Nature of Science – Case Study

How is Scientific Inquiry used in a real-life scientific investigation?

Vocabulary

- Variable
- Independent Variable
- Dependent Variable

When Scientists design a ***controlled experiment***, they have to identify factors that might affect the outcome.

- A **variable** is any factor that can have more than one value.
- The **independent variable** is the factor that you want to test. It is changed by the investigator to observe how it affects a dependent variable.
- The **dependent variable** is the factor you observe or measure during an experiment

When the independent variable is changed, it caused the dependent variable to change.

Controlled Experiment

A controlled experiment has two groups

- The experimental group is used to study how a change in the independent variable changes the dependent variable.
- The control group contains the same factors as the experimental group, but the independent variable is not changed.

Without a control, it is hard to know if your observations result from the variable you are testing or from another factor.

The Iceman's Last journey

In 1991, two hikers discovered the remains of a man in a melting glacier on the border between Austria and Italy.

Controlled experiments were needed to unravel the mystery of who this man was, and where he came from.

Let's begin analyzing this investigation:

Observation: a corpse was found buried in ice in the Tyrolean Alps.

Hypothesis: The corpse is the body of a music professor because he went missing in 1938 and has not been found.

**An ax, bow and quiver, and dagger and sheath were found with the Iceman's body. He was found in a mountain glacier covered in ice and snow, and was well preserved.

Observation: Artifacts suggest the body is much older than the professor would have been.

Revised Hypothesis: the corpse was dead long before 1938 because artifacts appear to date before 1930.

Prediction: If the artifacts date before 1930 and belong to the corpse, then the corpse is not the professor.

Inference: Based on its construction, the ax is at least 4,000 years old.

Prediction: If the ax is 4,000 years old, then the body is also 4,000 years old.

Test Results: Radiocarbon dating showed the man to be 5,300 years old.

Conclusion: The Iceman is about 5,300 years old. He was a seasonal visitor to the high mountains. He died in autumn. When winter came, the body was buried, frozen, and preserved in the snow.

More Observations and Revised Hypothesis

Observation: Plant matter near the body to study – grass on shoe, splinter from longbow, sloe berry fruit, charcoal wrapped in maple leaves, wood in charcoal – some from lower elevations than where body was found

Hypothesis: Iceman had recently been at lower elevations before he died because the plants identified grow only at lower elevations.

Prediction: If the identified plants are found in the digestive tract of the corpse, then he was at a lower elevation just before he died.

Question: What did the Iceman eat the day before he died?

**food will show up as pollen grain in experiment

Experiment to test hypothesis

There is more than one way to test a hypothesis. Scientists might gather and evaluate evidence, collect data and record observations, create a model, or design and perform an experiment. They also might perform a combination of these skills.

Test Plan

- Divide a sample of the digestive tract into 4 pieces
- Examine the pieces under microscope
- Gather data from observations of the pieces and record observations

Procedure and Results

1. Sterilize lab equipment
2. Prepare saline slides
3. View saline slides under electron microscope. Results: no pollen grain
4. Add digestive tract sample to one saline slide
5. View this slide under electron microscope. Results: pollen grain present

Dependent Variable: presence of pollen grain found on slide

Independent Variable: digestive tract sample on slide

Control Group: sterilized slide

Experimental Group: sterilized slide with digestive tract sample

Mapping the Iceman's Journey

Observation: The Iceman's digestive tract contained pollen grains.

Inference: Knowing the rate at which food and other pollen decompose after swallowed, it can be inferred that the Iceman ate items from a lower elevation in the day and a half before he died. The pollen grains also show us that our initial thought of the Iceman dying in autumn is incorrect, as these grains bloom in the spring.

Prediction: The Iceman died in the spring within hours of digesting the pollen grains.

New Conclusion

Scientific investigations may disprove an early hypothesis or conclusion to be revised many times.

Revised conclusion: In spring, the Iceman traveled from high country to the valleys. He was involved in a violent confrontation, climbed the mountain to region of permanent ice, and died of his wounds.

Scientists recognize that their hypothesis can never be proven, only supported or not supported.

With advances in technology, scientists are able to more thoroughly investigate mysteries of nature.