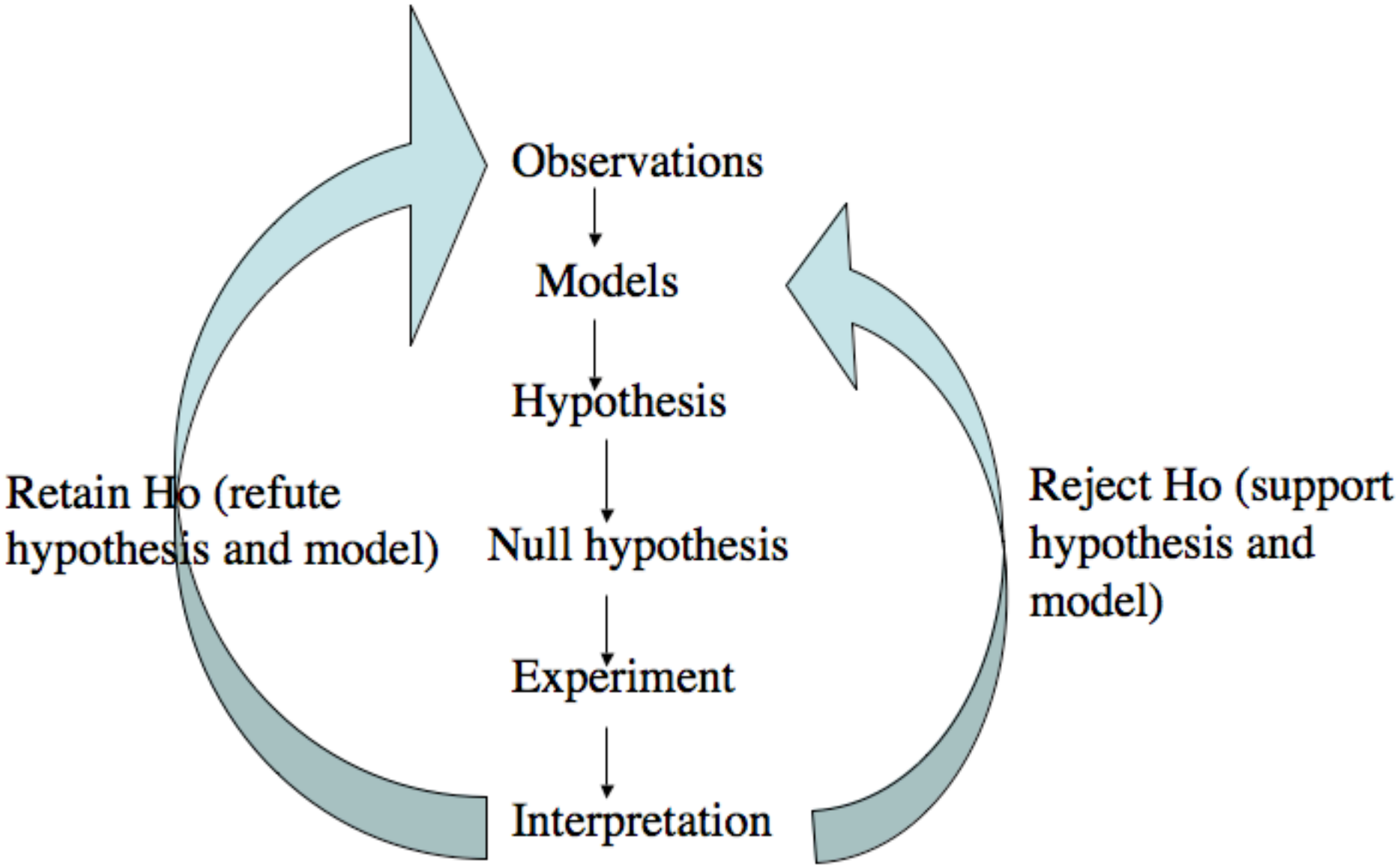
The Scientific Method



What is an observation?

- A persistent pattern observed in nature
  - It can vary in time and space

What is a model?

- It is a theory explaining a pattern

What is a hypothesis?

- Predictions based on model (verbal or quantitative)

Why use a null hypothesis?

- A null hypothesis is logical opposite to hypothesis
  - To prove a hypothesis (a true prediction) requires every possible observation to be available.
    - Not practical or possible. Instead use falsificationist procedure
      - If null hypothesis is rejected then hypothesis is correct

What is an experiment?

- Critical test of null hypothesis
  - Experiments can be mensurative or manipulative

Experimental design

- Response variable: measures an outcome of interest
- Explanatory variable: variable used to explain outcome
- Extraneous variables: variables that may affect the results but that are not of direct interest
- Experimental units: smallest units to which treatments are assigned
- Experimental treatments: manipulation of conditions to test explanatory variable
- Control treatments: manipulation of conditions to control effect of extraneous variables

Example 1. Observations

- In spite of a large variety of potential herbivores, only a small proportion of the leaf area of a forest is consumed during growing season
- Birds eat insects

Example 1. Model (choose one from below)

1. Bird predation on insect herbivores reduces the amount of leaf area consumed by herbivores

2. Competition between birds and insects reduces the amount of leaf area consumed by herbivores

Example 1. Correct Model

1. Bird predation on insect herbivores reduces the amount of leaf area consumed by herbivores

2. Competition between birds and insects reduces the amount of leaf area consumed by herbivores

Example 1. Hypothesis (choose one from below)

1. If birds are excluded from foliage the numbers of insects and the amount of leaf area missing will increase

2. If birds have free access to foliage the numbers of insects and the amount of leaf area missing will decrease

Example 1. Correct Hypothesis

1. If birds are excluded from foliage the numbers of insects and the amount of leaf area missing will increase

2. If birds have free access to foliage the numbers of insects and the amount of leaf area missing will decrease

Example 1. Null hypothesis (choose one from below)

1. If birds are excluded from foliage the numbers of insects and the amount of leaf area missing will stay the same or decrease

2. If birds are excluded from foliage the numbers of insects and the amount of leaf area missing will increase

Example 1. Correct Null hypothesis

1. If birds are excluded from foliage the numbers of insects and the amount of leaf area missing will stay the same or decrease

2. If birds are excluded from foliage the numbers of insects and the amount of leaf area missing will increase

Design the experiment!

Hint below:

Example 1. Experimental design

- Experimental treatment: Exclude birds from trees by constructing bird-proof cages that allow insects to pass freely
- Control treatment 1: Obtain data for trees without exclusion cages paired w/experimental trees to account for spatial and temporal variation
- Control treatment 2: Enclose some trees within incomplete cages that allow birds access to the foliage, because the exclusion cages might have other effects on the foliage

Example 1. Results

- Researchers found that when birds were excluded, the numbers of insects recorded on foliage increased by 70%, and the percentage of leaf area missing at end of growing season increased from 22 – 35%

Interpretation

- Null hypothesis is rejected, hypothesis and model accepted
- Avian predators reduce abundance of insect herbivores as well as damage caused by herbivores to trees