of the column.
 - d. In the top twelve centimeters of water.
 - e. At the very top of the water's surface.
2. In the Gulf of Mexico, which conditions lead to formation of a "dead zone" where fish are absent?
 - a. Addition of nutrient fertilizer to coastal beaches.
 - b. Addition of soluble nutrients from runoff in northern states.
 - c. Growth of sediment decomposer microbes, regardless of the depth of the seawater.
 - d. Thermocline.
 - e. Wave action at the surface of the seawater.
3. The microbial metabolism of a Washington fresh water lake is altered radically each year between September and November because
 - a. Leaves from nearby trees drop carbon-rich debris in the lake.
 - b. Ruminant big horn sheep migrate from low to high ground, leaving fecal microbes in the water.
 - c. The ambient temperatures generally decrease greatly.
 - d. All of the (a., b. and c.) above are correct.
 - e. Only (a.) and (c.) above are correct.
4. Comparing bacteria when they first join a growing community in forming a biofilm to the bacteria's planktonic forms, those joining a biofilm have altered expression (increased or decreased) in which of the following genes?
 - a. Genes needed for binary fission.
 - b. Genes needed for cell membrane assembly, including fatty acids.
 - c. Genes needed for flagellum assembly.
 - d. Genes needed for production of Lipid A in the outer membrane.
 - e. Genes needed for secretion of exotoxin.

1. At every level of a generalized food-web, microbial activity is required for _____ of carbon compounds.
 - f. 0.1%.
 - g. Primary production.
 - h. Decomposition.
 - i. 90%.
 - j. Only (b.) and (c.) are correct.
5. When the Deep Horizon oil spill added large amounts of crude oil to the Gulf of Mexico, this event
 - a. Allowed organotrophs to convert large amounts of hydrocarbon into large amounts of biomass.
 - b. Converted carbon from biomass to a reservoir.
 - c. Increased the need for denitrifying microbes in the top six inches of nearby seawater.
 - d. Induced the growth of *Escherichia coli* and other coliform species in the seawater.
 - e. Made long-chain hydrocarbons unavailable for use in the carbon cycle.
6. In regard to carbon use, soil methanogenic microbes make _____ molecules from _____.
 - a. Reduced single carbon gas; organic acids produced during fermentation.
 - b. Reduced single carbon gas; methionine amino acids within biomass.
 - c. Reduced sulfur gas; undersea emission of sulfur-compounds.
 - d. Oxidized single-carbon gas; organic acids produced during fermentation.
 - e. Biomass; reduced single carbon gas.
7. Climate change scientists are worried about greenhouse gases, including carbon dioxide (CO₂), that affect the earth's temperature. In their calculations, they include microbes that
 - a. Are photosynthetic.
 - b. Respire anaerobically to fix carbon.
 - c. Use various forms of oxygen to reduce carbon to biomass.
 - d. Oxidize biomass aerobically.
 - e. All of the (a., b., c. and d.) above contribute to global climate change.
8. In a field of wheat, there is a spot where a farmer's tractor applying ammonia got stuck for a long time with the spraying continuing. The center of this spot has yellow, dead wheat. In a circle from the center of the dead spot, the wheat is a deeper green in color and actually grows higher than other areas of the field (where the tractor proceeded normally). Which of the following statements regarding the role of nitrogen and microbes in the soil under the crop is true?
 - a. The greener part of the spot has very low concentrations of available nitrogen after the ammonia washed it away.
 - b. The greener part of the spot has high concentrations of nitrifying microbes after the incident.
 - c. The yellow, dead spot has a high concentration of denitrifying microbes following the incident.
 - d. The yellow, dead spot has a high concentration of ammonia that killed the wheat after the incident.
 - e. Only (b.) and (d.) above are correct.
9. The soil microbe *Rhizobia* within the roots of legume plants
 - a. Form NOD proteins.
 - b. Release infectious threads to parasitize plant roots.
 - c. Actively defend the plant roots against attack by *Clostridium tetani*.
 - d. Reduce carbon to form methane in the endomycorrhizae.
 - e. Aid plants by oxidizing ammonia in the bacteroids.
10. Near deep-sea geothermal vents, ___ are primary producers that support the food web.
 - a. Aromatotrophs.
 - b. Chemoautotrophs.
 - c. Photoautotrophs.
 - d. Rhizospheres.
 - e. Tube worms.

11. Which of the following statements best describes the relationship of *Mixotricha paradoxa* to their insect hosts?
- The termite host depends on *Mixotricha paradoxa* to release exotoxins and lyse red blood cells for nutrients used by both the bacteria and the termite.
 - Mixotricha paradoxa* depends on symbiotic cytoplasmic prions for vital metabolites.
 - Mixotricha paradoxa* provides the termite with ammonia for the creation of new nitrogenous compounds.
 - Mosquitoes depend on *Mixotricha paradoxa* during their larval stage to deliver vital metabolites, allowing the mosquito to mature to the insect stage.
 - Mixotricha paradoxa* ferments cellulose to ultimately secrete acetic acid needed for the termite's production of biomolecules.
12. An unpasteurized container of milk left at room temperature for two weeks separates into a clear phase and an oily, lipid phase. It no longer looks white and opaque because
- Putrifying microbes degraded the opaque proteins.
 - Lactococcus lactis* converted sugar to lactic acid.
 - The pH of the milk at the end of two weeks is below 3.0.
 - The carbon found in the container has been converted to methane.
 - Fungi within the container have grown and taken up the space formerly occupied by the milk.
13. During the primary stage of sewage water treatment,
- Solid objects that cannot be degraded sink to the bottom of the tank.
 - Fecal material that is already solid sinks to the bottom of the tank.
 - Aerobic metabolism generates flocs that sink to the bottom of the tank.
 - Anaerobic metabolism of sludge mineralizes materials.
 - Solid material is treated with chlorine gas then neutralized after microbes have died.
14. In a water treatment plant, the material with the highest biochemical oxygen demand (BOD) value is found in the
- Primary treatment chamber.
 - Secondary treatment chamber.
 - Sludge.
 - Digester.
 - Effluent pipe returning the water to a nearby stream.
15. In a solid compost pile, *Cellulomonas*
- Is an aerobe active at the earliest stage.
 - Is an anaerobe active at the earliest stage.
 - Is a thermophile active at the secondary (middle) stages.
 - Is a segmented thermophile active at the secondary (middle) stage.
 - Is an extreme thermophile active at the tertiary (latest) stage.
16. In some cases, an active compost pile will be very warm, regardless of the outside temperature. This heat comes from
- Degradative enzymes breaking bonds, liberating heat.
 - Ignition of volatile gases in small-sized batches.
 - Fermentation.
 - Consumption of oxygen, leading to exothermic sulfur reactions.
 - Capture of sunlight for biosynthesis by photoautotrophs.
17. In general, microbes can digest an amazing diversity of materials that humans discard. Which of the following best characterize materials that CANNOT be digested by microbes?
- These materials are sensitive to breakdown by ultraviolet (UV) sunlight exposure.
 - These materials are sensitive to heat.
 - These materials have chemical composition that does not include carbon.
 - These materials have never come in contact with high concentrations of oxygen.
 - These materials lack sites where microbial enzymes can cleave chemical bonds.