

4. Albert Einstein "no amount of experimentation can ever prove me right; a single experiment can prove me wrong."
- v. Hypotheses can be tested with observational studies
 1. **Variable** is any aspect of nature that can change.
 2. **Statistics** a mathematical science that uses probability theory to estimate the reliability of data
- vi. Correlation is not causation
 1. **Correlation** means that two or more aspects of the natural world behave in an interrelated manner.
 2. Although there might be correlation there might not be a cause. Never assume there is a cause until proven otherwise.
 3. **Causation** observational studies that indicate a link between two variables
 4. Experiments are the most effective for showing causation
- vii. Experiments are the gold standard for establishing causation.
 1. **Experiment** is a repeatable manipulation of one or more aspects of the natural world.
 2. **independent variable** the variable that the investigator typically manipulates.
 3. **Dependent variable** is any variable that responds or could potentially respond to the change in the independent variable
 4. **Controlled experiment** a researcher measures the value of the dependent variable for at least two groups of study subjects. The groups must be comparable in all aspects. One is tested one is not
 5. **Control group** they are maintained under a standard set of conditions. With no change
 6. **Treatment group** is maintained under the same standards but is manipulated in a way that changes the independent variable.
 7. **Single blind experiment** the study subjects do not know whether they belong to the control group or the treatment group. Instead of the treatment the control group receives a **placebo** which is a dummy pill or sham treatment that mimics the actual treatment. The placebo effect is a very real possibility as well
 8. **Double blind experiment** neither the study subject nor the researchers know which participants are receiving the treatment. This helps eliminate bias during the study
- e. 1.3 Scientific facts and theories (Science Theory chapter one)
 - i. Scientific fact is a direct and repeatable observation of any aspect of the natural world.
 - ii. Scientific theory is a major explanation about the natural world that has been confirmed through extensive testing in diverse ways by independent researchers.
 - iii. Microbes minute organisms visible only with a microscope.
- f. 1.4 the characteristics of living organisms (Science Theory chapter one)
 - i. Intro