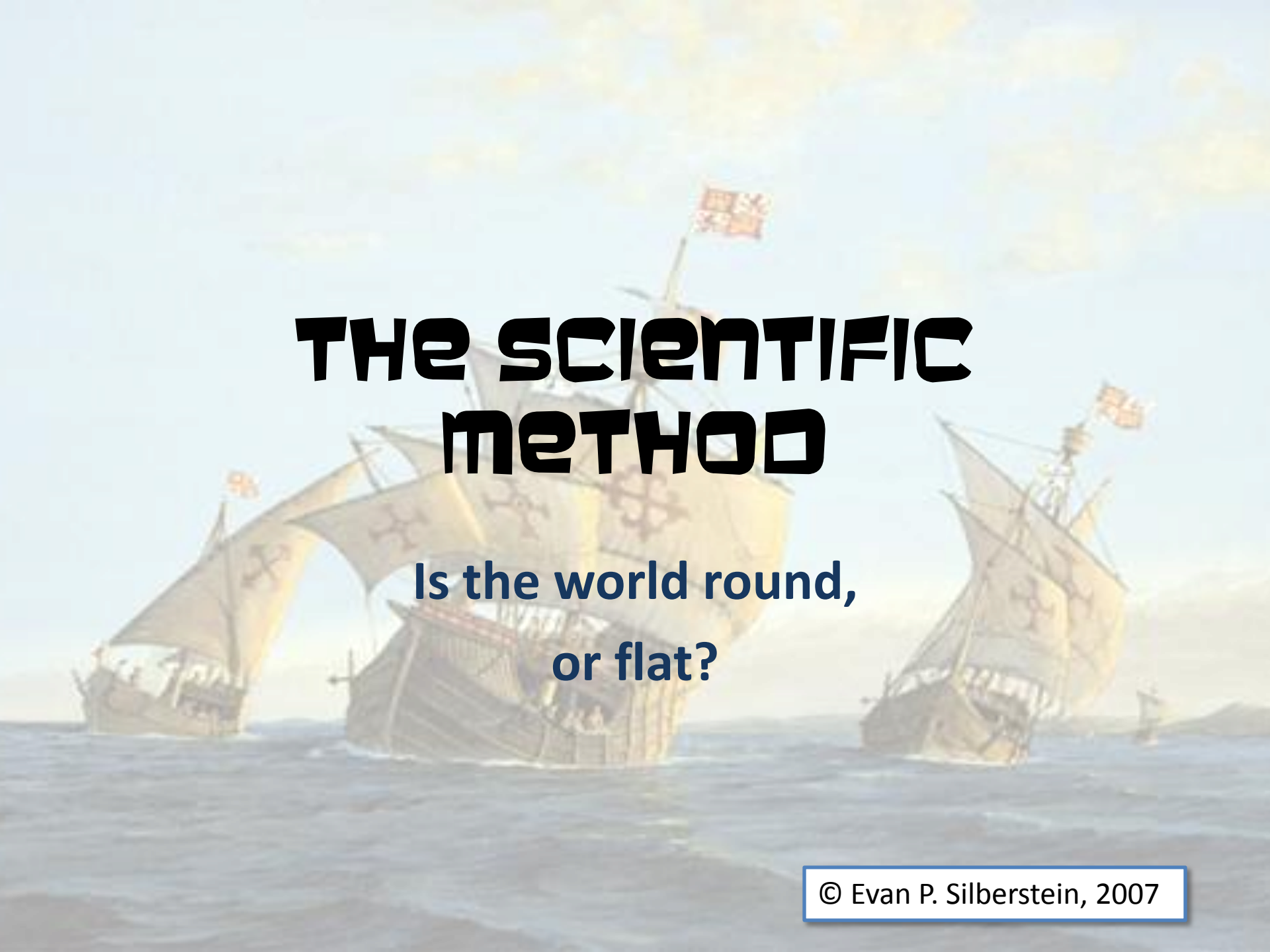


The Scientific Method

Is the world round, or flat?

Observations

It seems flat …

- When you walk, you don't feel like a circus elephant on a ball.

It seems round ..

- When a ship disappears over the horizon, it disappears bottom first.

Scientific Method: Step 1

Step 1: State the Problem

- Observations lead to questions.
- Questions about the world around us are the starting point of scientific investigation.

Step 1: What is the shape of the world?

- Why do ships disappear bottom first as they go over the horizon?
- Could the world be round?

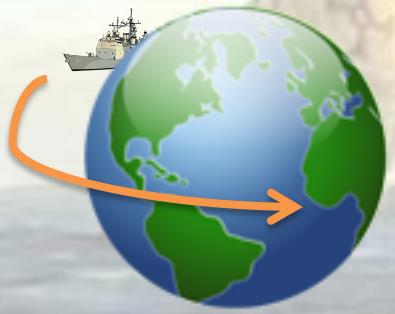
Scientific Method: Step 2

Step 2: Form a hypothesis

- Hypothesis = educated guess, *or* prediction
- Prediction stated in such a way that it is testable
- If …, then statement

Step 2: Shape of the World

- **If** the world is round, **then** it is possible to sail around the world in one direction and return to the starting point.



Scientific Method: Step 3

Step 3: Experiment

- Experiment = Test of a hypothesis
- A properly phrased hypothesis can be tried out!

Step 3: Shape of the World

- The hypothesis: **If** the world is round, **then** it is possible to sail around the world in one direction and return to the starting point.
- The experiment: Attempt to sail around the world.

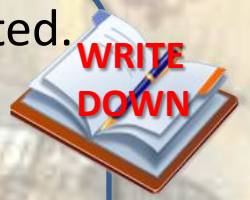
Scientific Method: Step 4

Step 4: Conclusion

- The experiment is a test of a hypothesis, so there are only two possible conclusions:
  - The hypothesis is supported.

  or

  - The hypothesis is ***not*** supported.



Step 4: Shape of the World

- Magellan's crew successfully sailed around the world by heading west during the years 1519 to 1522

- It ***<u>is</u>*** possible to sail around the world.
  - The hypothesis is supported.

Scientific Method

Summary

Step 1: State the Problem

Step 2: Form a Hypothesis

Step 3: Experiment

Step 4: Conclusion

Scientific Method Refined

Keeping an eye on variables

- A researcher gave some 11 year old boys a dietary supplement to speed their growth.
  - A year later, they were a lot taller.

  - The researcher concluded the supplement sped their growth. Is that right?
- No!! The growth could be due just to getting older.
  - It's necessary to control variables in an experiment
  - Control = standard for comparison
    - Compare boys who received the supplement to boys who didn't.

Reproducibility

- In 1989, Stanley Pons and Martin Fleischmann claimed they discovered cold fusion.
  - Fusion is the process that powers the sun.
  - Normally it occurs only at very high temperatures.

  - If it could be done at low temperatures it could provide cheap energy for us all.
- Unfortunately Pons' and Fleischmann's experiment could not be reproduced by others.
- Experimental results must be reproducible in order to be accepted.