**Chapter 2**

**Tools of Environmental Science**

**Section 1, Scientific Methods**

**Day 1**

**The Experimental Method – Scientific Method**

* Scientists make most of their discoveries using the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* This method consists of a series of steps that scientists worldwide use \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Observing**

* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is the process of obtaining information by using the senses as well as the information obtained by using the senses.
* Observing is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ step of the experimental method.
* Observations can take many forms, including \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Hypothesizing and Predicting**

* A **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is a theory or explanation that is based on observations and that can be tested.
* Forming a hypothesis is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ step of the experimental method.
* A hypothesis is not merely a guess.
* A good hypothesis should make \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_about the situation.

**Hypothesizing and Predicting**

* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** are statements made in advance that express the results that will be obtained from testing a hypothesis if the hypothesis is supported.
* A prediction is used to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Hypothesizing and Predicting**

* It is important that any hypothesis can be disproved.
* Every time a hypothesis is disproved, the number of possible explanations for an observation is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* By eliminating possible explanations, a scientist can zero in on the best explanation.

**Experimenting**

* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** are procedures that are carried out under controlled conditions to discover, demonstrate, or test a fact, theory, or general truth.
* An experiment is performed when questions that arise from observations \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ with additional observations.
* Experiments should be designed to pinpoint \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ relationships.

**Experimenting**

* Good experiments have two essential characteristics: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* The **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is the factor that changes in an experiment in order to test a hypothesis.
* To test for one variable, scientists usually study \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or situations at one time, with the variable being the only difference between the two groups.

**Experimenting**

* The **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is the group in the experiment that is identical to the control group except for one factor and is compared with controls group.
* The **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is the group in the experiment that serves as a standard of comparison with another group to which the control group is identical except for one factor.

**Organizing and Analyzing Data**

* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is any pieces of information acquired through observation or experimentation.
* Organizing data into \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ helps scientists analyze the data and explain the data clearly to others.
* Graphs are used by scientists to display relationships or trends in the data.

**Organizing and Analyzing Data**

* Bar graphs are useful for comparing the data for several things in one graph.

**Organizing and Analyzing Data**

* Graphing the information makes the trends presented in tables easier to see.

**Drawing Conclusions**

* Scientists determine the results of their experiment by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of their experiments with their prediction.
* Ideally, this comparison provides the scientist with an obvious conclusion.

**Drawing Conclusions**

* However, often the conclusion is not obvious.
* In these cases, scientists often use \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to help them determine whether the differences are meaningful or are just a coincidence.

**Repeating Experiments**

* Scientists often repeat their experiments.
* The more often an experiment can be repeated with the same results, in different places and by different people, the more sure scientists become about the reliability of their conclusions.
* Scientists look for a large amount of supporting evidence before they accept a hypothesis.

**Communicating Results**

* Scientists publish their results, sometimes in scientific articles, to share what they have learned with other scientists.
* Scientific articles include:
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
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**The Correlation Method**

* When the use of experiments to answer questions is impossible or unethical, scientists test predictions by examining correlations.
* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is the linear dependence between two variables.

**The Correlation Method**

* An example is the relative width of a ring on a tree trunk is a good indicator of the amount of rainfall the tree received in a given year.
* Trees produce wide rings in rainy years and narrow rings in dry years.
* This method was used to help scientists investigate why the settlers at Roanake Island all died and why many died at the Jamestown Colony.

**The Correlation Method**

* Although correlation studies are useful, they do not necessarily prove cause-and-effect relationships between two variables.
* Scientists become more sure about their conclusions only if they find the same correlation in different places and as they continue to eliminate other possible explanations.

**Scientific Habits of Mind**

* Good scientists tend to share several key habits of mind, or ways of approaching and thinking about things.
* The first habit of mind is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Good scientists are endlessly curious which drives them to observe and experiment.
* The second habit of mind is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. This means that good scientists do not believe everything that they are told.

**Scientific Habits of Mind**

* The third habit of mind is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Good scientists keep an open mind to how the world works.
* Another habit of mind is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. A good scientist is willing to recognize the results of an experiment even though it may mean that his or her hypothesis was wrong.

**Scientific Habits of Mind**

* Lastly, good scientists share \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* They are not only open to new ideas, but also able to conceive new ideas themselves.
* They have the ability to see patterns where others do not or can imagine things that others cannot.
* This allows good scientists to expand the boundaries we know.

**Chapter 2**

**Tools of Environmental Science**

**Section 2, Statistics and Models**

**Day One**

**How Scientists use Statistics**

* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is the collection and classification of data that are in the form of numbers.
* Scientists rely on and use statistics to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* Statistics is actually a branch of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that provides scientists with important tools for analyzing and understanding their data.

**Statistics Works with Populations**

* Scientists use statistics to describe \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* A statistical population is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that a scientist is interested in learning about.

**What is the Average?**

* Statistical populations are composed of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, but these individuals often have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ characteristics.
* A **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is the number obtained by adding up the data for a given characteristic and dividing this sum by the number of individuals.
* The mean provides a single \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for a population and allows for easy comparison.

**Distribution**

* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is the relative arrangement of the members of a statistical population, and is usually shown in a graph.
* The graphs of many characteristics of populations, such as the heights of people, form \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* A bell shaped curve indicates a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ where the data is grouped symmetrically around the mean.

**What is the Probability?**

* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is the likelihood that a possible future event will occur in any given instance of the event.
* Probability is usually expressed as a number between \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and written as a decimal rather than as a fraction.
* However, there must be a large enough sample size in order to obtain accurate results.

**Thinking About Risk**

* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is the probability of an unwanted outcome.
* People often worry about big oil spills, but as the pie chart shows, there is a much greater risk of oil pollution from everyday sources.

**Thinking About Risk**

* The most important risk we consider is the risk of death.
* Most people overestimate the risk of dying from sensational causes, such as plane crashes, but underestimate the risk from common causes, such as smoking.
* Likewise, most citizens overestimate the risk of sensational environmental problems and underestimate the risk of ordinary ones.

**Models**

* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** are patterns, plans, representations, or descriptions designed to show the structure or workings of an object, system, or concept.
* Scientists use several different types of models to help them learn about our environment.

**Physical Models**

* Physical models are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ models you can touch.
* Their most important feature is that they \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the object or system they represent, although they may be larger or smaller.
* The most useful models teach scientists something new and help to further other discoveries.

**Graphical Models**

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are the most common examples of graphical models.
* Scientists use graphical models to show things such as the position of the stars, the amount of forest cover in a given area, and the depth of the water in a river or along a coast.

**Conceptual Models**

* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** are verbal or graphical explanations for how a system works or is organized.
* A \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is an example of a conceptual model.
* A flow-chart uses \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Conceptual Models**

* Conceptual models can also be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* For example, one conceptual model of the structure of an atom describes the atom as one large ball being circled by several smaller balls.
* This illustrates another point, that a model can be more than one type.
* An atomic model made using plastic balls is both a conceptual and physical model.

**Mathematical Models**

* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** are one or more equations that represent the way system or process works.
* Mathematical models are especially useful in cases with many variables, such as the many things that affect the weather.

**Mathematical Models**

* Although mathematical models use number and equations, they are not always right.
* People are the ones who interpret the data and write the equations.
* Therefore, if the data or the equations are wrong, the model will not be realistic and will provide incorrect information.
* Like all models, mathematical models are only as good as the data that went into building them.

**Mathematical Models**

* Scientists use mathematical models to create amazing, as well as useful images.
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are created using mathematical models.
* Scientists use the models to relate the amount of energy reflected from objects to the objects’ physical condition.

**Chapter 2**

**Tools of Environmental Science**

**Section 3, Making Informed Decisions**

**Day 1**

**Values and the Environment**

* Scientific research is an essential \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in solving environmental problems.
* However, before research can begin, an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is usually needed.
* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** are principles or standards that an individual considers important.
* Many values affect environmental decision-making.

**An Environmental Decision-Making Model**

* A \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is a conceptual model that provides a systematic process for making decisions.
* Decision-making models can be used to help you make decisions about \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, which can be very difficult.

**A Decision-Making Model**

* The first step in the model is to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. This includes things such as watching news reports, and talking to experts.
* Second, consider which \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* Next, explore the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_of each option.
* Finally, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**A Hypothetical Situation**

* The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ population is declining in Valley County.
* The town of Pleasanton, in Valley County, is growing rapidly, and much of the new development is occurring outside the city limits.
* Biologists who have been studying the warbler warn county officials that if they do not take action, the state fish and wildlife service may list the bird as an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**A Hypothetical Situation**

* Several groups join together to propose that the county buy several hundred acres of land where the birds are known to breed and save the land as a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**A Hypothetical Situation**

* The group also proposes \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ on land surrounding the preserve.
* The group obtains enough petitions to put the issue to a vote, and the public begins to discuss the proposal.

**A Hypothetical Situation**

* People who own property within the proposed preserve oppose the plan.
* These property owners have an economic interest in the situation. They believe that they will lose money if they are forced to sell their land to the county instead of developing it.
* Other residents do not like the idea of more government regulations on how private property can be used.

**A Hypothetical Situation**

* Other landowners support the plan and fear that without the preserve the warbler will be listed as an endangered species.
* Once listed as endangered, the state will impose a plan to protect the bird that will require even stricter limits on land development.
* People who have land near the preserve think that their land will increase in value.
* Many residents also look forward to hiking and camping in the preserve.

**How to Use the Decision-Making Model**

* The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in Pleasanton can be used to illustrate how to use the decision-making model.
* Michael Price is a voter in Valley County who will vote on whether the county should create the nature preserve.
* The steps Michael took to make his decision follow.

**Gather Information**

* Michael studied the warbler issue thoroughly by
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Several of the arguments on both sides made sense to him.

**Gather Information**

* Michael also gathered scientific information that included \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the decline of the warbler population.

**Consider Values**

* Michael made a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to help him clarify his thoughts and values.
* Michael considered the environmental, economic, and recreational values of the preserve.
* He believed these to be important, but someone else might have thought other values were more important to consider.

**Explore Consequences**

* Michael decides that in the short term, the positive and negative consequences listed in his table were almost equally balanced.
* For example, some people would suffer financially from the plan, but others would benefit.
* In addition, taxpayers would have to pay for the preserve, yet all residents would have access the previously private property.

**Explore Consequences**

* The long-term consequences allowed Michael to make his decision.
* Michael realized that the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ were an important factor in his decision.
* The thought of the warbler becoming extinct distressed him, and protecting the habitat now would be less costly that protecting it later under a state imposed plan.

**Explore Consequences**

* Michael considered that there were long-term benefits as well.
* He had read that property values were rising rapidly in counties where land was preserved for recreation.
* He also found that people would pay more to live in counties that have open spaces.

**Explore Consequences**

* Because the county contained little preserved land, Michael thought that creating the preserve would bring the county long-term economic benefits.
* He also highly valued the aesthetic and recreational benefits of the preserve, such as walking trails.

**Make a Decision**

* Michael chose to vote in favor of the nature preserve.
* However, someone else who looked at the same table of pros and cons might have voted differently.
* If you lived in Valley County, how would you have voted?

**Make a Decision**

* As you learn about issues affecting the environments, use this decision-making model as a starting point to making your decisions.
* Be sure to consider you values, weigh the pros and cons, and keep in mind both the short-term and long-term consequences of your decision.