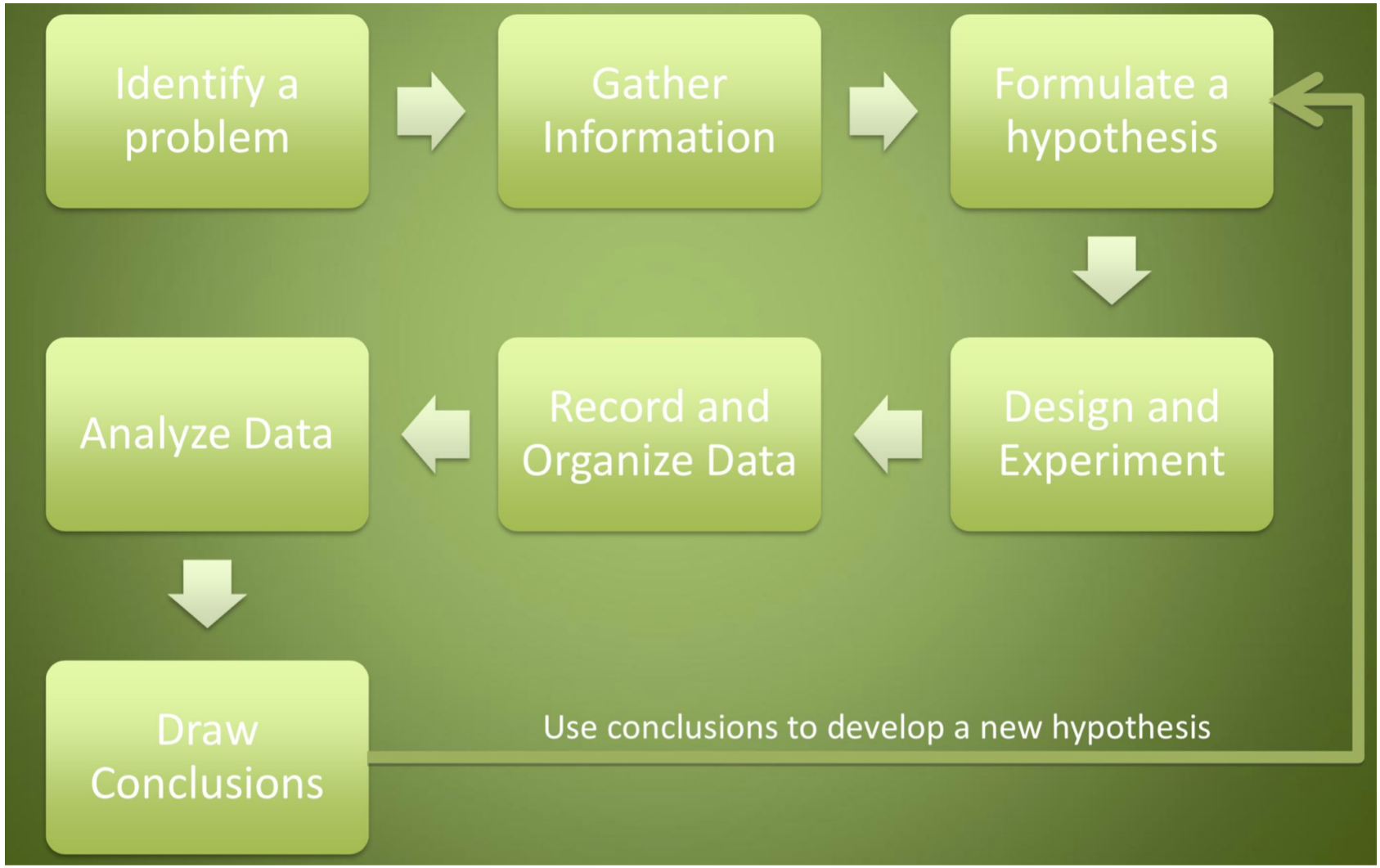
Scientific Method


Identify a problem
Gather Information
Formulate a hypothesis
Design and Experiment
Record and Organize Data
Analyze Data
Draw Conclusions
Use conclusions to develop a new hypothesis

Step 1: Identify the Problem

Observation

- Uses our **senses** to gather information
- **Qualitative**: uses our 5 senses
  - The termites follow a circle made with a blue pen on white paper
- Quantitative: uses **number**s
  - 3 termites follow a circular blue pen line that is 5 cm in diameter

Inference

- A logical interpretation of events based on prior **knowledge** or **opinion**
  - Educated guess
- Termites follow the blue line because the like it.

Do we use observations or inferences when identifying a problem?

Step 2: Gather Information

- Use references to do background research
  - Books
  - Journals
  - Magazines
  - Internet
  - TV
  - Videos
  - Interview Experts

- Example: Termites
  - Live underground
  - Don't have compound eyes (can only see light and dark)

Step 3: Form a Hypothesis

Hypothesis

- Possible answer to a question that can be tested
- based on **observations** and knowledge
- "If" "Then" "Because" statement

Example: Termites

- Termites:
  - I hypothesis that ***if*** the termites follow a dark colored pen on a dark background ***then*** they follow the dark pen on a light background ***because*** of the color contrast since they see light and dark, but not color.

Do we use observation or inference to formulate a hypothesis?

Step 4: Design an Experiment

Materials:

- **A list of all the things you need**
- Supplies

Procedure

- Step by step instructions
- Identifies the variables used in the experiment

Variables

Independent Variable- what is changed or manipulated in the experiment

Ex: Color of the pens, The color of the paper, The brand of pens

Dependent Variable- What is being measured in the experiment

Changes because of the independent variable

Ex: Do the termites follow the wall (yes/no)

How many termites follow the line (a number)

How long do the termites follow the line (time)

Constant

- All the factors in the experiments that are kept the **same**
- Everything except the independent variable
- Keeps the experiment 'fair'

Examples:

- If you test color of paper, keep the color of pen constant
- If you test the smell of pen, keep the color and type of pen constant (only change smell)
- The exact termites used
- The time of day and how long the termites are there
- The shape of the line drawn

Control

- The normal condition that you compare the other conditions to
- Recreate the conditions you first observed
- Example:
  - Termites in a Pitri dish on white filter paper and draw a blue line with a bic pen in the same shape as before.

Step 5: Record and Organize Data

- Write all observations and measurements
- Use a table to organize your data
  - List your **independent** variable on the left side
  - Record your dependent variables on the **right side**
    - If you have more than one dependent variable, use a new column for each dependent variable

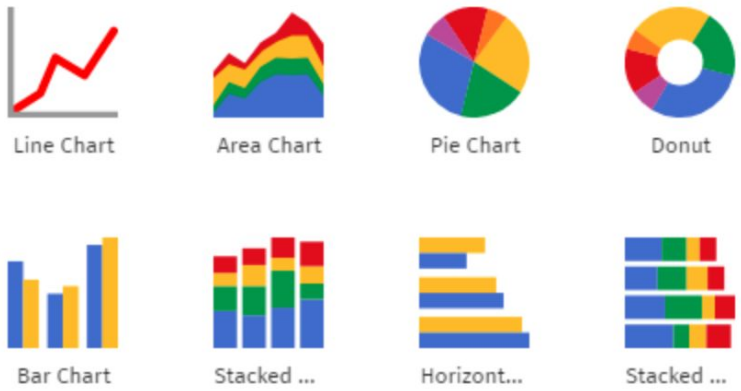
Independent Variable	Dependent Variable: Did they follow the line?
Blue ink on white paper	Yes/No
Blue ink on black paper	Yes/No

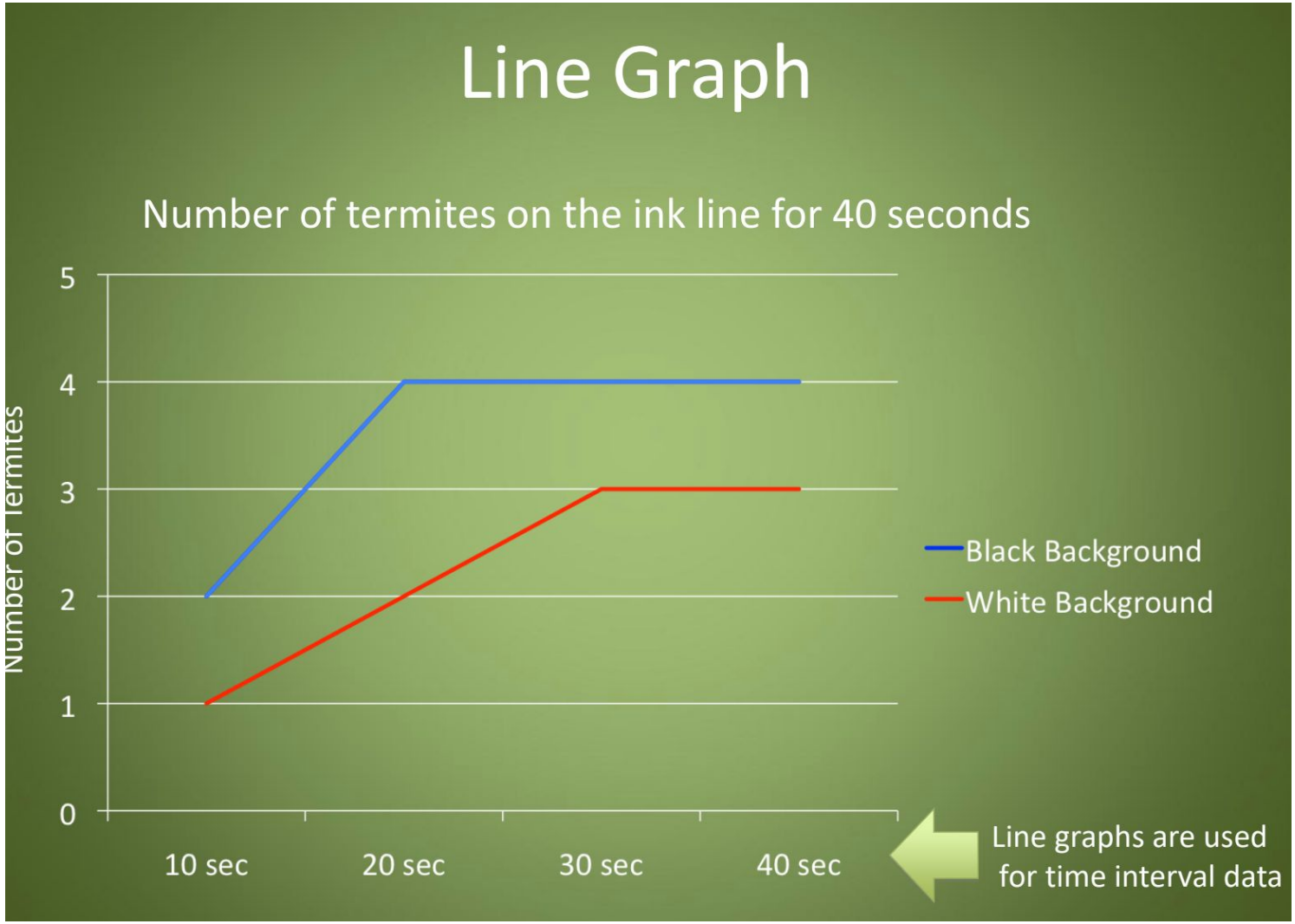
Which one of these independent variables is the control?

Which part of the independent variable is the constant?

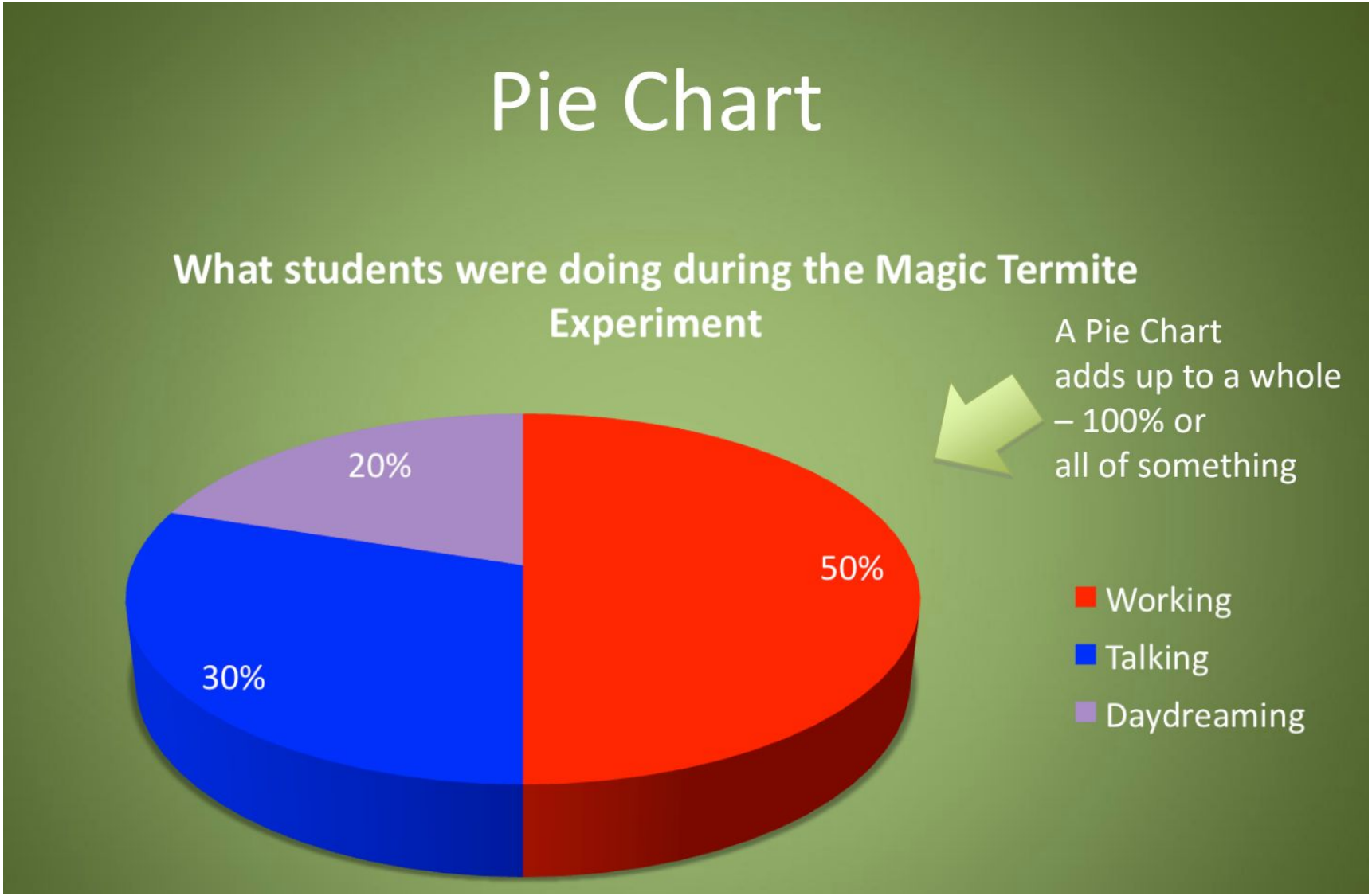
Step 6: Analyze Data

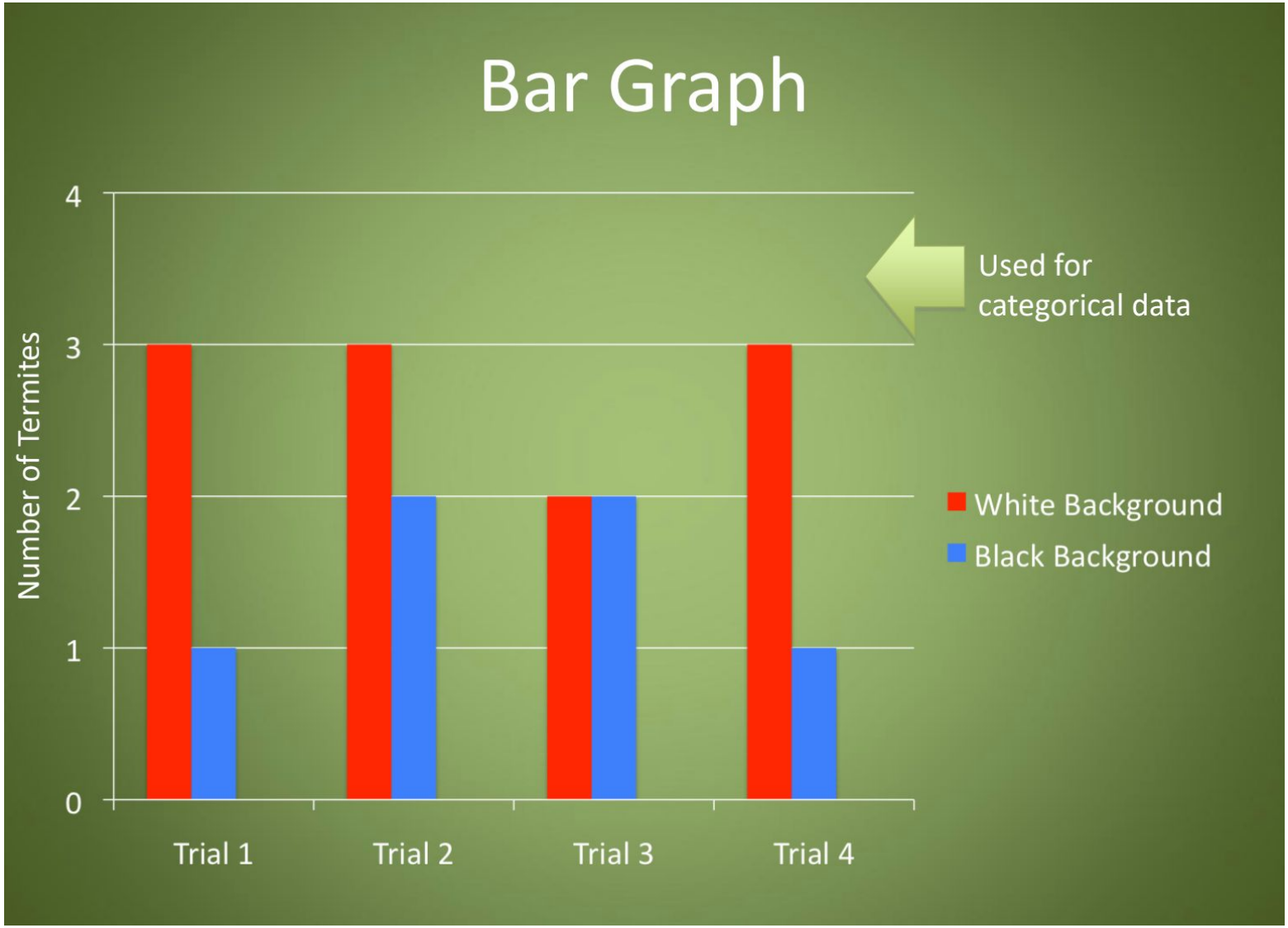
- “A picture is worth a thousand words”
- Compare and look for trends and patterns using graphs




Line Graph
Number of termites on the ink line for 40 seconds
Number of Termites
5
4
3
2
1
0
10 sec
20 sec
30 sec
40 sec
Black Background
White Background
Line graphs are used for time interval data

Pie Chart


What students were doing during the Magic Termite Experiment
A Pie Chart adds up to a whole – 100% or all of something
20%
50%
30%
Working
Talking
Daydreaming


Bar Graph
Number of Termites
4
3
2
1
0
Trial 1
Trial 2
Trial 3
Trial 4
Used for categorical data
White Background
Black Background

Step 7: Draw Conclusions and communicate your results

- You must repeat the experiment to confirm that the data is valid
- You need to publish your results. (usually in a paper submitted to a journal or other publication)
- Your work will then be peer reviewed (looked at by other scientists)