Scientific Investigations

Descriptive, Comparative or Experimental

I. Research starts with a research question, which is what the scientist wants to know.
   A. There are the three general types of research:
      1. Experimental
      2. Descriptive
      3. Comparative
   B. **Descriptive research** is based mainly on observations. Examples of descriptive research are…
      1. Making models
      2. Dissections
      3. Observing animals in the wild
      4. For example, how do the survivors of a disaster react to the disaster?
      5. No variables; data is based on watching and talking to survivors
   C. **Comparative Research** involve collecting data on different populations or organisms, or under different conditions (e.g., times of year, locations), to make a comparison.
      1. For Example, comparing the growth of two plants—one with fertilizer, one without.
   D. **Experimental research** is the manipulation and control of variables. Speaking of variables.…
   E. **What are the three types of variables?**
      1. Independent variables
      2. Dependent variables
      3. Controlled variables - Also called constants
   F. **Independent variables are**…
      1. What is being tested
      2. What is being changed
      3. The difference between the groups
      4. The ‘cause’ of a change
   G. **Dependent variables are**…
      1. What is observed
      2. What is measured
      3. The data
      4. The ‘effect’ caused by the independent variable
   H. **Controlled variables are**…
      1. Things that could change, but don’t
      2. Kept constant by the scientist
      3. Allow for a fair test
   I. **An experimental question has to indicate the variables**
      1. Should involve a process in which a “fair test” is designed in which variables are actively manipulated, controlled, and measured in an effort to gather evidence to support or refute a causal relationship.
   J. **For example, how does the temperature of ocean water affect the speed of a hurricane?**
      1. Independent variable = T of ocean water
      2. Dependent variable = Speed of a hurricane
   K. **Predictions**
      2. Educated guesses about what will happen during an investigation
      3. Based on prior knowledge (observations, background research, etc)
      For example, people in disasters will react by trying to help others as much as possible.
      4. This is a PREDICTION because it’s a guess about what you think will happen.
L. Hypothesis
   1. Special kind of prediction. What makes it so special?
      a. It’s a guess about the VARIABLES & their relationship.
      b. How will the independent variable affect the dependent variable?

M. How to write a hypothesis
   1. Use an If, Then statement
   2. IF the independent variable changes, THEN the dependent variable changes
      a. This type of sentence shows what the IV will do to the DV
      For example, IF the T of ocean water increases, THEN the speed of a hurricane will increase.
   3. This shows the expected relationship between the independent variable (the T of ocean water) and the dependent variable (the speed of a hurricane)
      a. If the T of ocean water changes, it will cause the speed of a hurricane to change too.

N. Planning the investigation – Experimental Design
   1. You absolutely, positively have to know what the variables are!
      a. What you are changing, how you are changing
      b. What you are measuring, how you are measuring
      c. Repeated trials
      d. Data tables

O. Data tables?
   1. Numerical (quantitative) data organized in rows and columns
   2. The specific independent variables are listed
   3. The number of trials are listed
   4. Blanks are left for the data (dependent variable) to be filled in

P. Analyzing the data
   1. Reduce the data
      a. Do something to make the amount of data smaller
      b. Central tendencies - Mean (average), Median, Mode, Range, frequency

Q. Graph the data
   1. Lets us see trends, patterns, relationships, comparisons
   2. Bar graphs let us compare data
   3. Line graphs let us see trends or changes

R. Conclusions
   1. How we sum up the investigation?
   2. Does the data support the hypothesis?
      • If it does – we accept the hypothesis
      • If it does not – we reject the hypothesis
   1. Always back up what you say with data
      • Evidence
   2. Discuss issues or problems with the investigation.
   3. Discuss the importance or relevance of the investigation.

S. Communicate what you know
   1. Finding out something new doesn’t do anyone any good unless the new knowledge is shared
      • Journals & magazines
      • Presentations