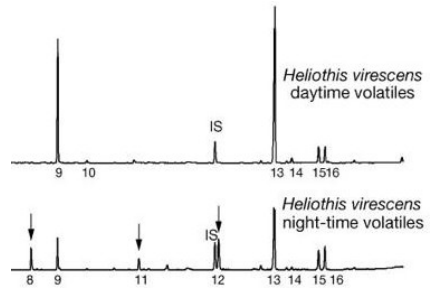


Read each question carefully and don't hesitate to ask if a question seems unclear. If possible, answer each question in the space provided, but if needed, continue on the back. If you use a drawing as part of your answer, be sure to also include a written explanation. These questions have specific answers, although for some, more than one answer is possible. To receive full credit you must clearly and fully answer the question. Each question is worth 10 points for a total of 100 points.

1. You want to help a plant defend itself from pathogens, so you genetically modify the plant with the human antibody gene. Give **two** reasons why this will not protect plants from pathogens.
Any two of: The antibody gene DNA needs to be rearranged to make a functional antibody, and the plant cannot do this. If the DNA does get rearranged, it can only make one antibody, and that will not protect against many pathogens. Even if the plant can make an antibody, it has no macrophages (white blood cells) to destroy the pathogens.

2. Near the equinox, when the day and night are both 12 hours, you move a plant underneath a tree. After a few days, it flowers. Is this a long-day or short-day plant? Explain.
Short-day. Since the plant will only be exposed to dark or far-red light, its phytochrome will not be activated. So it will see a very long night. Short-day plants flower when there is a long night.

3. The figure below represents some of the volatile gases released by a plant in response to herbivory during the day and at night. Which of these chemicals attract the parasitoid wasps? How do you know?
9 and 13. Plants only attract the parasitoid wasp during the day. These gases are released during the day in high quantities, but only in small quantities at night. 10 is also only released during the day, and not at night.



4. Plant and animal self-incompatibility have many differences, but the two molecular types of plant self-incompatibility (sporophytic and gametophytic) have some similarities with the human immune system. Which molecular type of plant self-incompatibility is more like the non-specific part of the human immune system? Why?
The non-specific immune system acts as a barrier keeping pathogens from getting into the animal. In sporophytic SI the pollen is inhibited from germinating on the surface of the stigma.

5. Signaling in the nervous system involves the Na⁺/K⁺ pump. One other **ion pump** is necessary for signaling between neurons. What is this **ion pump**, and why is it necessary for signaling between neurons?
A calcium pump is needed to maintain the high concentration of calcium outside the cell, so when the depolarization at the end of the axon causes calcium channels to open, the calcium will rush in from outside the cell to signal the release of the neurotransmitters.

6. In class we looked at an experiment that showed mice are sensitive to the plant produced chemical capsaicin while birds are insensitive to capsaicin. If you switched the brains of a bird and mouse, would you switch their capsaicin sensitivities? Why or why not?

No. The sensory neurons sensitive to capsaicin have not been changed. So even with a bird brain, the bird-brained mouse still has its capsaicin sensitive sensory neurons and will sense capsaicin as spicy.

7. One of your patients is going to need a bone marrow transplant. After the transplant they will need to take drugs that suppress their immune system. Since flu season is approaching, you want to vaccinate them before the bone marrow transplant. After the transplant, will they have gained any protection against the flu from the vaccine given before the transplant? Why or why not?

Yes. Memory B-cells can last years. Since the immune system was functional when the vaccination was given, the memory B-cells were produced, and are still present, after the transplant. The overall immune system is suppressed, but the patient is better protected with the vaccination than if they did not get the vaccination.

8. Two ectotherms (aka cold-blooded) are using sunlight to get warm. They both weigh 10 lbs. One is shaped like an oval and is 12" long and 6" wide. The other is circular and about 9" in diameter. Which would warm more quickly? Why?

In this case the animal is trying to absorb heat, not stop the loss of heat. The oval animal has more surface area in contact with the environment to absorb the sun's heat. Another way to say the same thing is that the oval animals has more of the cells in its body closer to the surface where they can absorb the sun's heat.

9. What limits how far, the distance, a muscle cell can contract?

The distance between the actin filaments.

10. The figure below represents five neurons, the arrows are the ends of the axons. Neurons A, B, C, and D all release excitatory neurotransmitters, but none of them alone releases enough excitatory neurotransmitter to cause neuron E to have an action potential, yet neuron E has an action potential. How is this possible?

If neurons A, B, C, and D all fire, the excitatory neurotransmitters released by all of those neurons may be enough to cause E to reach an action potential threshold.

