ACT Science Prep Notesheet C. Kohn, Waterford WI

Name: Hour Date:

Date Assignment is due: Why late? Score: + ✓ -  
 Day of Week Date If your project was late, describe why**Overview:** in order to maximize your preparation for the Science component of the ACT Exam, this packet has been designed to organize your day-to-day instruction. While online instructional modules exist to support your preparation, most research indicates that your performance will be maximized if you couple handwritten work with screen-based instruction. While you certainly should utilize the online options, not utilizing this component (or only doing the bare minimum) will result in minimal preparation for the ACT Science Test.

Your instruction for this component will utilize the following schedule:

**Day 1:** Introduction, Program Overview, Slides 1-8.

**Day 2:** The “How” of Science (Slides 9-15).

**Day 3:** Types of ACT Questions, Look-up Questions (Slides 16-22).

**Day 4:** Trend-spotting Questions (Slides 23-31).

**Day 5:** Inference Questions (Slides 32-38).

**Day 6:** Scientific Method Questions (Slides 39-50).

**Day 7:** Compare and Contrast Question, Final Thoughts (Slides 51-62).

**Day 8:** Finish Final Thoughts; Practice Test.

This packet will be utilized at the start of class. This will be followed by application and then discussion at the conclusion of the class period.

All materials are available online, including the accompanying PowerPoint. Note-taking and instruction will be done on an *independent basis* – all information you need will be available in the accompanying PowerPoint. **However, if you find that there is something you do not understand, simply raise your hand and ask for assistance from your instructor in whatever manner needed**.

While the responsibility of learning the material is on you, you always have the option of seeking assistance (much like how it will work in college).

How to use this packet

Most days in this curriculum will utilize the following schedule:

1. **Instruction questions**: individual time will be provided at the start of the period for you to answer two pages of questions related to the key content of the day.
   1. This is where you actually learn the strategies that will help you to succeed on the ACT.
   2. If you fail to finish these questions, or if you answer these questions poorly, you will not have the same level of preparation as other students. You will *not* get instruction directly from your instructor – the onus of responsibility is on you to learn and grasp the material.
   3. If you fail to finish in the time provided, you should finish the questions outside of class; you should consider completing the questions in advance if you feel you cannot answer all the questions in the time provided.
   4. All information needed to answer the questions will be found in the accompanying PowerPoint. If you are unsure of how to answer a question, speak with the members of your student group first; you can ask your instructor for assistance if your group as a whole is unable to find the correct answer.
2. **Application & Discussion**: when the members of your group are finished with their individual questions, you should move on to the applied questions as a group.
   1. These questions are similar to what you will find on the actual ACT.
   2. These questions are designed to help you to learn what to expect on the ACT Science exam and will help you to apply the strategies you’ve learned in the Instruction Questions.
   3. You should work on these questions as a group and come to a unanimous conclusion as to what is the correct response to each question.
      1. Be prepared to defend your responses using evidence and data from the passages.
   4. Once all of the groups have had sufficient time to complete the A&D question, time will be provided at the end of the hour for discussion as a class.
      1. Your instructor will likely call on groups at random (and possibly a person at random in the group) to explain their choice for the correct answer and a defense of that answer.
      2. Make sure you know WHY you chose the answer that you did!!!

## The following time lengths should be appropriate for a 45 minute period:

* 15-20 minutes: Instruction Questions (individually).
* 15-20 minutes: Application Questions (in groups).
* 10 minutes: Class Discussion (as a class).

## Final note

It is likely there is more material here than time available to complete the material. Your instructor may ask you to move on to the next section before you are finished even if you used all of your time wisely and productively. If you waste any time, you are almost certain to fall behind.

Tips for Success

This packet was designed to guide you through a large amount of material as quickly and effectively as possible. This packet was based directly on the online Peterson’s Test Prep program available through the WUHS website. However, the material on this program was condensed and summarized as much as possible so that more time would be available for you to focus on questions and passages like those found on the ACT exam.

In order to do well and maximize your performance on the ACT Science exam, we recommend the following:

1. **Answer every question!** The combination of hearing, writing, and discussing will utilize more of your brain than simply just reading the material. If you only read the material, you will have little difference in your outcome; you might as well not even have participated in this program. Hearing, reading, writing, and applying this material is ALL necessary to ensure your maximal performance when you actually take the test.
2. **Actively participate!** When working on the Application and Discussion components of this packet, work with other people. Groups of 3-4 are ideal for this purpose. If a group of 3-4 works together to answer each question and are able to defend their choices, you will be more actively engaged in the process and will be more able to permanently comprehend the strategies you’ll need to do well on the ACT exam.
3. **Ask for help!** Everything you need to succeed is in this packet. You may be used to your instructor lecturing as you sit and passively listen. If you are expecting this from this course, you will be surprised to learn that most of the instruction will be *your* responsibility. Your instructor will be on hand to facilitate discussion and to assist you if you have any problems. If you do have a problem or a question, raise your hand. You cannot get help unless you ask for it so always make sure you are asking for assistance when you need it.
4. **Challenge yourself.** Don’t do the bare minimum – the more you put into this program, the more you’ll get out of it. Vice versa, the more minimal your effort, the more minimal your gains. Do work outside of class, review the online program, and take as many practice tests as you can.
5. **Use all the space provided.** For questions that require you to write, a set amount of space has been provided. Use all of this space – the more you write, and the more thoroughly you write, the more you’ll gain and retain.
6. **Finish your work!** Depending on your skill level and ability to read and write, you may find that you are unable to finish a section in the time allotted. Your instruction for this program will come primarily from this packet, so if you fail to finish a section, you will fail to get the instruction you’ll need to maximize your success.
7. **Assume you need more preparation.** Some sections may seem like a review. You have likely enrolled in at least a few science courses in high school; this does not mean you know everything you need to know about the scientific method. In reality, very few students are prepared to take college level science courses by their junior year – assume that even the things that are a review need careful consideration and attention.

## Remember – what you put into this program directly determines what you get out of it. This is about your performance. Do your work, ask for help, and actively participate and you will see much greater improvement. Work well and you will do well. Good luck!

Day 1: Program Overview

Directions: begin by reading Slides 1-8 in the accompanying PowerPoint. Use the information to answer the Instruction questions below. Then move onto Application and Discussion.

# Instruction Questions *See slides 1-8 in the accompanying PowerPoint. All answers can be found in these slides.*

1. The ACT Science exam tests what three mains skills? Describe them in the spaces below:
2. The ACT Science exam makes up \_\_\_\_\_\_\_% of your final ACT Score.
3. The ACT Exam consists of \_\_\_\_\_\_\_\_\_\_ questions.
4. You will have \_\_\_\_\_\_\_\_\_\_\_ minutes to complete these questions.
5. What subjects are covered on the ACT Science exam?
6. Should you review textbooks of these four subjects before taking the test?   
     
   Why or why not?
7. ACT Science exam questions fall into what two categories?
8. How will you know if you have a data analysis passage? What are the key attributes of this kind of question?
9. How will you know if you have a compare & contrast passage? What are the key attributes of this kind of question?
10. Summarize what you need to know for the two major rules of pacing:   
      
    **Answer as many questions as you can:**   
     **Answer the easiest questions first:**
11. What do you need to do often in order to determine your average score?
12. Once you know your average score, what should you do?
13. What would be a reasonable goal by which to improve your average score? points.
14. If you got 28 questions correct (out of 40), this would put you in the th percentile.
15. To get into the 85th or 90th percentile, how many questions would you have to get correct?
16. If you wanted to be in the 99th percentile, how many questions (or more) would you need correct?

*Continue to the next page.*

# Application & Discussion

*Use the information you recorded on the previous pages to answer the questions below. You may work in groups.*

1. Your friend Bill is preparing for the ACT and believes that science will be the hardest portion. He says he will just skip it because it isn’t a big part of his final score. Is he right or wrong? Explain using the space provided.
2. Bill sees your point. The next day he brings home a backpack full of science textbooks. Will this help his score? Explain:
3. Provide Bill with three pieces of advice that you think could help his score the most:  
     
   1.   
     
      
     
   2.   
     
      
     
   3.
4. How would Bill determine his average score?
5. How would knowing his average score help Bill do better on the ACT Science Test?
6. If Bill was in the 50th percentile, by how much could he reasonably improve through practice?
7. Be prepared to discuss these answers as a class once most have finished.

Day 2: The “How” Of Science

Directions: begin by reading Slides 9-15 in the accompanying PowerPoint. Use the information to answer the Instruction questions below. Then move onto Application and Discussion.

# Instruction Questions *See slides 9-15 in the accompanying PowerPoint. All answers can be found in these slides.*

1. The ACT Science Exam tests two kinds of skills; these are &
2. Define Analysis:
3. Define Logic:
4. What is a dependent variable?
5. A dependent variable is usually a .
6. What are examples of an independent variable?
7. Why would “radish growth” be a poor choice of a dependent variable?
8. What is an independent variable?
9. If you wanted to determine the impact of a brand of fertilizer on the rate of growth of radishes, what would be…  
     
   The Independent Variable?   
     
   The Dependent Variable?
10. How many independent variables can you have? Why?
11. What is a control?
12. Is a control always necessary for an experiment? Why?
13. If our radish-fertilizer experiment did not have a control, why would this be a problem?
14. When encountering a passage on the ACT Science Test, always begin by asking the following:   
      
    1.   
      
    2.   
      
    3.   
      
    4.   
      
    5.

# Application & Discussion

*Use the information you recorded on the previous pages to answer the questions below. You may work in groups.*

**Passage 1:** To test the hypothesis that all antibiotics are equally effective in preventing bacterial growth, the following three experiments were carried out using clear plastic plates filled with nutrient agar (a mixture of ingredients that support the growth of bacteria).

Experiment 1: Three plates (A, B, and C) of agar were set up, each with an equal amount of bacterial culture (Bacterium X) spread over the agar surface and with a paper disk placed in the center. Plate A’s disk was soaked in Antibiotic I; Plate B’s disk was soaked in Antibiotic II; Plate C’s disk was soaked in plan water. After incubation overnight at 37o C (body temp), Plates A and B had a clear area, 2” in diameter surrounding the paper disk, but beyond this 2” region, the plates were cloudy. Plate C was entirely clouding, including the area adjacent to the paper disk. When bacteria reproduce successfully, colonies form on the agar, giving it a cloudy appearance.

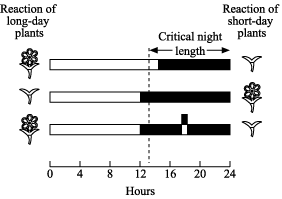
Experiment 2: Identical procedures were followed except that Plates A, B, and C were incubated overnight at 22oC (room temp). After incubation, Plate A had a clear area, 2” in diameter, surrounding the paper disk. Plates B and C were entirely cloudy.

Experiment 3: Identical procedures were followed except that the concentrations of Antibiotic I (Plate A) and Antibiotic II (Plate B) were made twice as strong. After incubation overnight at 22oC, Plates A and B both had clear, 2” areas around the paper disk, while Plate C remained entirely cloudy.

*Taken from Victory for the ACT, Plan, and EXPLORE Tests, Eleventh Edition 2011 by Cambridge Publishing Inc.*

1. What were these scientists trying to determine?
2. What was the independent variable?
3. Shouldn’t there only be one independent variable? Didn’t they test three different things? Explain how this work is actually a completely acceptable scientific experiment.
4. What was the dependent variable?
5. Did this experiment have a control? Explain:
6. What trends occurred in the results? List and explain all that you noticed:
7. What was the outcome of this experiment?

**Passage 2:**  It has long been known that different species of flowering plants flower at various times of the year in response to some environmental stimulus. Botanists have found that the duration and timing of light and dark conditions to which a plant is exposed, known as its *photoperiod,* is the crucial factor in flowering. Botanists generally classify flowering plants in three groups: *long-day plants,* which flower when the day length exceeds some critical value, usually in summer; *short-day plants,* which flower when the day length is below some critical value; and *day-neutral plants,* which can bloom during either long or short days. In an effort to define more precisely the critical element in the photoperiod, scientists conducted the following experiments.  
  
*Experiment 1*

  
    A greenhouse in which conditions of light and darkness were carefully controlled was stocked with several long-day and short-day plants. These were maintained with a light regime of 14 hours of daylight alternating with 10 hours of darkness. Under these conditions, the long-day plants flowered, while the short-day plants did not.  
  
*Experiment 2*  
    A similar greenhouse was stocked with several long-day and short-day plants. These were maintained with a light regime of 12 hours of daylight and 12 hours of darkness. The short-day plants flowered, while the long-day plants did not.  
  
*Experiment 3*  
    In a similar greenhouse with the same assortment of plants, 12 hours of daylight and 12 hours of darkness were maintained. However, halfway through the dark period, all the plants were illuminated by a momentary flash of white light. Under these conditions, the long-day plants flowered, while the short-day plants did not. These results are summarized in Figure 1.   
Taken from the Peterson’s Test Prep Program.

1. Which of the following statements best describes the purpose of the research conducted in the passage?
   1. Scientists conducted experiments to determine how photoperiods affect plant flowering.
   2. Scientists conducted experiments to determine the components of photoperiods.
   3. Scientists conducted experiments to determine how greenhouse locations affect plant flowering.
   4. Scientists conducted experiments to determine how plant flowering affects the duration of photoperiods.
2. Which of the following represents the independent variable under study in this investigation?
   1. Plant height b. Plant flowering c. Hours of uninterrupted darkness d. Intensity of light
3. Which of the following statements best describes the purpose of the research conducted in the passage?
   1. Scientists are measuring how the population density of a species is affected by its rate of growth.
   2. Scientists are measuring how the rate of growth in the numbers of a species is affected by its population density.
   3. Scientists are measuring the life cycles of the flour beetle.
   4. Scientists are measuring the factors that affect population density.
4. Which of the following represents the dependent variable under study in this investigation?
   1. Population density b. Flour beetles c. Rate of growth d. Excessive crowding

Day 3: Types of Questions, Look-up Questions

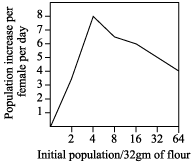
Directions: begin by reading Slides 16-22 in the accompanying PowerPoint. Use the information to answer the Instruction questions below. Then move onto Application and Discussion.

# Instruction Questions *See slides 16-22 in the accompanying PowerPoint. All answers can be found in these slides.*

1. What are the five kinds of questions that are found on the ACT Science Exam?
2. What kind of questions are the easiest?
3. How many are found on the ACT Science Exam?
4. How will you recognize these kinds of questions?
5. Why should you always answer these kinds of questions?
6. What are two important strategies for maximizing your chances of getting these questions right?   
     
   1.   
     
   Explain:   
     
   2.   
     
   Explain:
7. In the space below, draw a graph and label the x-axis and y-axis. Then label which is most likely to show the independent variable and which is most likely to show the dependent variable.
8. What does it mean to “anticipate the answer” and how could this help your score?

# Application & Discussion

*Use the information you recorded on the previous pages to answer the questions below. You may work in groups.*

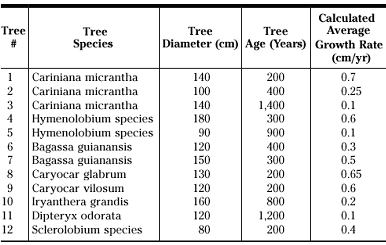
1. **In the space below, circle the types of questions that would be Look-up Questions:   
     
   *According to Figure 2, which took the longest to grow?   
     
   Which conclusions are best supported by the data provided?   
     
   Which solution had the highest pH?   
     
   Which reaction took .07 seconds to complete in Table 2?*

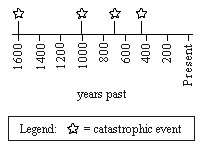
*Use the following passage the answer the accompanying questions:*  
The optimum population density for the survival and growth of a particular species of animal is often an intermediate one. Excessive crowding produces competition for scarce resources, such as water, food, space, and light, and encourages the spread of infectious diseases. On the other hand, a low population density has its own disadvantages, including diminished protection against attacks by predators, inability to modify the environment in a helpful fashion, and greater vulnerability to changes in temperature.   
Figure 1, depicting the effect of initial population density upon the rate of population growth in the flour beetle, illustrates this principle.

1. According to Figure 1, at what initial population density is population growth the highest?
   1. 2 b. 4 c. 8 d. 16

Tree age is important to researchers for understanding typical life cycles in the forest and developing sustainable forestry practices. Counting tree rings is the method that is usually used to determine the age of trees, but in tropical rain forests, such as the Amazon, tree rings may be irregular (not annual) or nonexistent.   
            *Carbon-14 dating* is another method of determining tree age. Trees take carbon dioxide, which contains some of the radioactive element carbon-14, into their tissues at a known rate. By measuring the levels of carbon-14 in a plant, scientists can determine its age. Table 1 lists the age and other data for trees that have emerged from the canopy in a small Amazon forest plot. The age of the trees was determined by carbon-14 dating.   
            Historical patterns of forest disturbance are also important to biologists for determining the extent to which the forest is affected and the forest’s pattern of recovery. Figure 1 shows the catastrophic events that are known to have occurred in the area where the trees in Table 1 were growing.

Table 1





1. Based on the information given in Table 1, which of the following trees has the fastest growth rate?
   1. Tree 4 b. Tree 8 c. Tree 9 d. Tree 12
2. According to the passage, the carbon-14 dating method of determining tree age works because trees regularly absorb which of the following?
   1. Nitrogen b. oxygen c. carbon monoxide d. carbon dioxide
3. According to Table 1, which of the following tree species contains the youngest tree in the forest plot?
   1. Bagassa guianansis
   2. Hymenolobium species
   3. Cariniana micrantha
   4. Iryanthera grandis

Day 4: Trend-spotting Questions

Directions: begin by reading Slides 23-31 in the accompanying PowerPoint. Use the information to answer the Instruction questions below. Then move onto Application and Discussion.

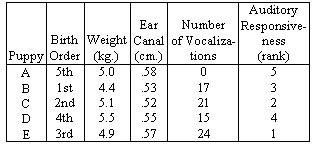
# Instruction Questions *See slides 23-31 in the accompanying PowerPoint. All answers can be found in these slides.*

1. Typically there are trend-spotting questions on the ACT Science exam, or roughly   
   per passage.
2. These are the to answer.
3. Trend-spotting requires you to   
     
   (your ) and then use this known information to   
     
    .
4. Trend-spotting involves three key skills: ,   
     
   and .
5. What is interpolation?
6. Use interpolation to determine the following: *if a single-scoop ice cream cone costs $1, and   
   a triple scoop ice cream cone costs $3, how much would a double-scoop ice cream cone cost? $*
7. What is extrapolation?
8. How is this different from interpolation?
9. Use extrapolation to determine the following: *a seedling grows at a rate of 2 mm per day at 50o F and at a rate of 4 mm at 55o F. At 60oF the seedlings grow at a rate of 6 mm. What rate would these seedlings grow at 65o F?* How do you know?
10. What is a direct relationship?
11. How can you tell if a graph shows a direct relationship?
12. Draw a graph that shows direct relationship in the space below:
13. What is an inverse relationship?
14. How can you tell if a graph shows an inverse relationship?
15. Draw a graph that shows an inverse relationship in the space below:
16. What is a combination relationship?
17. How can you tell if a graph shows a combination relationship?
18. Draw a graph that shows direct relationship in the space below:
19. What is a random relationship?
20. In these particular situations, the has no

# Application & Discussion

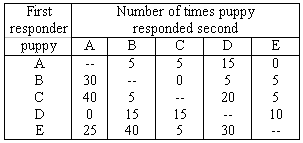
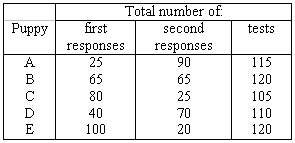
*Use the information you recorded on the previous pages to answer the questions below. You may work in groups.*

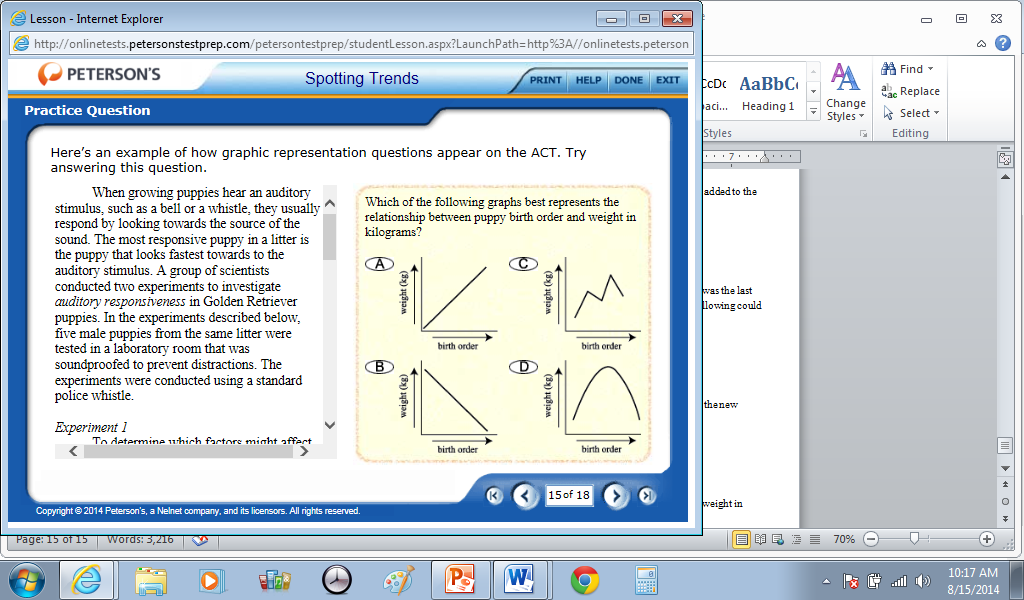
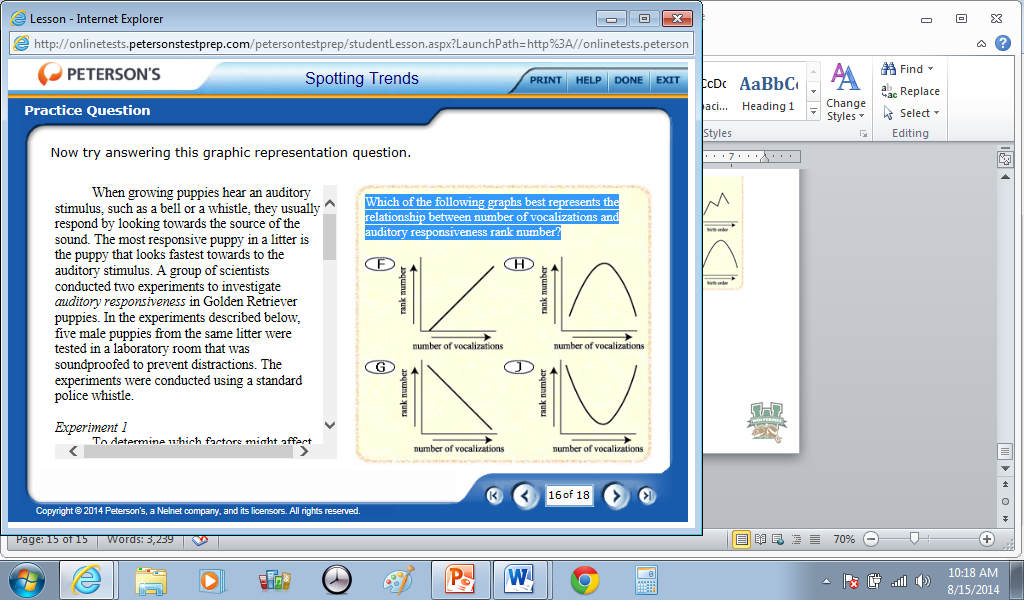
**Passage 1:** When growing puppies hear an auditory stimulus, such as a bell or a whistle, they usually respond by looking towards the source of the sound. The most responsive puppy in a litter is the puppy that looks fastest towards to the auditory stimulus. A group of scientists conducted two experiments to investigate *auditory responsiveness* in Golden Retriever puppies. In the experiments described below, five male puppies from the same litter were tested in a laboratory room that was soundproofed to prevent distractions. The experiments were conducted using a standard police whistle.   
  
*Experiment 1*   
           To determine which factors might affect auditory responsiveness, the scientists recorded the birth order of each puppy, their weight, the size of their ear canals, and the number of vocalizations each puppy made during the experiment. In addition, the puppies were ranked according to their responsiveness to the auditory stimulus, from the most responsive (1) to the least responsive (5). The results are shown in Table 1.

Table 1

*Experiment 2*   
          The puppies were placed in the experiment room in pairs. For each pair, the individual responsiveness of each puppy to the auditory stimulus was recorded. A puppy was labeled as a �first responder� if he responded to the police whistle before the other puppy, the �second responder.�   
  
Table 2 shows the results of tests conducted with each pair (below left).

Table 3 (below right) summarizes the results of all the paired tests for each puppy.

1. A sixth male puppy from the same Golden Retriever litter was added to the experiment. This puppy made more vocalizations than Puppy A and fewer vocalizations than Puppy D. Based on the results of Experiment 1, how many vocalizations could the sixth puppy have made?
   1. 0 b. 2 c. 17 d. 25
2. In Experiment 1, if a new puppy who weighed more than Puppy C and less than Puppy D was added to the experiment, the new puppy’s weight in kilograms would most likely be nearest:
   1. 5.0 b. 5.1 c. 5.3 d. 5.6
3. A new puppy from the same Golden Retriever litter was added to the experiment. This puppy was the last born of all the puppies in the litter. Based on the information given in Table 1, which of the following could be the new puppy's birth order?
   1. 1st
   2. 3rd
   3. 5th
   4. 8th
4. In Experiment 1, if a new puppy with the smallest size ear canal was added to the experiment, the new puppy’s ear canal would most nearly measure:
   1. .50 cm
   2. .52 cm
   3. .59 cm
   4. .60 cm
5. Which of the following graphs best represents the relationship between puppy birth order and weight in kilograms?
   1. b. c. d.
6. Which of the following graphs best represents the relationship between number of vocalizations and auditory responsiveness rank number?
   1. F b. G c. H d. J
7. A new puppy, whose weight was 5.2 kg and whose ear canal measured .56 cm, was added to Experiment 1. It was observed that the puppy made a total of 16 vocalizations during the experiment. Based on the results presented in Table 1, what would be the rank number of the new puppy in terms of its auditory responsiveness?
   1. 1
   2. 3
   3. 4
   4. 6

Day 5: Inference Questions

Directions: begin by reading Slides 32-38 in the accompanying PowerPoint. Use the information to answer the Instruction questions below. Then move onto Application and Discussion.

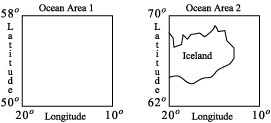
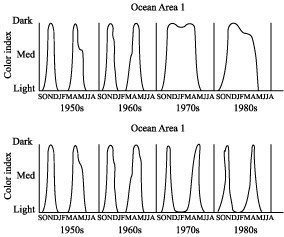
# Instruction Questions *See slides 32-38 in the accompanying PowerPoint. All answers can be found in these slides.*

1. Science inference questions are the questions.
2. In these types of questions, you will be asked to   
     
   based on
3. These are one of types of questions found on   
     
   the ACT Science exam (usually are this type).
4. Inference questions are ; occasionally they may   
     
   even rank
5. In all cases of inference questions,   
     
   will not
6. Three of the four answer options will either   
     
   in the passage or
7. How is this similar to what actual scientists face every day?
8. Summarize in your own words how the ACT Exam will try to ‘trick’ you on these types of questions:
9. What is one method for more easily identifying the main information provided in the passage?
10. The trickiest inference questions will
11. These are usually best to as they tend to be among the   
      
     .
12. What are three things you ask yourself before answering an inference question in which a large amount of information is provided?   
      
    1.   
      
    2.   
      
    3.
13. Science at its simplest is about finding
14. Focusing on   
    will help you the most on inference questions.

*Continue to the next page*.

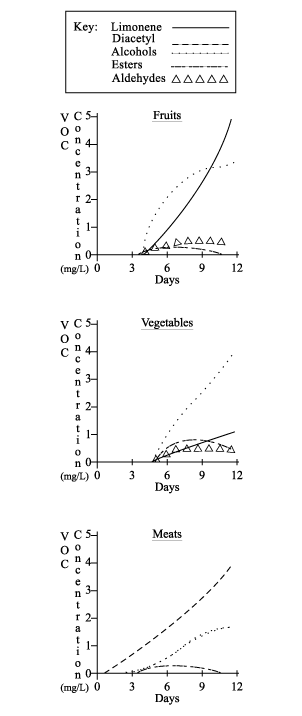
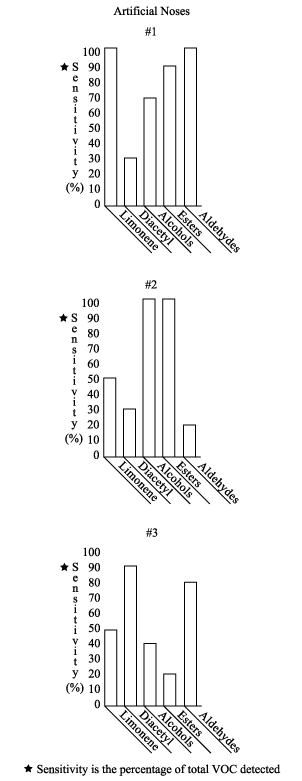
# Application & Discussion

*Use the information you recorded on the previous pages to answer the questions below. You may work in groups.*

**Passage 1:** *Phytoplankton* are tiny aquatic plants that are an important food source for larger animals and may be an important source of carbon (the element that is a building block of all living organisms). Phytoplankton abundance is dependent on the presence of warm surface waters. Consequently, changes in phytoplankton abundance can be used as an indicator of changes in surface water temperature.   
  
   A system for documenting phytoplankton abundance has been developed using filtering silk towed by merchant ships. The organisms color the silk green, and the intensity of the color is correlated with their abundance. The first figure shows data on the average monthly phytoplankton abundance for four decades, as determined by the color index system. Data is given for two ocean areas in the Northern Atlantic just below the Arctic Circle. The boundaries of these areas are depicted in the second figure.   
  


1. Based on the information in the first figure, which of the following statements concerning phytoplankton abundance in the four decades of the study is correct?
   1. There was no discernible change in patterns of phytoplankton abundance in Ocean Area 1.
   2. Annual phytoplankton abundance increased in Ocean Area 2.
   3. Annual phytoplankton abundance increased in Ocean Area 1 and decreased in Ocean Area 2.
   4. The season of high phytoplankton abundance increased in length in both Ocean Areas.
2. Assuming that the changes on phytoplankton abundance seen in the study occurred solely because of surface water temperature variations, the information in the figures indicates that which of the following statements is true?
   1. Surface ocean waters above latitude 62o North in the map areas cooled during the study.
   2. Surface ocean waters above latitude 50o North in the map areas cooled during the study.
   3. Surface ocean waters east of longitude 10o in the map areas warmed during the study.
   4. Surface ocean waters west of longitude 10o in the map areas cooled during the study.
3. Which of the following statements best describes typical phytoplankton abundance in Ocean Areas 1 and 2 in the 1950s?
   1. Abundance increased in October and remained at high levels until about June.
   2. Abundance increased slowly and fell off rapidly in two distinct periods.
   3. Abundance increased rapidly in two distinct periods and remained at peak levels for approximately three months.
   4. Abundance increased and fell off rapidly in two distinct periods.
4. The first figure suggests what about the changes in phytoplankton?
   1. Changes occurred evenly over the course of the four decades.
   2. The most dramatic changes occurred over the course of about a decade.
   3. The most dramatic changes occurred over the course of a year.
   4. Changes in area 1 were apparent earlier than changes in area 2.
5. Some researchers hypothesize that changes in phytoplankton abundance reflect an increase in global temperature. Which of the following findings supports this hypothesis and fit the data in the first figure?
   1. A greater abundance of fresh water from melted ice and permafrost has begun flowing south to north from Antarctica during the last century.
   2. A greater abundance of fresh water from melted ice and permafrost has begun flowing north to south from the Arctic during the last century.
   3. Warmer temperatures have been recorded in and around Iceland during the last century.
   4. Barring few exceptions, phytoplankton numbers have begun to decrease dramatically in ocean areas around the globe during the last century.

**Passage II:** Researchers are experimenting with chemical sensors that could act as artificial noses. These artificial noses are capable of detecting odors indicating that meats or produce are spoiling, making these noses useful in the food industry. The sensors detect volatile organic compounds (VOCs), which are indicators of food quality. In an experimental system, researchers created thick films of certain semiconductors (materials that are neither food electrical conductors nor insulators). Each film is sensitive to a small range of VOCs. When they come into contact with these VOCs, they are *oxidized*. In this process, oxygen molecules combine with the semiconductors to form new molecules, and free electrons are released. The addition of the free electrons alters the electrical properties of the semiconductor films, and this electrical change is detected.

**Experiment 1(Left)**

Researchers developed artificial noses by coupling a number of different VOC detectors, similar to those described above. They then tested the ability of the different artificial noses to detect these VOCs. Results appear in the following figure.

**Experiment 2 (Right)**

The researchers sampled the air on a daily basis above a variety of stored fruits, vegetables, and meats. The air samples were injected into the column of a chromatograph. A chromatograph is a tool that separates mixtures into component parts allowing researchers to identify the vapors. The results of the chromatograph experiment appear in the following figure. (Low-molecular weight alcohols, esters, and aldehydes appear grouped in the results.)

1. Which of the following statements is best supported by the experimental data presented?
   1. Alcohols are the most important VOCs for the detection of fruit spoilage.
   2. Limonene is the most important VOC for the detection of fruit spoilage.
   3. Diacetyl is the most important VOC for the detection of vegetable spoilage.
   4. Esters are the most important VOCs for the detection of meat spoilage.
2. Which of the following is the most likely interpretation of the data on vegetable spoilage?
   1. Vegetables start to spoil slightly earlier than fruits.
   2. Vegetables start to spoil on about day 5, but show improvement by day 9.
   3. The concentrations of some VOCs continue to rise as vegetables decay, while others begin to drop, making them less useful as indicators.
   4. The concentrations of all VOCs begin to drop after some time, showing that they are not reliable indicators of food spoilage.
3. Would Nose #1 be an effective detector of fruit spoilage?
   1. Yes, because it is a reliable detector of diacetyl.
   2. Yes, because it is a reliable detector of limonene.
   3. No, because it is an unreliable detector of alcohols.
   4. No, because it is an unreliable detector of limonene.

Day 6: Scientific Method Questions

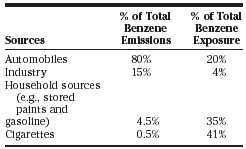
Directions: begin by reading Slides 39-50 in the accompanying PowerPoint. Use the information to answer the Instruction questions below. Then move onto Application and Discussion.

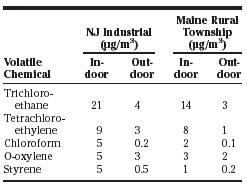
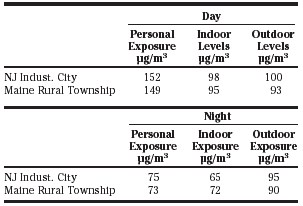
# Instruction Questions *See slides 39-50 in the accompanying PowerPoint. All answers can be found in these slides.*

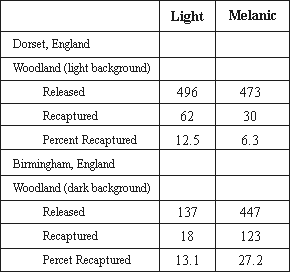
1. Scientific method questions require you to think like and measure  
     
   your ability to
2. These are among the on the ACT Science exam.
3. If you’ve taken a lot of science courses, does this mean that you’ll do well on this portion?   
     
   Explain:
4. Out of 40 questions on the ACT Science exam, these questions would usually amount to .   
     
   These would be found in groups of among
5. What are two key characteristics for spotting a scientific method question?
6. Summarize what you will need to know about each of the following:   
     
   Observation:   
     
      
     
   Hypothesis:   
     
      
     
      
     
   Prediction   
     
      
     
      
     
   Experimentation:   
     
   Objectivity:   
     
      
     
   Reproducibility:   
     
      
     
   One independent variable:   
     
      
     
   Control:   
     
      
     
   Modification:

# Application & Discussion

*Use the information you recorded on the previous pages to answer the questions below. You may work in groups.*

**Passage 1:** Environmental levels of the *organic volatile chemical* benzene are of concern to public health officials because studies have shown that continual exposure to high concentrations of this compound can cause leukemia. Organic volatile chemicals are carbon-containing compounds that are easily vaporized and therefore are present in the air. Experiments to test for the presence of such chemicals were devised.   
  
**Experiment 1**   
Researchers outfitted individuals in urban, suburban, and rural areas with monitoring instruments that they could wear throughout the day. These instruments recorded the concentrations of benzene they were exposed to as they went about their normal activities. Other monitoring devices were used to record the benzene output of various known sources in the participants� environment. The average percentage of total benzene that participants were exposed to from various sources as well as the average percentage of total output from these sources are given in Table 1.   
  
**Experiment 2** The researchers decided to look   
at whether other volatile organic compounds were found in greater concentrations indoors or outdoors. Residents from the two areas wore monitoring devices that recorded the levels of a number of volatile organic compounds that they were exposed to during outdoor and indoor activities for several days. The first area was a highly industrial New Jersey city and the other was a rural township in Maine. The average exposure levels of residents in these areas are listed in Table 2.

**Experiment 3** Fine particles in the air,  
particularly breathable particles (those that are 10 microns or smaller and are able to penetrate into the lungs), are another environmental concern. Large population studies have suggested that elevated outdoor concentrations of fine particles are associated with premature death. Most fine particles form through process of combustion   
such as burning candles smoking, or burning firewood.  
    Researchers wanted to see what the total levels on such particles were indoors and outdoors and exposure levels. Monitors that recorded levels of breathable particles were put inside and outside the homes of one individual from each of the communities in Experiment 2. These individuals were also asked to wear monitoring devices from this experiment are shown in Table 3.

1. The results of Experiment 1 indicate that which of the following statements is true?
   1. Automobiles and industrial pollution are not significant sources of benzene emissions.
   2. The largest sources of benzene output were also the sources that caused that highest individual exposure.
   3. Cigarettes caused more benzene emissions than any other source tested.
   4. An individual’s highest exposure to benzene was more likely to occur indoors than outdoors.
2. One of the differences between Experiment 1 and Experiment 2 is that:
   1. Experiment 1 did not investigate a volatile compound.
   2. Experiment 2 showed that people are exposed to higher levels of volatile organic compounds indoors, a finding that was contradicted by Experiment 1.
   3. Experiment 1 looked at compound emission levels, while Experiment 2 looked only at compound exposure levels.
   4. Experiment 2 looked at the average compound exposure levels from a pool of data, while Experiment 1 looked at individuals’ compound exposure levels.
3. If the researchers conducting Experiment 3 added another study subject and found that he had a daytime indoor exposure level of 75 micrograms/meter3, which of the following would be the most likely daytime personal exposure level for this person?
   1. 50 micrograms/meter3
   2. 75 micrograms/meter3
   3. 85 micrograms/meter3
   4. 120 micrograms/meter3
4. Which of the following hypotheses would best explain the results seen in Experiment 3?
   1. Moving about stirs up a personal cloud of breathable particles.
   2. Industrial sites tend to perform most combustion activities in the night hours, thus raising particle levels at night.
   3. Particles formed during cooking and smoking tend to remain suspended for at least 24 hours.
   4. Exposure to breathable particles is largely attributable to automobile emissions.
5. To prove the hypothesis that volatile organic compounds follow the same pattern of personal exposure versus indoor exposure levels as that seen with breathable particles in Experiment 3, researchers would need to do which of the following?
   1. Conduct Experiment 2 again, but ask the subjects to wear monitoring devices only during the day.
   2. Conduct Experiment 3 again, this time asking all of the subjects from Experiment 2 to participate.
   3. Conduct Experiment 2 again, but this time place monitors in the indoor settings in addition to those worn by individuals.
   4. Conduct Experiment 2 again, but break down the individual exposure levels into those encountered during the day and during the night.

**Passage II:** Industrial melanism, the spread of darkly colored moths and butterflies near polluted, industrial centers, was observed in the late 1840s in England. Before the 1840s, tree trunks throughout Britain were a whitish color due to the growth of lichens on the trees. These lichens are sensitive to airborne pollutants and are unable to survive near major industrial centers. In the polluted areas, the lack of lichens on the trees results in the trees being darker than in the unpolluted areas.  
  
The peppered moth (*Biston betularia*) began to appear more and more in its melanic form in the polluted areas. In certain areas, the darker moth constituted 98% of the population. Scientists hypothesized that the cause of the decline in light colored moths was due to predation by the birds and not a result of the pollution itself.  
  
Scientists performed an experiment to determine the selective force that caused the appearance of the darker moths. They distributed light and melanic moths in polluted and non-polluted areas and recorded the results, shown in the table below.  
  
The scientists noted that they were also able to see birds capturing a higher proportion of moths that did not match their background. Scientists were also able to determine that the change in color is due to a genetic mutation. Once the mutation occurs, the new coloration can therefore more successfully be passed to a greater percentage of the offspring.

1. The fact that at least 100% more moths survived if they matched the background of the trees supports which of the following hypotheses?
   1. The presence of pollution negatively affects the survival of melanic moths.
   2. The existence of lichen on trees increases the survival chances of all moths.
   3. Birds eat more moths that differ in color from their background than moths that are the same color as their background.
   4. Birds are not selective as to the moths they eat.
2. If the scientists did not observe birds capturing a greater number of moths that did not match their backgrounds, all the following could explain the data observed EXCEPT:
   1. Appearance of lichen increases the likelihood for moth survival.
   2. The pollution itself causes the light moth’s difficulty with survival.
   3. A selective force selects against the melanic moths in the unpolluted area and light moths in the polluted area.
   4. Too few moths were released in the areas to allow for their fates to be easily observed.
3. A critic of the experiment might point out that the scientists have not adequately accounted for which of the following?
   1. With a light background, a greater percentage of light moths survived compared to the percentage of melanic moths.
   2. Light moths were recovered in approximately the same percentage regardless of background color.
   3. With a dark background, an increased percentage of melanic moths survived compared to the percentage of light moths.
   4. Over both trials, the percentage of melanic moths recovered is close to the percentage of light moths.
4. The increase in the percentage of melanic moths recaptured in polluted areas is consistent with which of the following?
   1. Selection can be strong enough to nearly complete a color change in a species in a short time frame.
   2. Moths depend on lichen for survival in polluted and non-polluted areas.
   3. Pollution is the cause of the demise of the moth as a species.
   4. The survival rate for the melanic moth is the same regardless of pollution.
5. If it were determined that, as a result of decreased pollution, the lichens were increasing in many areas, the scientists would probably suggest that:
   1. the number of melanic moths would increase and the number of light moths would increase.
   2. the number of melanic moths would decrease and the number of light moths would increase.
   3. the number of both melanic and light moths would remain the same.
   4. the number of both melanic moths and light moths would decrease.

Day 7: Compare & Contrast Questions

Directions: begin by reading Slides 51-62 in the accompanying PowerPoint. Use the information to answer the Instruction questions below. Then move onto Application and Discussion.

# Instruction Questions *See slides 51-62 in the accompanying PowerPoint. All answers can be found in these slides.*

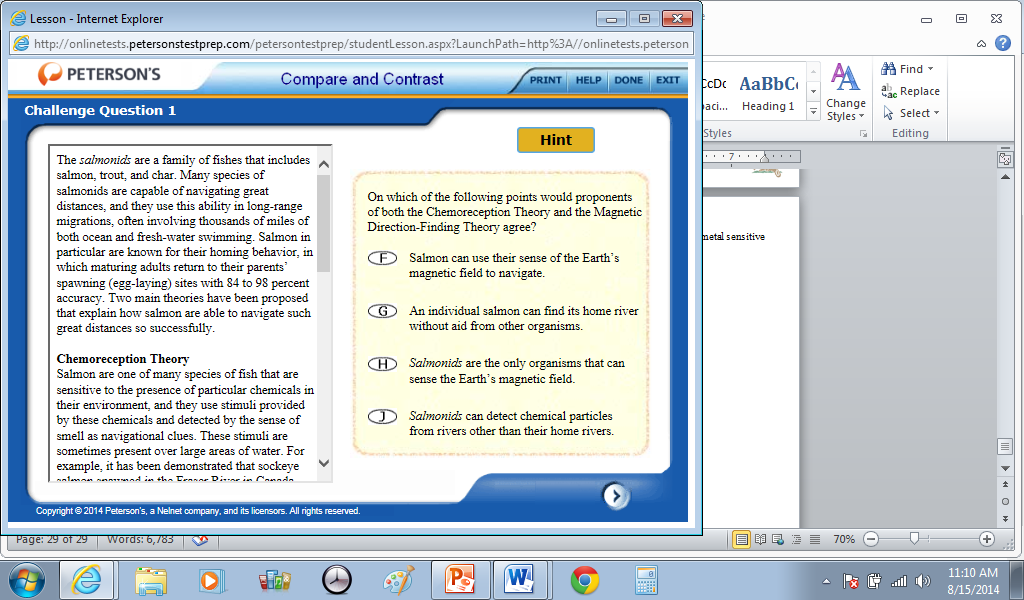
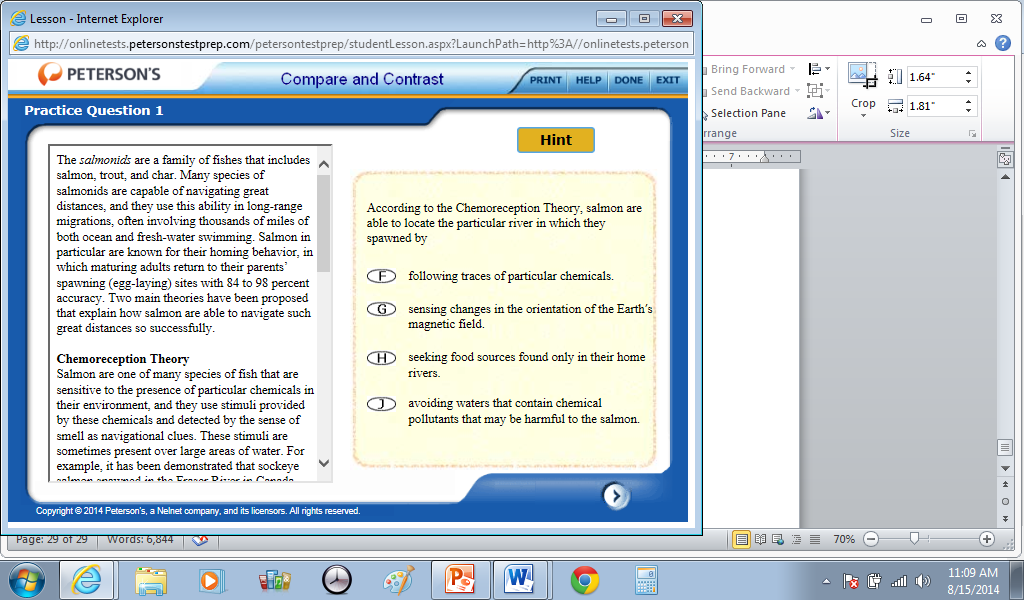
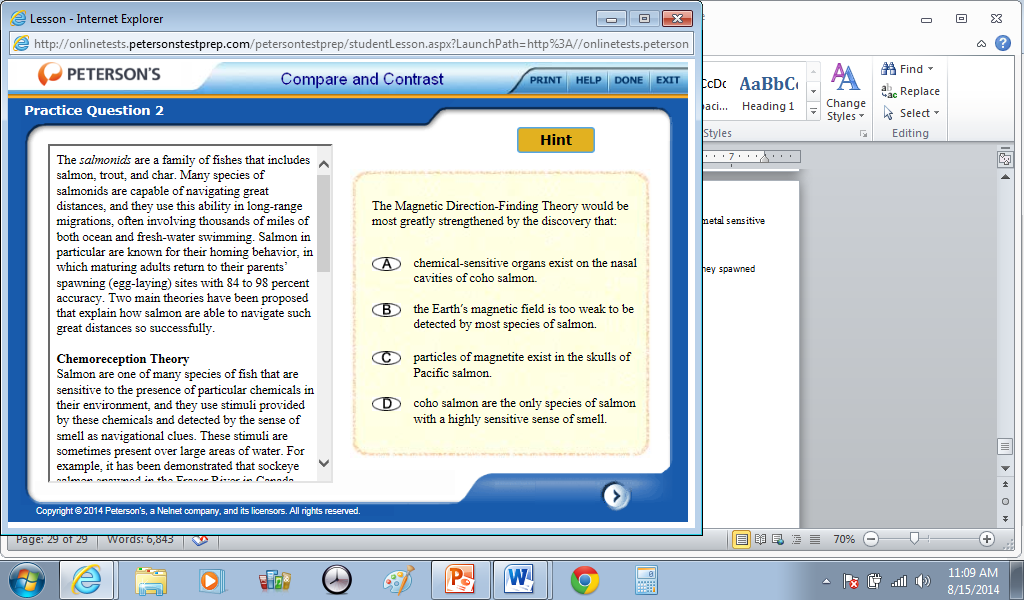
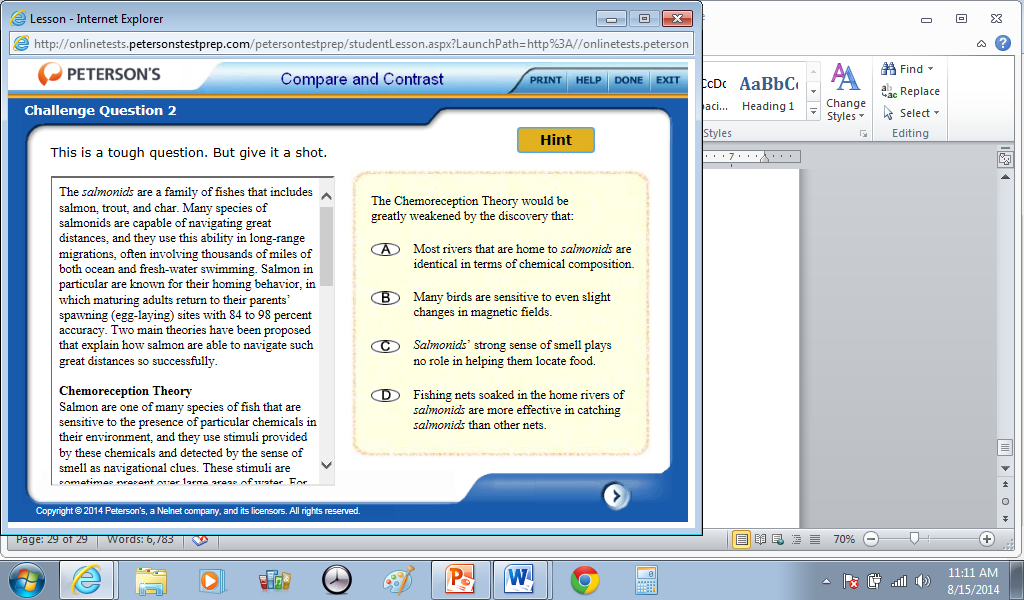
1. Compare and contrast questions present
2. The two sides will be . While the data and graphs will be   
     
   in these passages, the   
     
   will be as
3. To do well on these passages, you will need to understand:
4. Write two possible questions that could occur in this type of passage:
5. What kind of difficulty do these questions have?
6. Often the passages will be written to make   
     
    . Do not read the passages assuming that
7. Why is it best to do these questions last?
8. It is a good idea to use   
     
   and your
9. Summarize what each of the following strategies mean:   
     
   Know what is being asked:   
     
      
     
   Do them last:   
     
   Think like a scientist:

# Application & Discussion

*Use the information you recorded on the previous pages to answer the questions below. You may work in groups.*

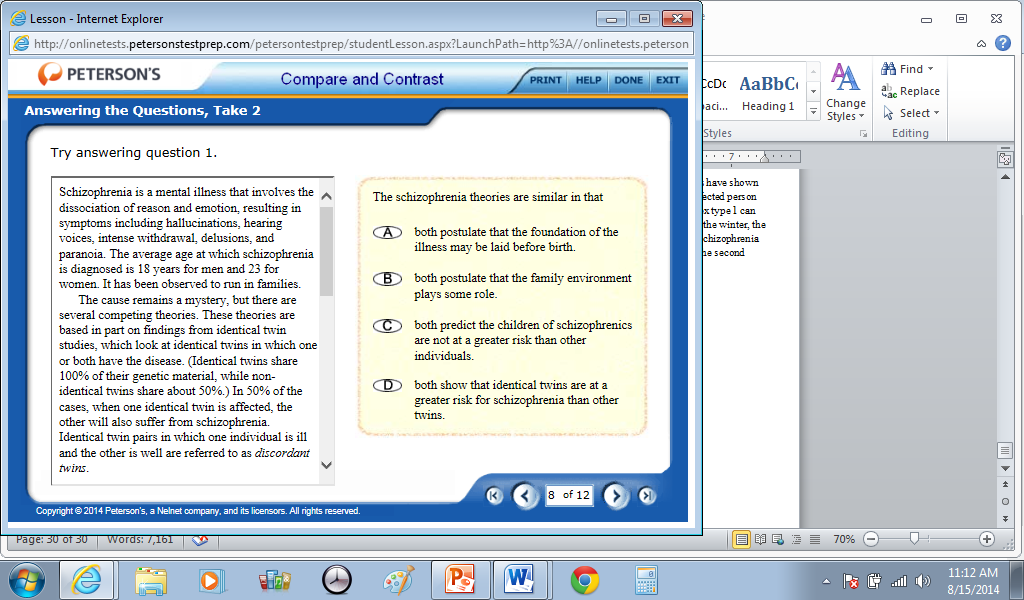
**Passage 1:** The *salmonids* are a family of fishes that includes salmon, trout, and char. Many species of salmonids are capable of navigating great distances, and they use this ability in long-range migrations, often involving thousands of miles of both ocean and fresh-water swimming. Salmon in particular are known for their homing behavior, in which maturing adults return to their parents’spawning (egg-laying) sites with 84 to 98 percent accuracy. Two main theories have been proposed that explain how salmon are able to navigate such great distances so successfully.  
  
**Chemoreception Theory**Salmon are one of many species of fish that are sensitive to the presence of particular chemicals in their environment, and they use stimuli provided by these chemicals and detected by the sense of smell as navigational clues. These stimuli are sometimes present over large areas of water. For example, it has been demonstrated that sockeye salmon spawned in the Fraser River in Canada can recognize water from that river in the open sea as much as 300 kilometers from its mouth.  
     To test the hypothesis that smell is the crucial sense for salmon navigation, scientists blocked the nasal cavities of some migrating coho salmon with absorbent cotton and marked the fish to facilitate tracing. Another group of coho salmon was differently marked and not treated in any other way. When the travels of both groups were studied, it was found that the untreated group returned accurately to their rivers of origin, while the salmon that were unable to smell selected rivers at random.  
  
**Magnetic Direction-Finding Theory**Various species navigate using clues provided by the Earth’s magnetic field. This field, which generates magnetic lines of force running in a north-south direction, can be used in direction- finding by many birds and, some scientists believe, by some fish, including salmon.  
     One species of Pacific salmon, the chum, was tested for its sensitivity to magnetism in the following way. An experimental apparatus consisting of two electrical coils was built around a tank housing the salmon. When a current was run through the coils, a magnetic field was generated, capable of intensifying, weakening, or altering the Earth’s magnetic field, depending on the positioning of the coils. When this field was rotated 90º from the normal north-south orientation, the chum’s own orientation also rotated, indicating the fish’s ability to directly detect the Earth’s magnetic field and its responsiveness to that stimulus.

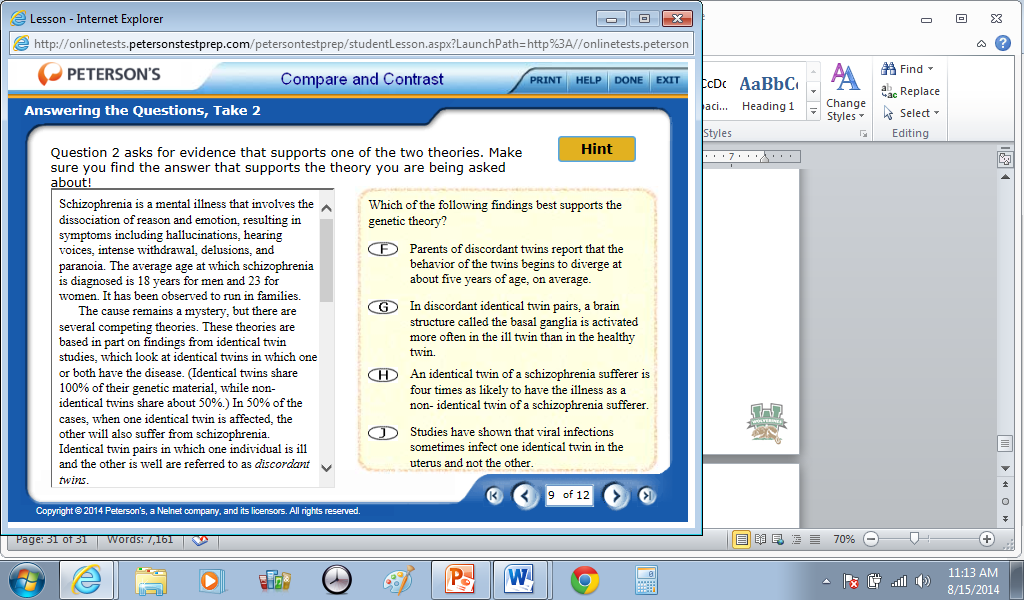
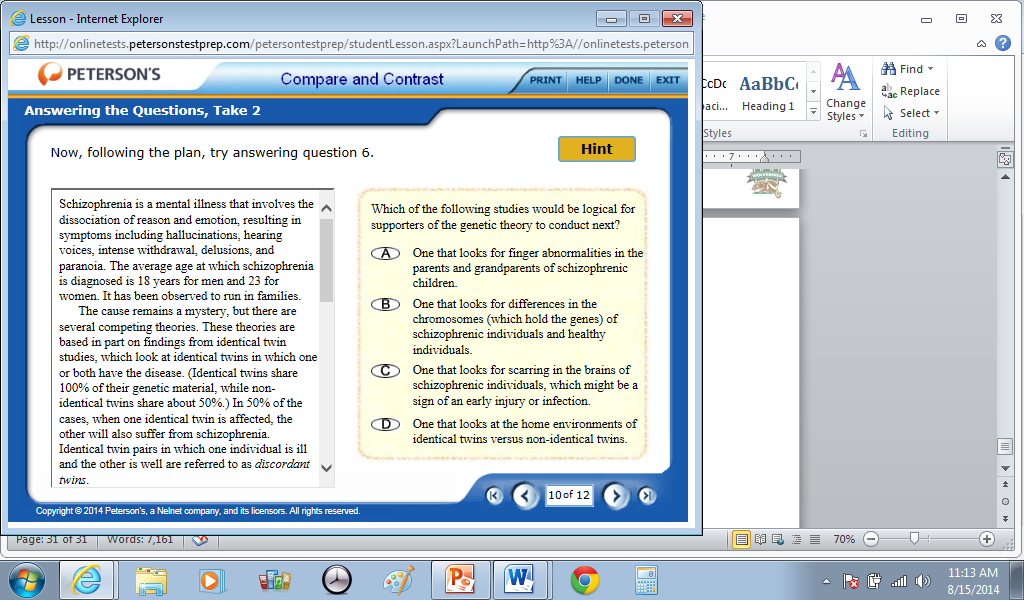
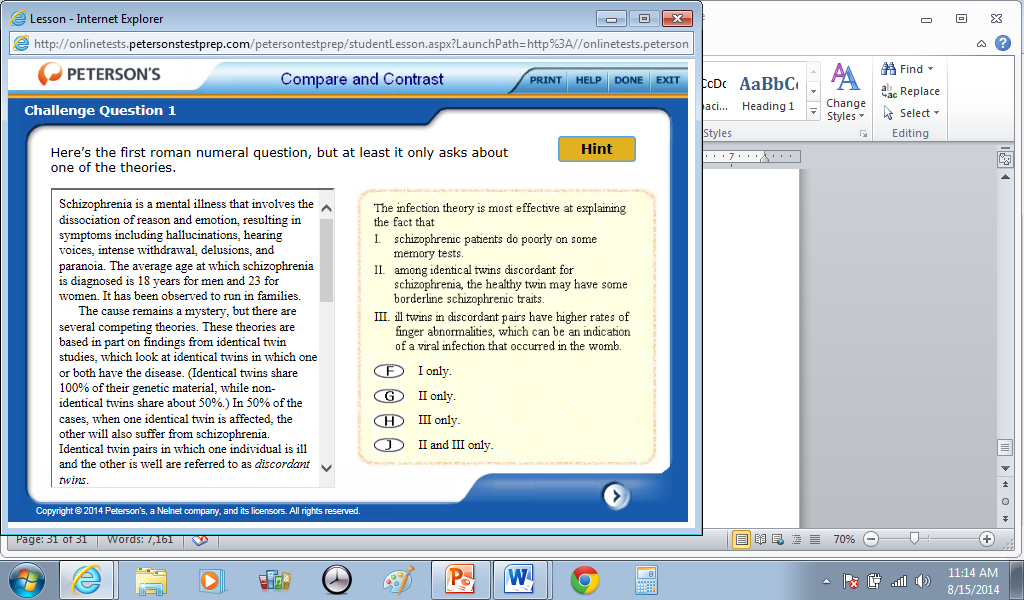
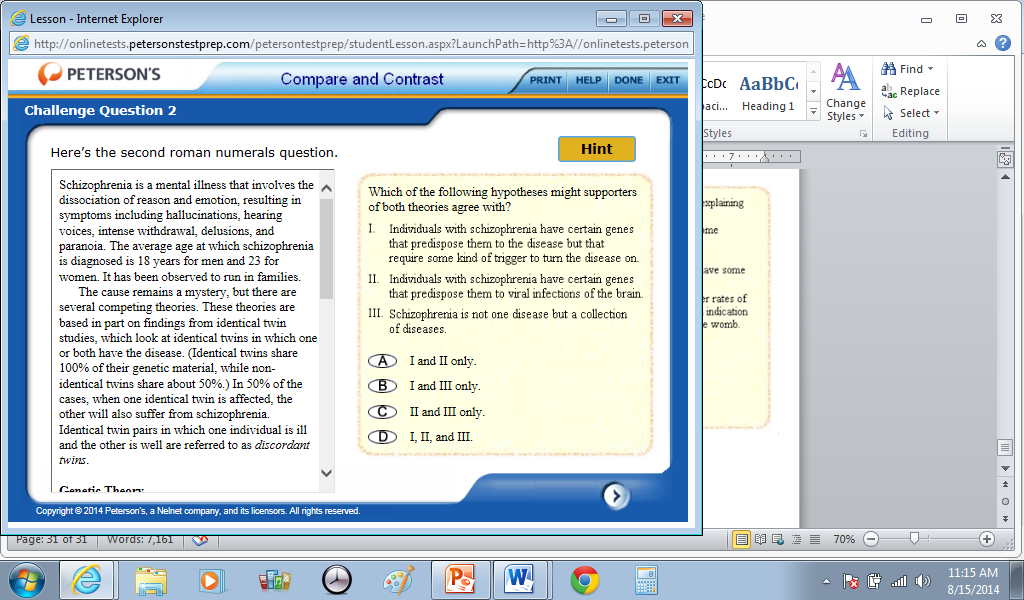
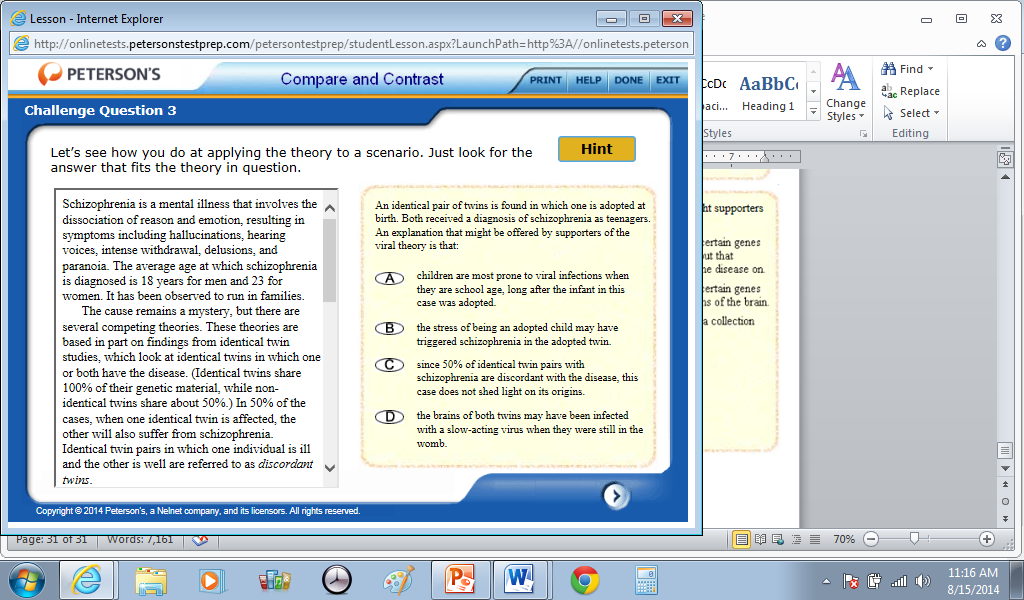
     Unlike in some birds, however, whose skulls have been shown to contain particles of *magnetite*, a metal sensitive to magnetism, no mechanism has yet been discovered in salmon



.

**Passage II:** Schizophrenia is a mental illness that involves the dissociation of reason and emotion, resulting in symptoms including hallucinations, hearing voices, intense withdrawal, delusions, and paranoia. The average age at which schizophrenia is diagnosed is 18 years for men and 23 for women. It has been observed to run in families.  
      The cause remains a mystery, but there are several competing theories. These theories are based in part on findings from identical twin studies, which look at identical twins in which one or both have the disease. (Identical twins share 100% of their genetic material, while non-identical twins share about 50%.) In 50% of the cases, when one identical twin is affected, the other will also suffer from schizophrenia. Identical twin pairs in which one individual is ill and the other is well are referred to as discordant twins.  
  
Genetic TheoryOne school of thought is that schizophrenia is a genetic disorder (one passed through the genes from parents to children). This theory gained support from the fact that schizophrenia runs in families. While it was originally believed that it was the family environment that caused this, a study has shown that children of schizophrenics adopted by families without the disease have the same risk of developing the illness as those raised by both parents. A final piece of evidence is the fact that the children of discordant identical twins all have the same chance of developing the illness: 17%. This indicates that even the healthy twin is somehow carrying the agent of the disease, presumably in the genes.  
  
Infection TheoryAnother school of thought is that schizophrenia arises because of a viral infection of the brain. Studies have shown that a class of viruses called "slow viruses" can linger in the brain for 20 years or longer before the infected person shows symptoms. Brain infections with viruses such as the common cold-sore virus and herpes simplex type 1 can cause symptoms that resemble schizophrenia. Schizophrenia is also more common in children born in the winter, the season when viral infections are more common. Also, one study looking at families with a history of schizophrenia showed a 70% increase in the rate of schizophrenia among children whose mother had the flu during the second trimeter of pregnancy





Day 7-8: Final Thoughts

Directions: begin by reading Slides 51-62 in the accompanying PowerPoint. Use the information to answer the Instruction questions below. Then move onto Application and Discussion.

# Instruction Questions *See slides 58-62 in the accompanying PowerPoint. All answers can be found in these slides.*

1. If you don’t know ‘everything’ about science, could you still do well on the ACT Science exam?   
     
   Explain:
2. If you don’t understand a term, is it a big deal? Explain:
3. How many passages will mostly entail reading graphs and charts?   
     
   How many will be the more difficult compare and contrast?
4. Summarize five strategies that will help you the most: