AP and College Biology SUMMER ASSIGNMENT for students enrolled for Fall 2019

PART A.

Acquire the following text book:


ISBN-10 number 0805367772 or 080537146X

PART B.

Complete the following Reading Guide: “AP Activity 1.0 Scientific Inquiry and the Nature of Science”

This assignment will be due the first day of class. You will need the text book to complete the assignment.

If you did not get a hard copy of this assignment, email me and I will send it to you electronically.

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INSTRUCTIONS

I. Read Concept 1.5 (Chapter 1, pages 19 to 26) in Campbell’s Biology 7th Edition. Reading a textbook like this may not come easy to all students. Refer to the handout titled “How to Read Your AP Biology Textbook” for guidance.

II. Objectives:
   A. To become scientifically literate by learning about the philosophy of science and the language scientists use to communicate about scientific inquiry. Pay close attention to Bolded words and underlined phrases.
   B. To be able to distinguish between proper use and misuse of scientific terminology.

There are two basic types of scientific inquiry: Discovery Science and Hypothesis-Based Science (sometimes called experimental science).

1. Discovery Science is about __________________________ nature.

2. Hypothesis-Based Science is about __________________________ nature.

3. Two kinds of data that can be collected for both types of inquiry are:

   __________________________ data and __________________________ data.

4. Distinguish between these two types of data:

   __________________________

   __________________________

5. Identify the following as Discovery Science (DS) or Hypothesis Based Science (HS). The first two are done for you.

   DS ☐. Describing new species of frogs in Indonesia.

   HS ☐. Predicting that the colorful frogs are not poisonous.

   a. Sending probes to Mars to measure abiotic factors.

   b. Seeing if Earth weeds will grow on Mars.

   c. Dissecting a starfish to see what’s inside.
AP Activity 1.0 Homework continued:

____ d. Checking if starfish organs are similar to snail organs.
____ e. Seeing if related species have similar chromosomes.
____ f. Photographing the chromosomes in different species.
____ g. The Human Genome Project.
____ h. Recording the song of humpback whales.
____ i. Compiling incident report data on aggressive behavior in dogs.
____ j. Predicting which dog breeds are the most aggressive.
____ k. Taking the flashlight apart to see what's inside.
____ l. Determining why a flashlight is not working.
____ m. Cutting open a fish to see what it has eaten lately.
____ n. Trying different baits to catch fish.
____ o. Describing the different layers of rock (strata).
____ p. Testing which strata are older using isotopes.
____ q. Describing fossils found in each stratum.
____ r. Predicting which fossils will not be found in a stratum.
____ s. Measuring how much sleep video-gamers get.
____ t. Testing if sleep deprivation results in better grades.
____ u. Recording climate data for a hundred years.
____ v. Predicting the climate of the future.
____ w. Determining if snake coloration deters predators.
____ x. Documenting all the snake species in an area.
____ y. Testing the effectiveness of a vaccine in rats.
____ z. Describing viruses that infect both humans and rats.

6. How did you decide which type of scientific inquiry each example represented?
AP Activity 1.0 Homework continued:

7. Discovery science often leads to __________________ reasoning.

8. Hypothesis-Based science leads to __________________ reasoning.

9. Identify the following examples as Inductive Reasoning (IR) or Deductive Reasoning (DR).

   ___ a. Many people have been attacked by Pit Bulls so all Pit Bulls are aggressive animals.

   ___ b. If I meet a Pit Bull, then it will attack me.

   ___ c. Every time my flashlight dies, it is because of dead batteries. Therefore, all flashlights that don’t work have dead batteries.

   ___ d. If I replace the batteries in the flashlight, then the flashlight will work again.

   ___ e. Video-gamers are sleep deprived and therefore will do poorly in school.

   ___ f. If we look at all students’ grades, then there will be no difference between gamers and non-gamers.

   ___ g. Frogs with bright colors are known to be toxic. Therefore, all newly discovered brightly colored frogs are poisonous.

   ___ h. Bright-colored frogs A, B and C will have the same toxicity as dull-colored frog D.

10. How did you decide which statements were inductive vs. deductive reasoning?

_____

_____

_____

_____

At first glance it might be inferred from this exercise that inductive reasoning is unreliable or closely related to practices that have a negative connotation, such as generalization or prejudice. However, much of our understanding of nature is based on frequent observations and identifying patterns in those observations. If the pattern is observed consistently and without deviation it may be designated a scientific Law or Principle. For example, we witness gravity’s effects every day. As a result, there is now a Law of Gravity that describes the observation. Laws like this one can often be expressed as a mathematical formula (i.e. force of gravity: \( F = \frac{G m_1 m_2}{r^2} \)).

Also notice that many of the statements above (a-z) are If/then Statements which usually identifies them as deductive reasoning. These statements are specific Predictions that are probably based on a working hypothesis. Remember that the term “Hypothesis” is defined as one possible answer to a well framed Question. The goal of a scientist using deductive reasoning is to pose a hypothesis and test its...
predictions using a Controlled Experiment. If the results of the experiment are inconsistent with the hypothesis, then a scientist may say the hypothesis is rejected, falsified, or not supported by the data. If the results of the experiment are consistent with the hypothesis, a scientist may say the experiment failed to reject, or failed to falsify the hypothesis.

To further illustrate this very important concept, consider the flashlight example on page 20 of your textbook. Note that there are two hypotheses presented.

11. Which of these are good useful working hypotheses? _________________________

If you answered “both”, then you would be correct. That is because both can be tested and both are falsifiable.

12. Which is the better scientist? One who poses hypothesis #1 or one who poses hypothesis #2?

If you said “neither”, then you would be correct. Even though hypothesis #1 was falsified (not supported), learning that the batteries alone were not the cause of the flashlight malfunction was a step toward answering the underlying question: Why does the flashlight not work?

Many students are surprised to learn that, in the true nature of science, hypotheses are never proven. Science does not determine absolute truth and never did. Science is a particular “way of knowing” that produces tentative explanations for natural phenomena. It is tentative because new data arising from new discovery science, advances in technology, or more clever experimental designs should always be considered in confirming the validity of current hypotheses or theories. Also, remember the goal of the scientist is not to validate his hypothesis, but make every attempt to falsify it no matter how much he/she wants it to be supported. For example, consider the following hypothesis: New Drug A is safe for human consumption. Scientists at the Food and Drug Administration (FDA) hopefully try their very best to falsify this hypothesis before the new drug hits the market. This is the mark of good science.

Speaking of theories, the term Theory has various definitions in modern language and unfortunately a “Theory” in science means something entirely different from a “Theory” in everyday conversations and the media.

13. Three important features of a theory in science are (see page 24 in textbook):
   a. _________________________
   _________________________
   _________________________
   b. _________________________
   _________________________
   _________________________
14. Identify the following statements as proper use (PU) or mis-use (MU) of terminology in scientific inquiry:

_____ a. I proved my hypothesis to be true.
_____ b. My theory is that dogs can smell fear.
_____ c. Clearasil® is scientifically proven to reduce acne.
_____ d. My data falsifies my hypothesis.
_____ e. Evolution is just a theory.
_____ f. The data is right because it proves the answer is true.
_____ g. My data supports my theory.
_____ h. A Theory can become a Law if the data support it.
_____ i. A good hypothesis is one that is validated.
_____ j. Our hypothesis showed that our data was right.
_____ k. The new data requires that we modify the current theory.

To summarize, scientific inquiries can take on several different forms. We looked at Discovery Science as an activity of careful observation and recording of those observations. We said that Hypothesis-Based Science involves conducting and analyzing controlled experiments. We now understand that conclusions made through Discovery Science involve inductive reasoning and that conclusions made through Hypothesis-Based Science represent deductive reasoning. We learned that A Scientific Law describes a natural phenomenon while a Scientific Theory explains a natural phenomenon. And finally, we can recognize a working Hypothesis as a possible answer to a specific question which is testable and falsifiable.