

The Living Book of **Biology**

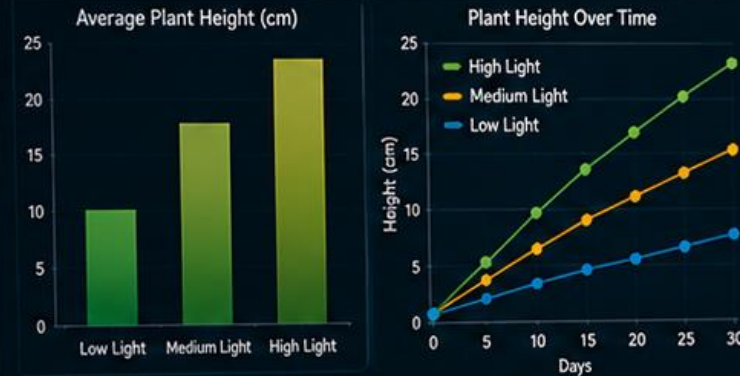


INTRODUCTION TO BIOLOGY

LESSON 5: DATA ANALYSIS AND GRAPHING

HOW DO SCIENTISTS TURN NUMBERS INTO DISCOVERIES?

Plant Growth Experiment
Effect of Light on Plant Height



DATA ANALYSIS

1. Collect Data
2. Organize Data
3. Graph the Data
4. Analyze Patterns
5. Draw Conclusions



1

Different Types of Biological Data



Quantitative



Qualitative



Measurements



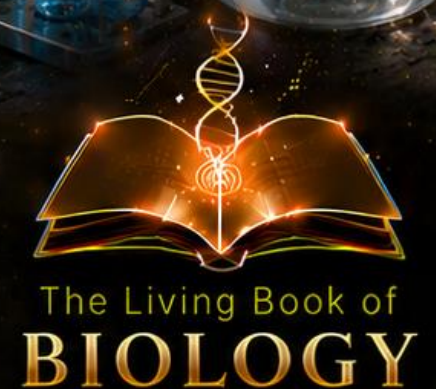
Categorical



Environmental



Behavioral



2

Organizing and Summarizing Data



Tables



Spreadsheets



Averages



Ranges



Percentages



Rates



Day	Temp (°C)	Mass (g)	Height (cm)
1	20.1	2.31	3.2
2	20.3	2.58	3.9
3	20.4	2.85	4.6
4	20.6	3.16	5.3
5	20.7	3.48	6.1
6	20.8	3.85	6.8
7	21.0	4.21	7.5

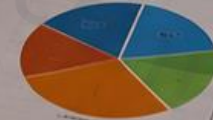
Calculations

$$\text{Average Mass} = \frac{\sum x}{n} = \frac{22.44}{7} = 3.21 \text{ g}$$

$$\text{Average Height} = \frac{37.4}{7} = 5.3 \text{ cm}$$

$$\text{Range} = \text{Max} - \text{Min} = 4.21 - 1.90 = 2.31 \text{ g}$$

DATA SUMMARY



Category	Percent (%)
Type A	40.0
Type B	30.0
Type C	20.0
Type D	10.0

Total = 100%

Summary

Average Temperature: 20.6 °C

Average Mass: 3.21 g

Average Height: 5.3 cm

Range (Mass): 1.90 - 4.21 g

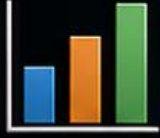
Growth Rate: 0.72 cm/day



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3

Choosing the Right Graph



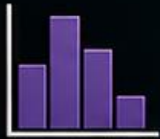
Bar Graph
Compare



Line Graph
Change over time



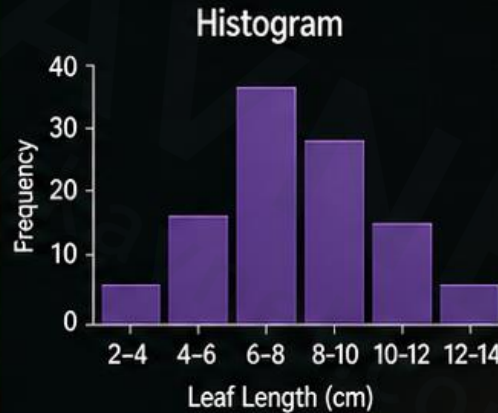
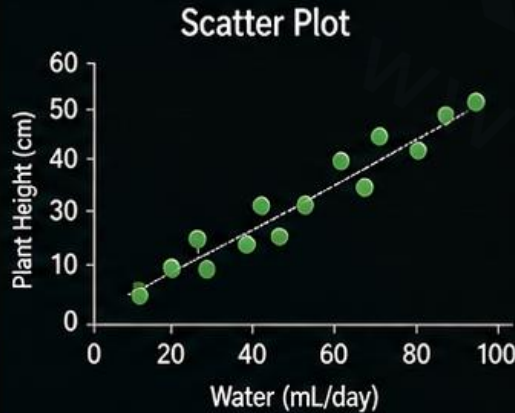
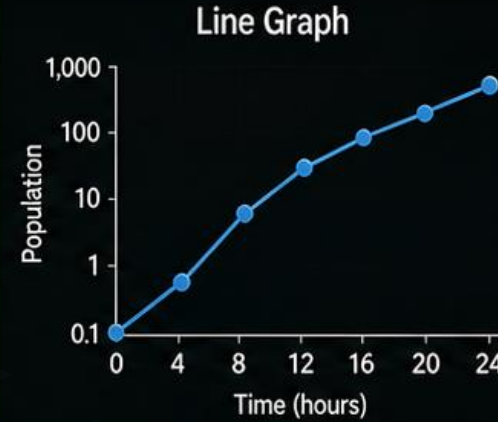
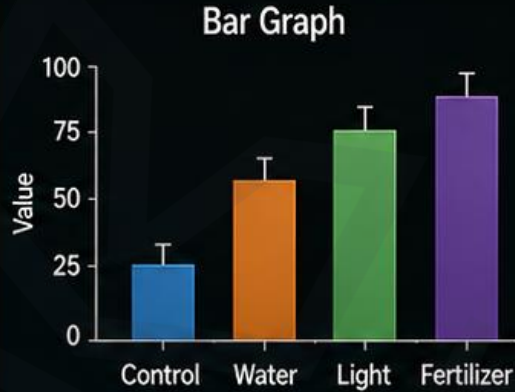
Scatter Plot
Relationship



Histogram
Distribution



Label Clearly
Titles, axes,
units



Choose the graph that matches your question.



Graphing Checklist

- ☒ Title
- ☒ Axis labels
- ☒ Units
- ☒ Appropriate graph
- ☒ Legend (if needed)

Graph Types Guide



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4

Recognizing Patterns and Variation



Patterns help us
Variation is natural



Trends



Clusters



Differences



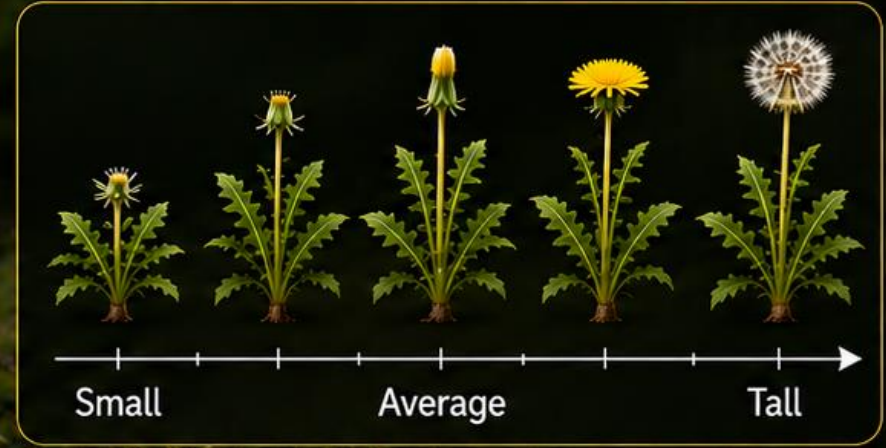
Outliers



Variation



Variation in a Population

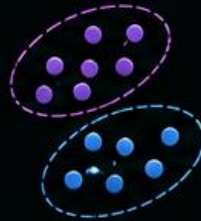


Trend Over Time



Change over time.

Clusters



Groups of similar
points.

Differences
Between Groups



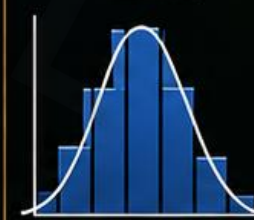
Groups are
different.

Outlier



An unusual
value.

Variation Within
a Group



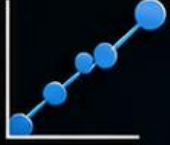
Values are spread
out.



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5

Correlation Is Not Always Causation



Variables
change together



Not always
cause



Other factors
may explain



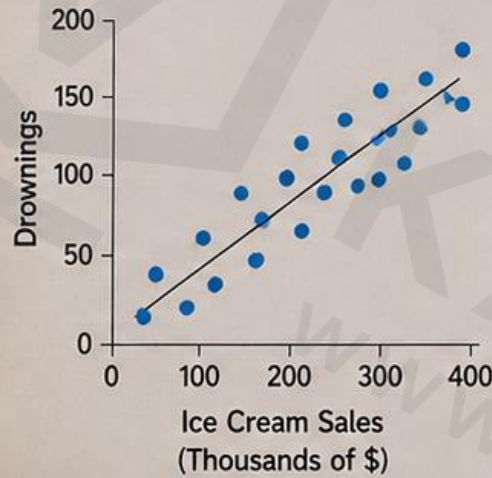
Need
evidence



Think before
concluding

CORRELATION

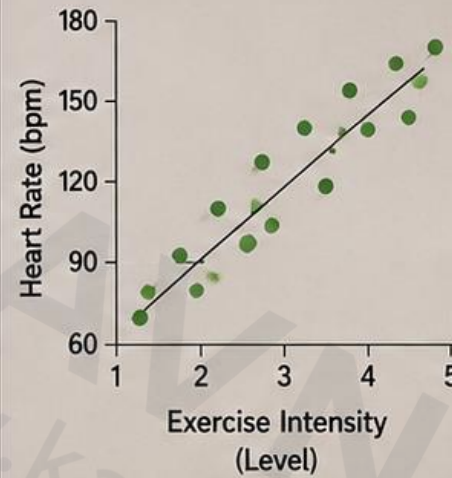
Ice cream sales and
drowning increase together.



Not caused.

CAUSATION

Exercise causes an increase
in heart rate.



Caused.

Ask:

- ☒ Third factor?
- ☒ Controlled?
- ☒ Evidence?

Question

↓
Evidence

↓
Conclusion



Correlation does not mean causation.



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6

Communicating Uncertainty Honestly



Report
Uncertainty



Show
Variation



State
Support



Acknowledge
Limitations



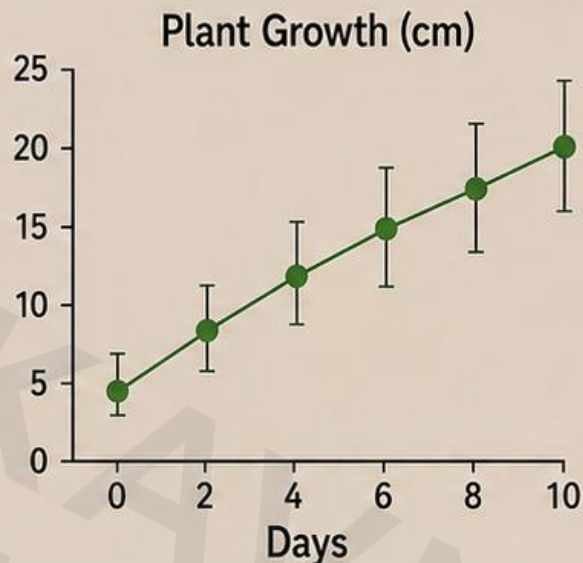
Leave
Questions

✓ Compare

✓ Explain

✓ Note
limits

✓ Identify
unknowns



✓ Supported



✗ Not
Supported



⚠ Limitations



? Questions



Be honest.
Match conclusions to evidence.



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Summary



1. Collect

Different types of data.



2. Organize

Summarize and describe.



3. Graph

Choose the right graph.



4. Interpret

Find patterns and variation.



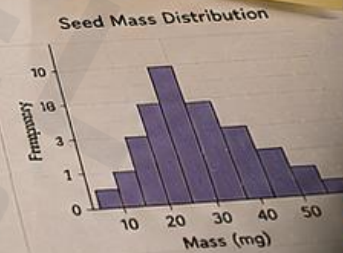
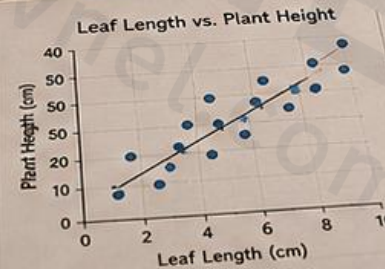
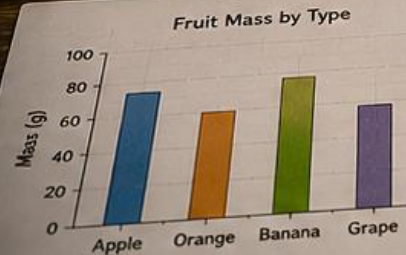
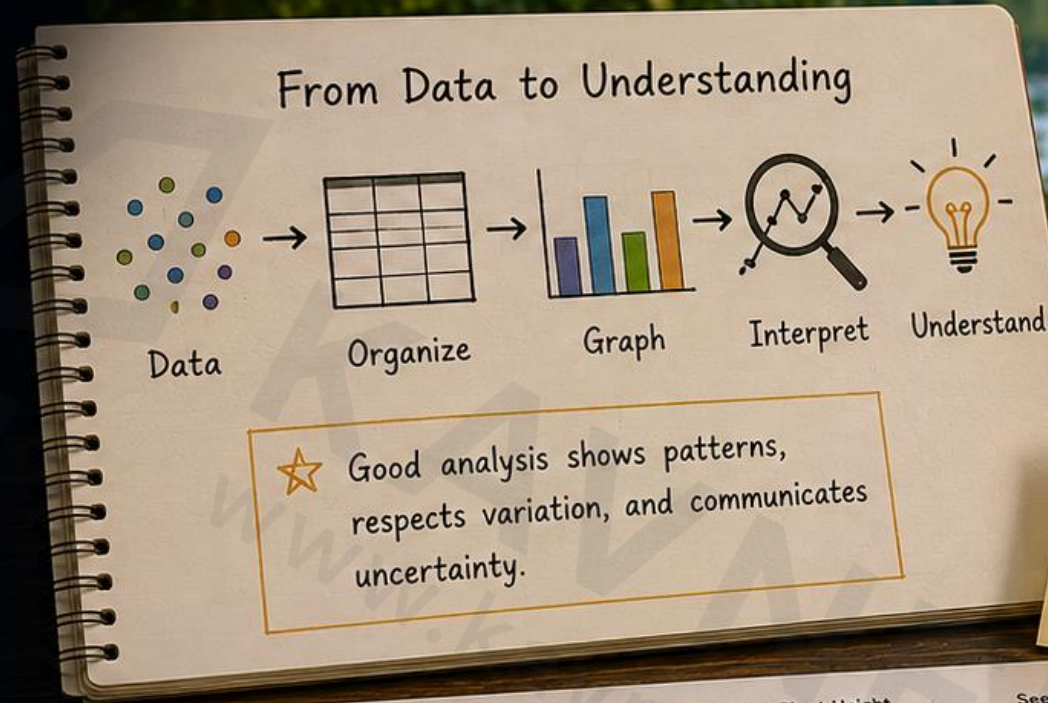
5. Be Cautious

Correlation $\neq$ causation.



6. Be Honest

Report uncertainty.



Strong conclusions come from strong evidence.



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