

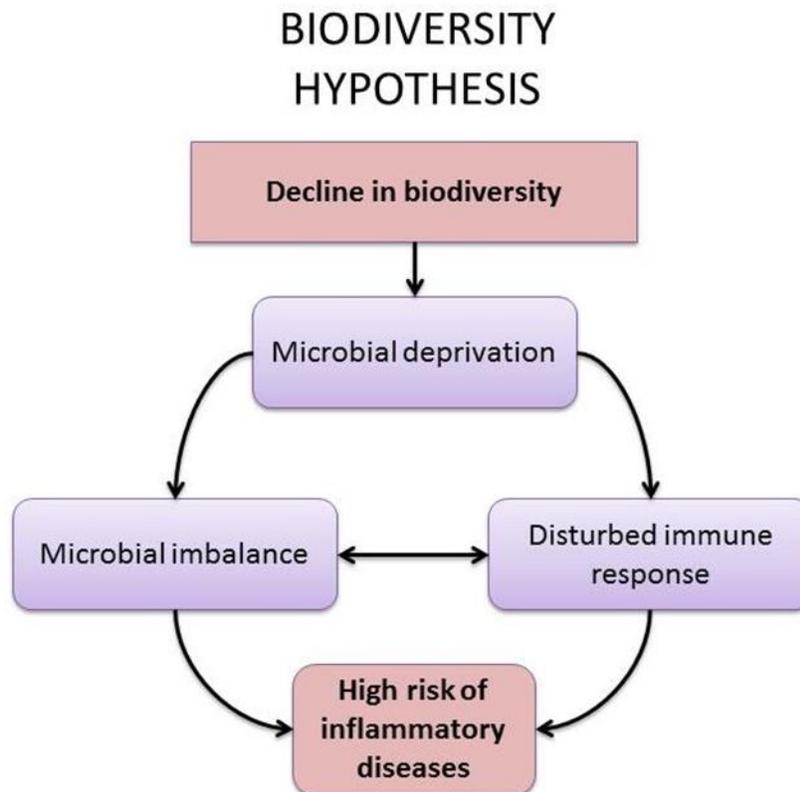
LECTURE 1 – The Scientific Method

QUESTIONS TO TRY FOR PRACTICE

1) Identify if the following hypotheses are good or if they are untestable:

- (i) Cactus spines reduce herbivory
- (ii) Fishes are smarter than cats
- (iii) Men are smarter than women
- (iv) Ultra- violet radiation causes limb deformities in frogs

2) Consider the Figure below which outlines the link between a decline in biodiversity and a high risk of inflammatory diseases within a population. Devise a suitable hypothesis statement which a scientist can test in order to validate this observation.



Reference: von Hertzen et al. 2011

- 3) Question- How does a scientific theory differ from a scientific hypothesis?
- a) The terms are interchangeable – there is no difference
 - b) A theory is an explanation for a very general phenomenon or observation whilst hypotheses treat more specific observations.
 - c) A hypothesis is an explanation for a very general phenomenon whilst theories treat more specific issues.
 - d) Theories define scientific laws whilst hypotheses are used to set up experiments.
- 4) Take a look at the video (TedEd) below which outlines the discovery of Penicillin by Scottish scientist, Alexander Fleming and answer the questions:

Video link: <https://www.youtube.com/watch?v=CNbnLgetqHs>

- State the question or problem that Fleming investigated.
 - What was Fleming's hypothesis?
 - How was the hypothesis tested?
 - Write a statement that summarizes the results of the experiment.
 - This experiment led to the development of what major medical advancement?
- 5) Louis Pasteur's experiment had a good design because
- A) simple equipment was used.
 - B) a major question, spontaneous generation, was tested.
 - C) the possible outcomes led to distinct, unambiguous conclusions.
 - D) the experiment was a success.
- 6) Which of the following is the best description of a control for an experiment?
- A) The control group is kept in an unchanging environment.
 - B) The control group is left alone by the experimenters.
 - C) The control group is matched with the experimental group except for one experimental variable.
 - D) The control group is exposed to only one variable rather than several.
 - E) Only the experimental group is tested or measured.
- 7) Why was it important that researchers use large sample sizes?
- A) It holds the experimental conditions constant.
 - B) It controls for all variables except for one.
 - C) It reduces the amount of distortion or "noise" in the data caused by unusual individuals or circumstances.
 - D) It allows the researchers to create a null hypothesis.

- 8) Which of the following is a powerful way to test a hypothesis?
- A) Incorporate the hypothesis into a more general theory.
 - B) Formulate a competing or alternative hypothesis.
 - C) Formulate a null hypothesis.
 - D) Perform an experiment that tests a prediction that follows from the hypothesis.
- 9) A friend of yours calls to say that his car would not start this morning. He asks for your help. You say that you think the battery must be dead, and that if so, then jump-starting the car from a good battery will solve the problem. In doing so, you are
- A) only stating a hypothesis for why the car won't start.
 - B) searching for observations that might inspire a hypothesis for why the car won't start.
 - C) stating both a specific hypothesis about why the car won't start and a prediction of the hypothesis.
 - D) performing an experimental test of a hypothesis for why the car won't start.

Use the following information to answer Questions 10-12

In 1668, Francesco Redi did a series of experiments on spontaneous generation. He began by putting similar pieces of meat into eight identical jars. Four jars were left open to the air, and four were sealed. He then did the same experiment with one variation: Instead of sealing four of the jars completely, he covered them with gauze (the gauze excluded flies while allowing the meat to be exposed to air). In both experiments, he monitored the jars and recorded whether or not maggots (young flies) appeared in the meat.

- 10) What hypothesis was being tested in the initial experiment with open versus sealed jars?
- A) Spontaneous generation is more likely during the long days of summer.
 - B) The type of meat used affects the likelihood of spontaneous generation.
 - C) Maggots do not arise spontaneously, but from eggs laid by adult flies.
 - D) Spontaneous generation can occur only if meat is surrounded by air.
- 11) In both experiments, flies appeared in all of the open jars and only in the open jars. Which one of the following statements is correct?
- A) The experiment was inconclusive because Redi used only one kind of meat.
 - B) The experiment was inconclusive because it did not run long enough.
 - C) The experiment supports the hypothesis that spontaneous generation occurs in rotting meat.
 - D) The experiment supports the hypothesis that maggots arise only from eggs laid by adult flies.

12) Why was it important that Redi replicate each treatment four times in each experiment?

- A) to reduce the likelihood of getting an accidental result
- B) to practice his technique and make sure the experiment was done correctly
- C) to make sure that there was enough meat to attract flies
- D) to make sure that he made efficient use of his lab equipment

13) Fireflies are nocturnal beetles that emit flashes of light to attract mates. A scientist studying the firefly population over the past 5 years observes that the firefly population has declined significantly as the area that she has been studying has become more developed (more buildings). The scientist proposes a series of hypotheses to explain the decline. Which of her hypotheses is most likely to be correct?

- A) Due to excess amounts of artificial light, the firefly is now active during the day; the scientist is trying to study them at the wrong time leading to incorrect counts of the number of fireflies.
- B) Excess amounts of artificial light prevent the female fireflies from seeing the male's flashing mating signal.
- C) Excess amounts of artificial light resulted in the evolution of a different mechanism in the male firefly for attracting females and the females no longer recognize this signal.