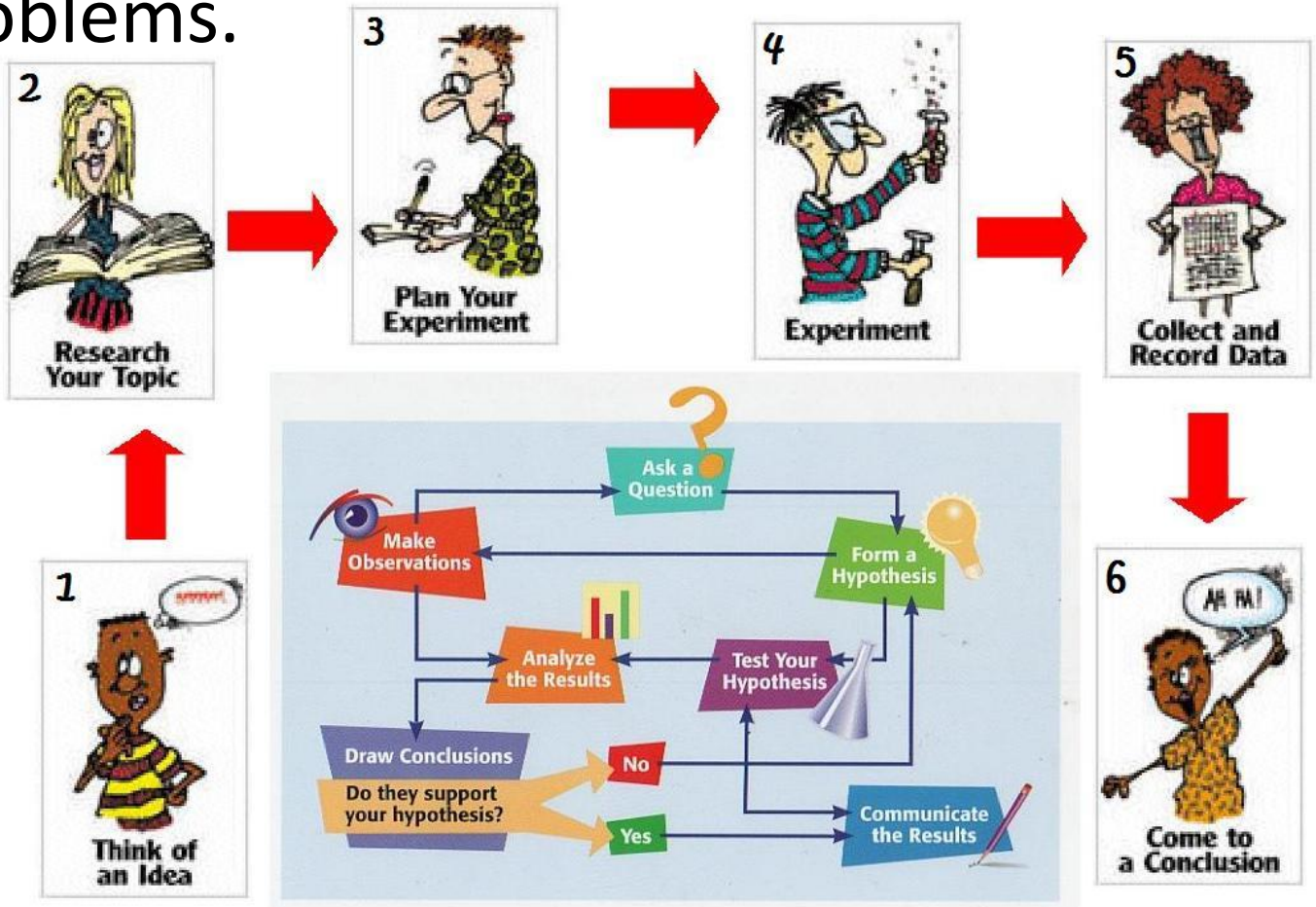
The Scientific Method:

Learning Targets

- Identify the difference between an observation and an inference.
- Identify the components of a controlled experiment
- Differentiate between the independent and dependent variable
- Write a hypothesis that includes an independent variable, dependent variable, and prediction.

The Scientific Method:

- A logical, organized method for solving problems.



Steps of the Scientific Method:

1. Observation
2. Problem Identification
3. Hypothesis
4. Experiment
5. Data Collection
6. Conclusion

Observation:

- **Observation**: the act of noticing and describing what is happening in an orderly way.
  - Sight, smell, touch, hearing, and taste.
  - Observations often lead to new questions.

Types of Observations:

- **Qualitative**: descriptive, usually describes things that can not be counted.
    - Example: The leaf color was brown.

- **Quantitative**: measured, often uses a number.
    - Example: The plant was 16 cm tall.

Inferences:

- **Inference**: a logical interpretation based on prior knowledge and experience.
  - May change with new observations.
  - Inferences involve combining information from other sources with observations to make a logical conclusion.
  - "Inferring".

Let's Practice:

Observation: The grass outside is wet.

What are some possible inferences:

- It rained.
- The sprinklers were on.
- There is dew on the grass from the morning.

Let's Practice:

Observation: The school's fire alarm is going off.

What are some possible inferences:

- The school is on fire.
- We are having a fire drill.
- A student pulled the fire alarm.

Hypothesis:

- **A *testable* statement that includes a prediction.**
  - An “educated guess”.
  - Could be a possible solution to the problem.

“If……Then….”

Variables:

- **Independent**: the factor that is manipulated.
  - Ask yourself: *What did we do?*
  - This is the variable in the experiment that you control.
- **Dependent**: the measurement that is taken of the data that is collected in the experiment.
  - Ask yourself: *What did we measure?*.

Experiment:

- Testing the hypothesis.
- A detailed plan
- Must be ***controlled*** using 2 variable (everything else in the experiment stays the same)
    - Dependent Variable
    - Independent Variable

Experiment:

- **Experimental Group**: the test condition is changed.
    - The experimental group should have lots of replicates/trials.
    - Tests the independent variable.
- **Control Group**: the group that is exposed to the same conditions as the experimental group except for one independent variable.
    - Used to compare with the experimental group.
    - All “normal” conditions exist
    - Basically like a second experiment where nothing is varied/changed.

Conclusion:

- Relate your results and back to your hypothesis.
- Discuss experimental error.
- Raise additional problems/questions for future experiments.

Conclusion:

- Does my experiment SUPPORT my hypothesis?
  - YES!
    - The hypothesis is not proven, it is supported
      - Your hypothesis will never be “wrong” or “correct”
    - A **Theory** is a well-tested explanation that unifies a broad range of observations and hypotheses, and enables scientists to make accurate perditions about new situations.
  - NO….
    - Retest
    - What did you learn
    - How can you revise your hypothesis?

What criteria do ALL good experiments have?:

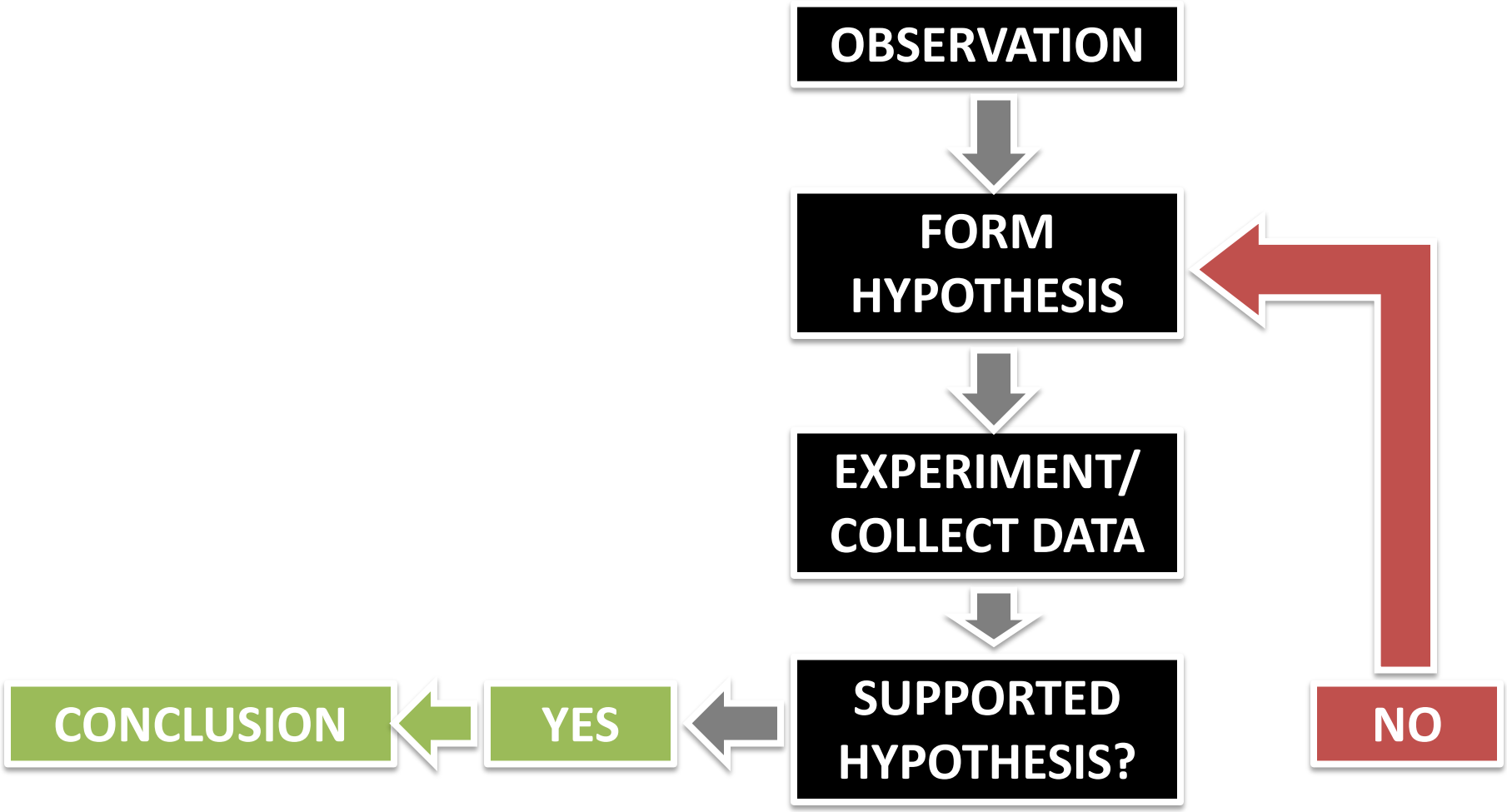
1. Only one variable is being tested at a time.

2. There is a control group maintaining “normal” conditions as a basis for comparison.

3. Includes a sufficient number of test cases.

4. Uses accurate measurements.

5. Collects relevant data.


OBSERVATION
FORM HYPOTHESIS
EXPERIMENT/ COLLECT DATA
SUPPORTED HYPOTHESIS?
NO
YES
CONCLUSION

A biologist wondered whether caffeine had an effect on resting heart rate over the course of 6 weeks. Describe how the experiment should be set up according to the scientific method. Be sure to include a hypothesis in correct format and identify the dependent and independent variables.