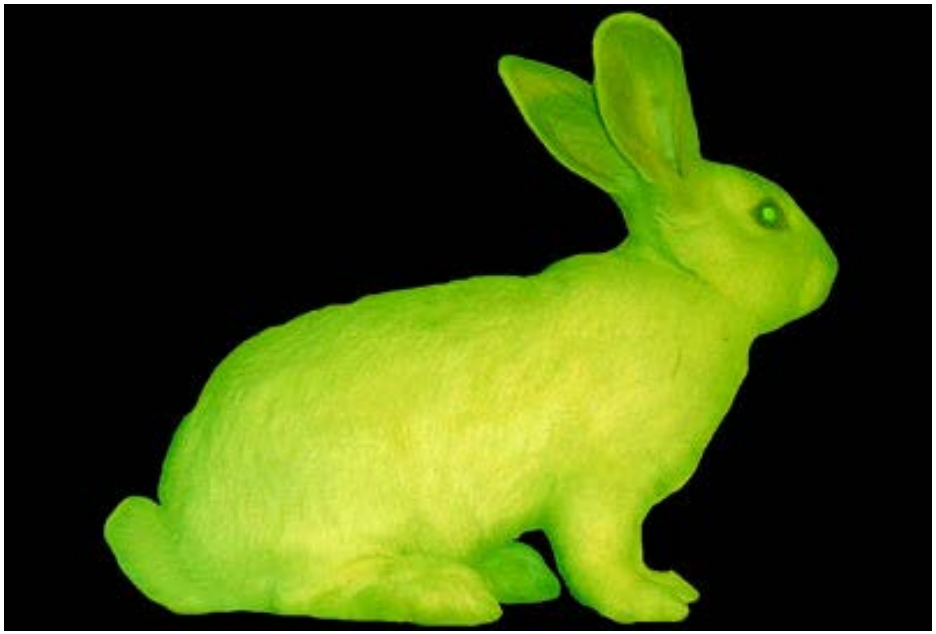
Chapter 1

Scientific Method
Experimentation
Characteristics of Life
Tools of Science

Why scientific Method?

- Organized
- Used to investigate the natural world
- Universal: used by all scientists- if you want to be legitimate
- Constantly changing our scientific knowledge



Steps

1. Observation (Ask a question) use 5 senses
2. Hypothesis – Use If…. Then… statements
   - Educated prediction of outcome
   - Specific/ limiting to one variable
3. Test with **Experiment**
4. Collect **Data**
5. Analyze Results + draw conclusions
6. Report Results (if hypothesis is true)
   - If wrong rework hypothesis
   - Publish is a scientific journal (science, nature, etc)

Scientific Results

- Using the scientific method assumes that science is …
  - Logical
  - Backed up with evidence
  - Follows the laws of the natural world
    - Life has a natural explanation

Test with **Experiment**

- Make it a controlled experiment
  - Use two groups – differ by a variable (one factor)
    - Control group
    - Experimental group
- Variable
  - Manipulated variable (the one thing the scientist changes).
  - Responding variable (the change that is caused in the experiment).

Example

- What is the manipulated and responding variable? Which group is the control and which is the experimental group?

A	A	B	B
Percent of Fertilizer used	Root length of Plant After 5 days	Percent of Fertilizer used	Root length of plant After 5 days
0%	1cm	10%	5 cm
0%	1cm	20%	22 cm
0%	1cm	50%	15 cm
0%	1cm	70%	2 cm

Collect Data

- Data comes in two forms
  - Quantitative data – numbers
  - Qualitative data – description

  Which of the data shows quantitative and which shows qualitative data?

% Fertilizer Used	Growth in 5 days	Health of the Plant
0%	2cm	Leaves small, greenish yellow
5%	5cm	Leaves small and green
10%	15cm	Leaves large and bright green
15%	4cm	Leaves small, stunted and yellow

Characteristics of Life

- LIVING THINGS ARE
  - Made up of cells
  - Reproduce
  - Based on universal genetic code
  - Grow and develop
  - Obtain and use material and energy

Characteristics of Life

- LIVING THINGS ARE
  - Respond to their environment
  - Maintain homeostasis (stable internal environment)
  - As a group change over time

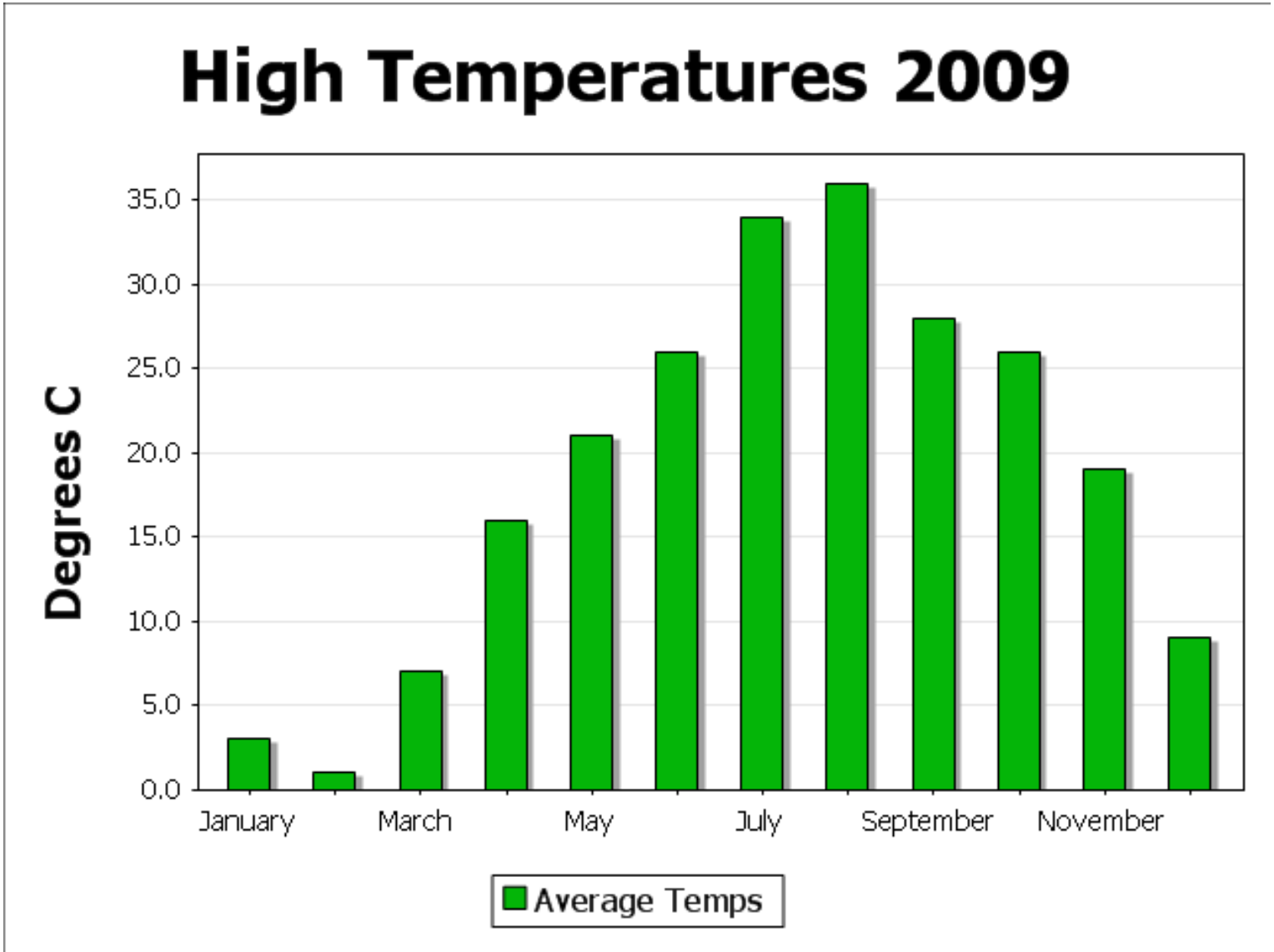
Graphing

- Line Graph
  - Shows relationship between 2 variables
  - Uses 1 or more lines
    - If using more than one line on the graph make sure to use a different color or line style
  - Horizontal axis = independent (manipulated) var.
    - Time, Temperature, % fertilizer used
  - Vertical axis = dependent (Responding) var.
    - RBC level, growth in cm, breathing rate

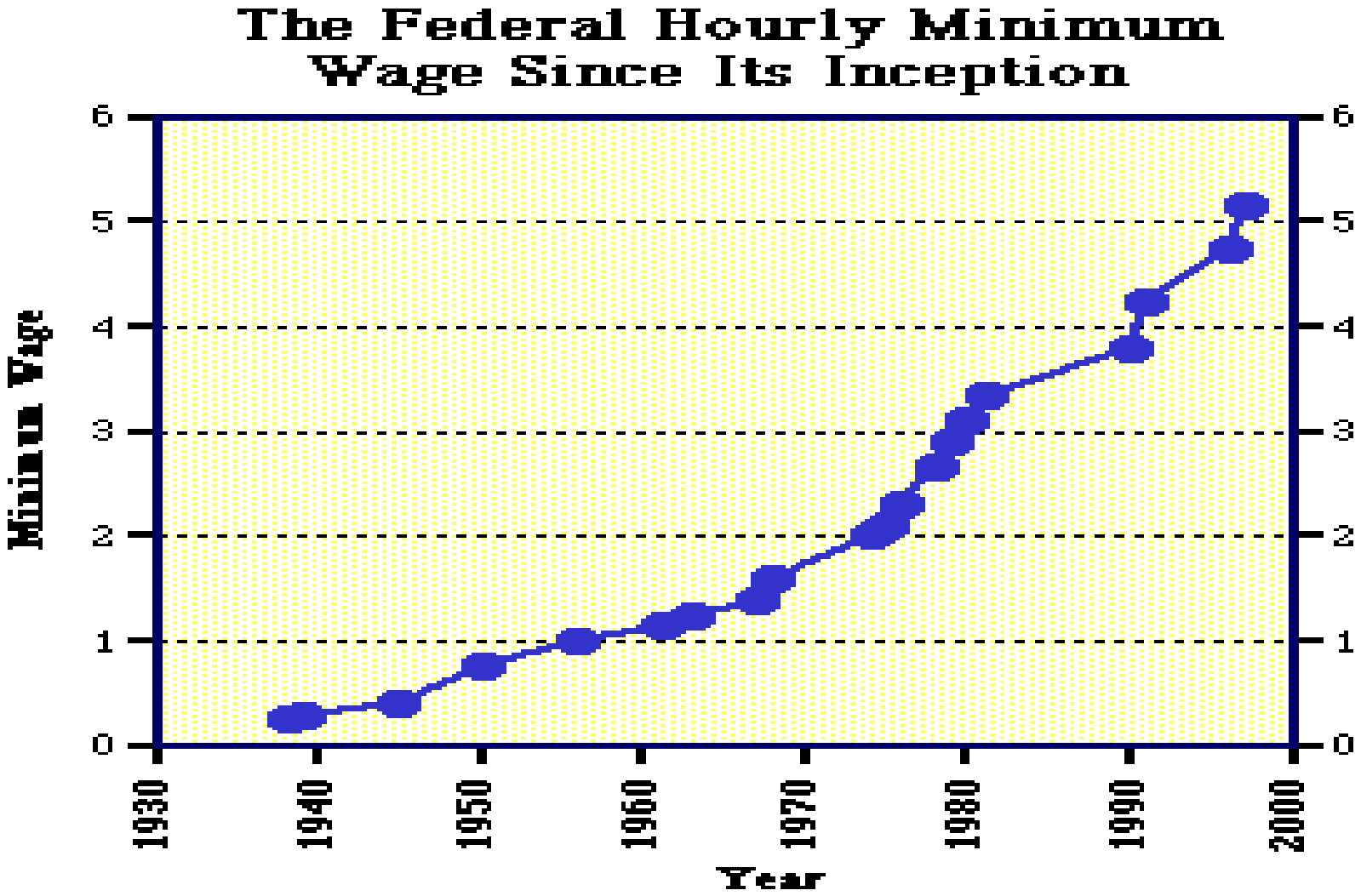
Graphing

- Bar Graph
  - Shows relationships between variables
  - X axis sometimes has labels instead of numbers
    - Seasons, bird species, color, month

Why was a bar graph used?



When did minimum wage increase the most?



Graphing

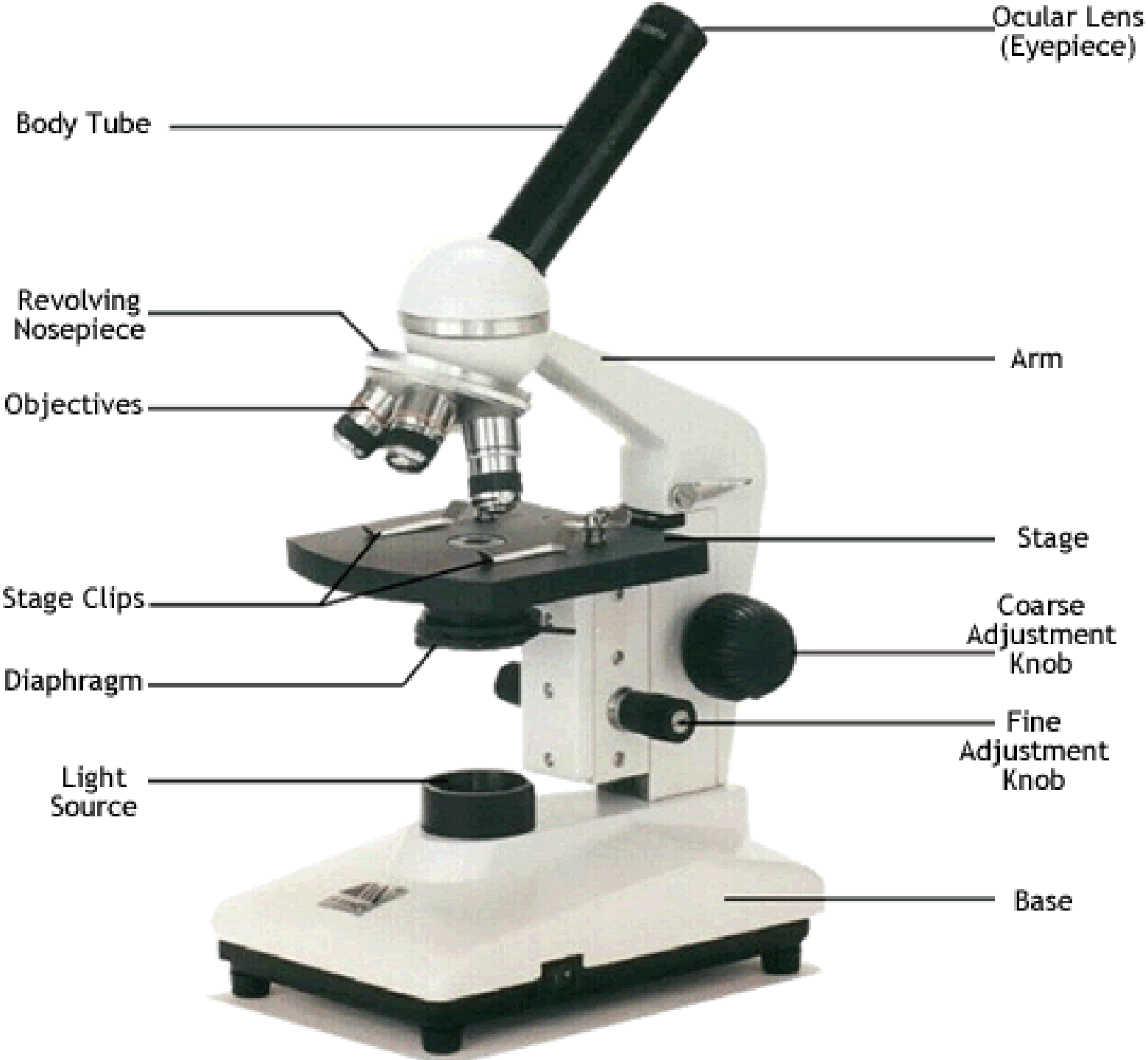
- Scale
  - Always make the graph as big as possible
  - Use the number scale that is consistent
    - 1,3,5,7 etc…
    - 5, 10, 15, 20 etc…
    - 100, 200, 300, 400 etc…
  - Never jump around with the number scale on the x-axis (never 1,2,4,5,7,12 etc….)
- Always title and label your axis with units
- A steep curve indicates a rapid change, while a flat (more horizontal) curve indicates slow change

Microscope

- Total Magnification – always put under your image drawing
  - Multiply the ocular X objective magnification
  - Ocular is always 10
  - Objective is 4, 10, or 40
- Wet mount
  - Put specimen in the middle of the slide, add a drop of liquid, place the cover slip on at an angle

How to focus an image

1. Put slide on stage
2. Center specimen over light hole and under objective lenses
3. Start on low power (shortest lens)
4. Put the stage all the way up
5. While looking into ocular lower the objective using the course adjustment knob
6. Use the fine tune knob to clarify when object is found
7. Switch to next power and only use the fine tune knob and re-center


Ocular Lens
(Eyepiece)
Body Tube
Revolving
Nosepiece
Arm
Objectives
Stage
Stage Clips
Coarse
Adjustment
Knob
Diaphragm
Fine
Adjustment
Knob
Light
Source
Base