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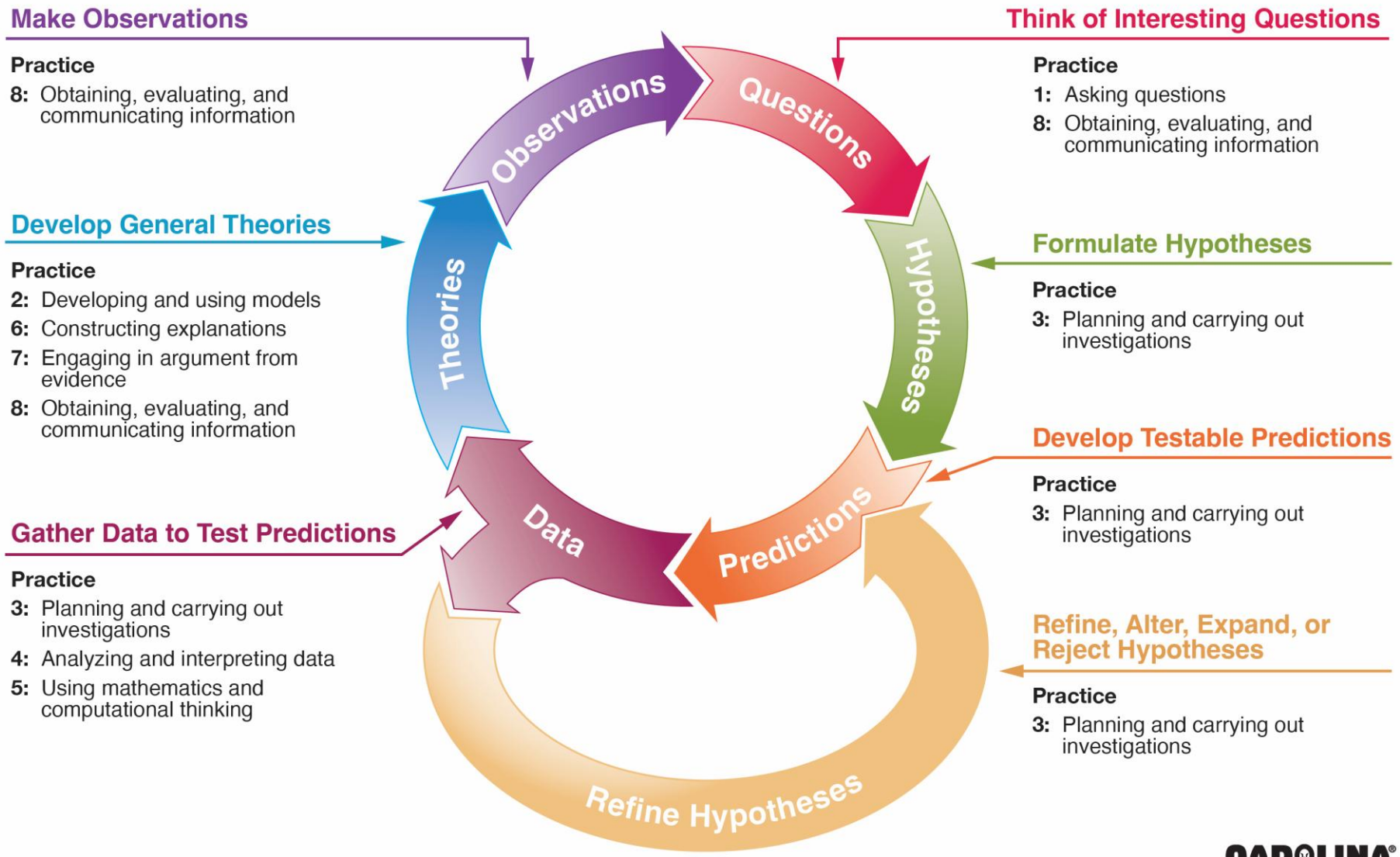
UNLEASH LEARNING™

Cultivating Inquiry: Using Wisconsin Fast Plants® to Teach Experimental Design and Inspire Independent Student Research

Science Practices



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Experimental Design

Use the following flow chart as you work through the experimental design process.

At any point, you may make an observation or collect data that leads you to a new question. This may cause you to start over at the beginning of the process, either before or after finishing your first experiment.

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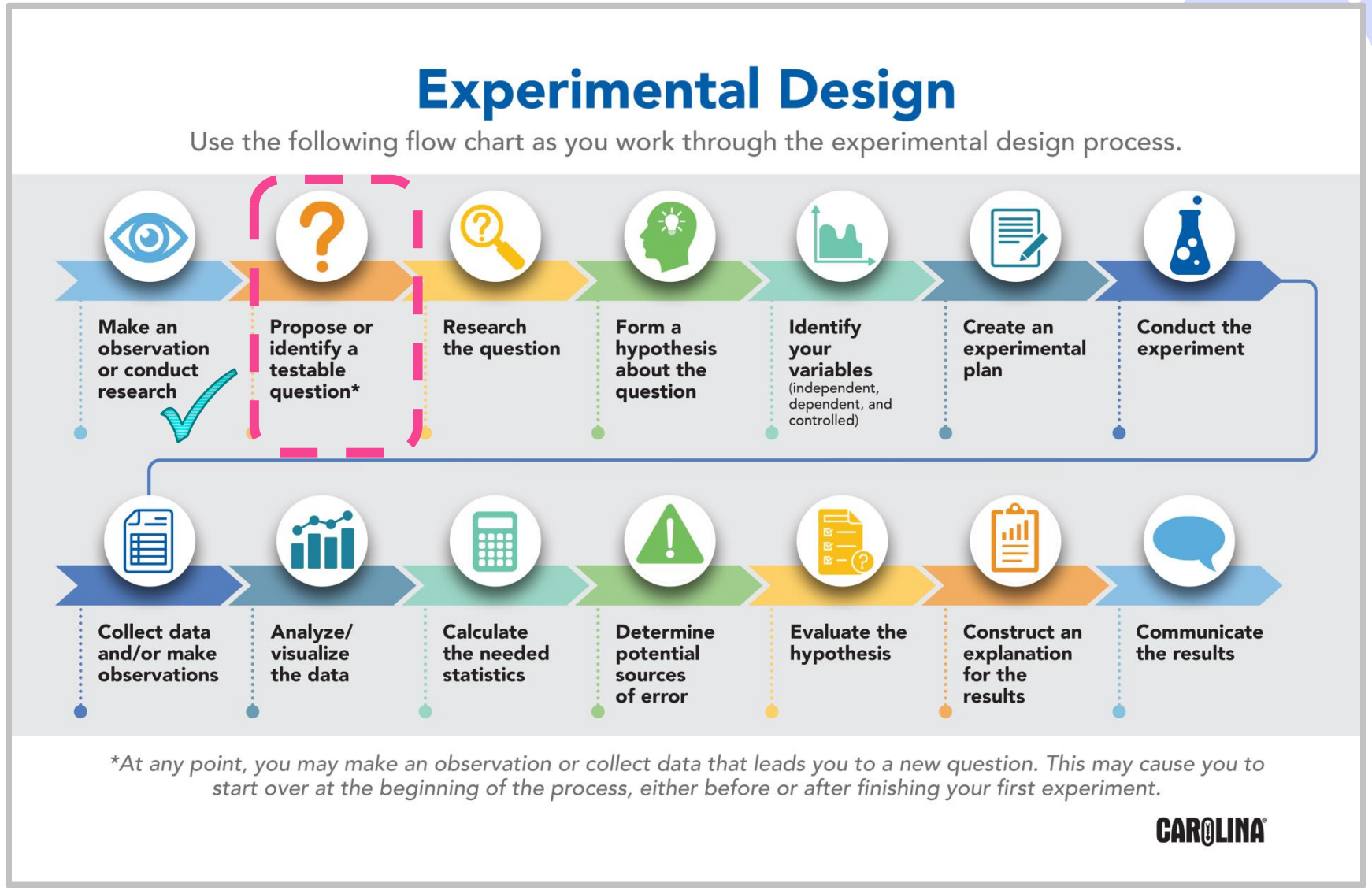
Make Observations

Making observations and asking questions come naturally to young children.

Think of Interesting Questions

- What do you see?
- What do you notice?
- What do you wonder?

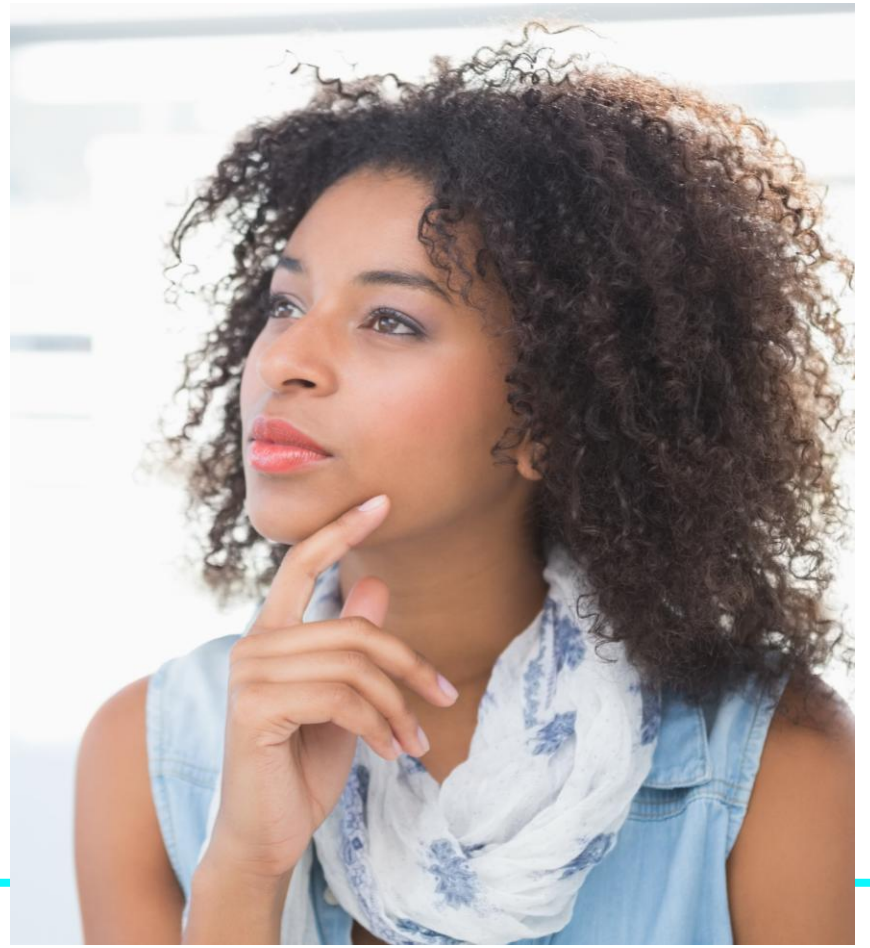
Asking Questions



Asking Good Questions

In science there are no bad questions…

…but there are testable questions and non-testable questions.



Question Stems that Lead to Testable Questions

- What is the relationship between…
- What is the effect of…
- How will X change if…

Question Stems that Lead to NON-Testable Questions

- Why…
- What if…
- Subjective: Is X better than Y?

Keep it simple!

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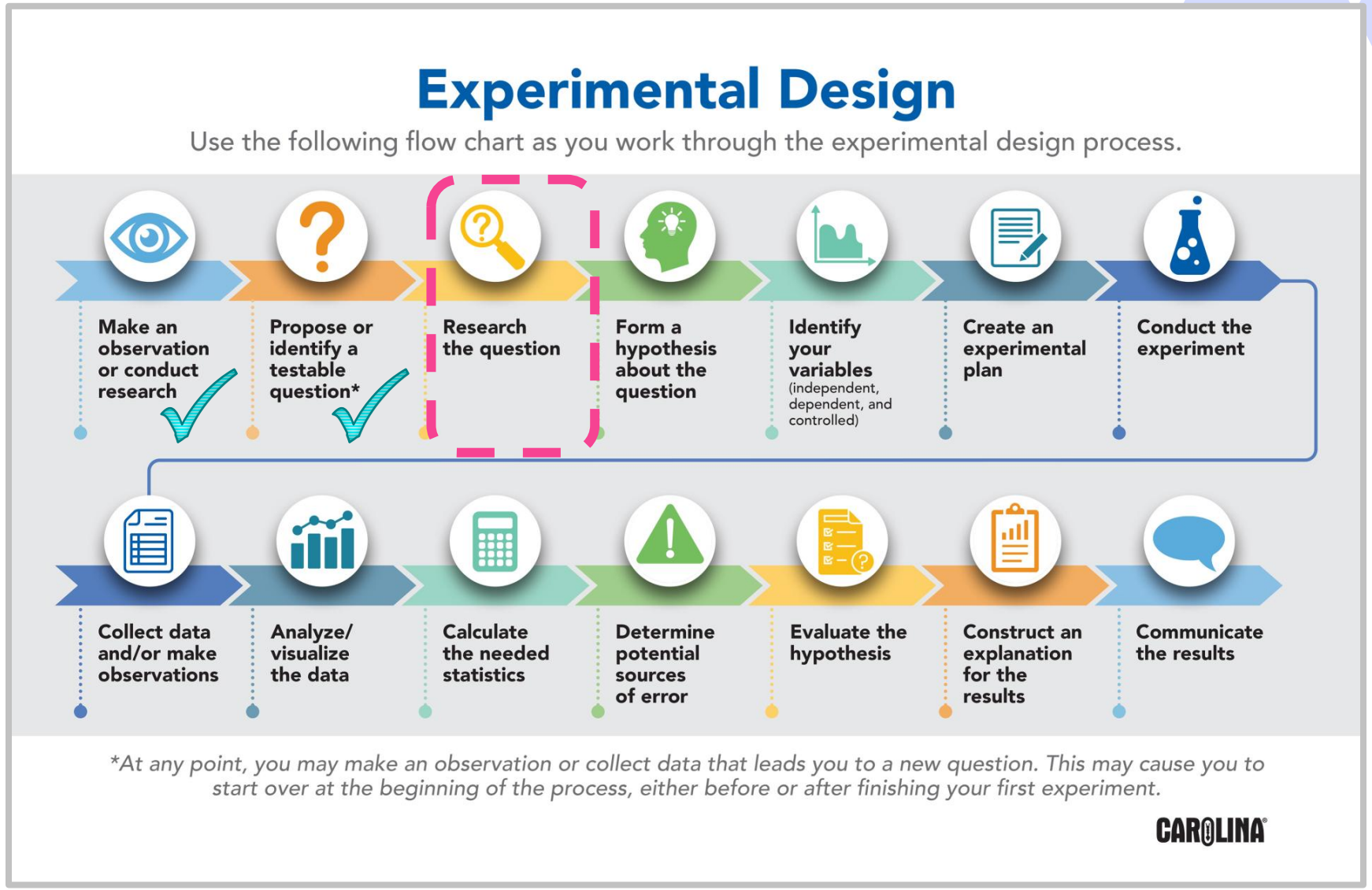
Research



Wisconsin Fast Plants® Developed Originally for Research

Started with Dr. Paul Williams and continues today

- University of Wisconsin-Madison
- Over 40 years of research
- Developed through selective breeding, not genetic engineering (non-GMO)

WISCONSIN FAST PLANTS®

WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON

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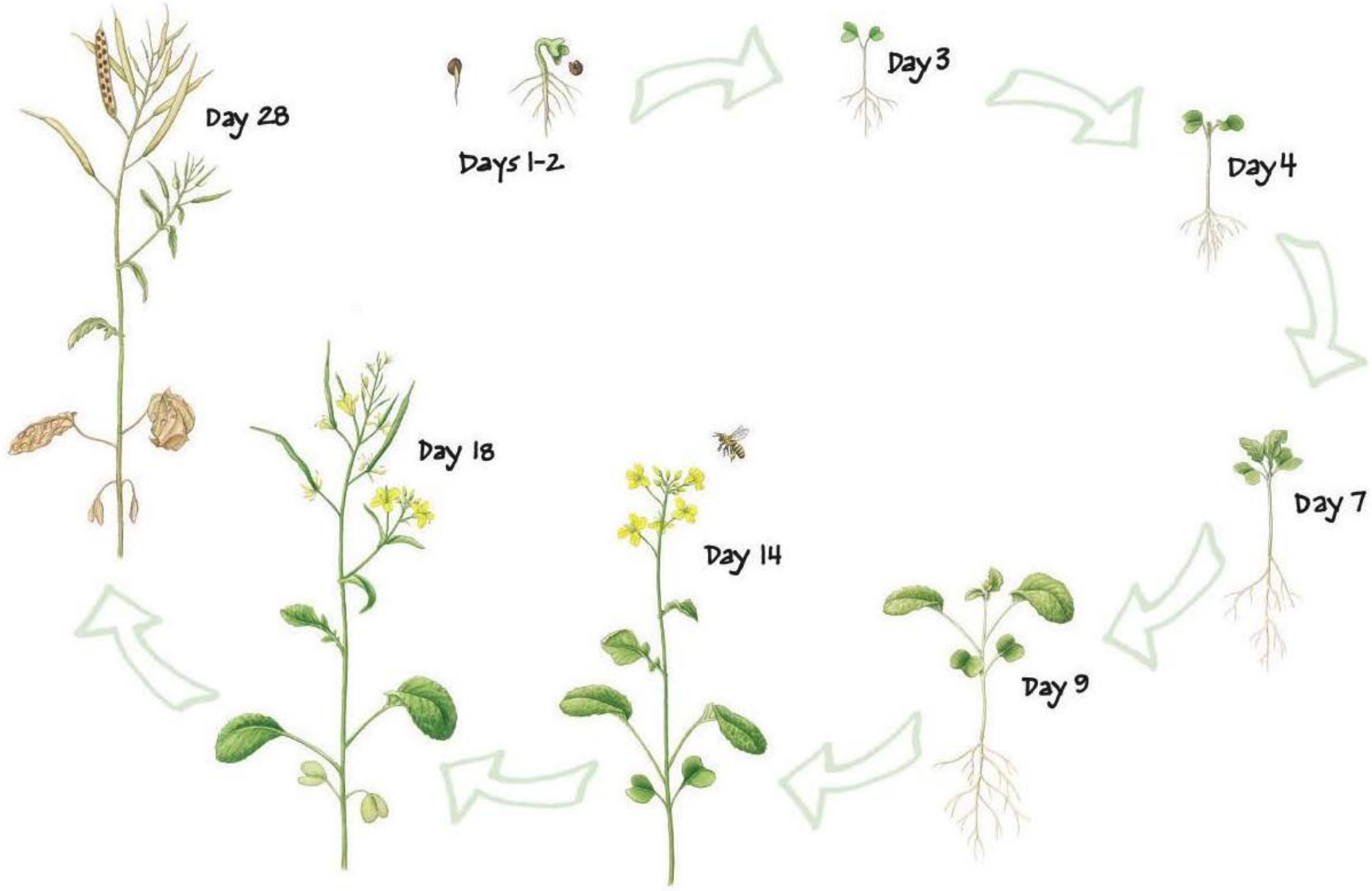
Rapid-Cycling *Brassica rapa*

In the crucifer family: turnips, cabbage, broccoli, kale, etc.



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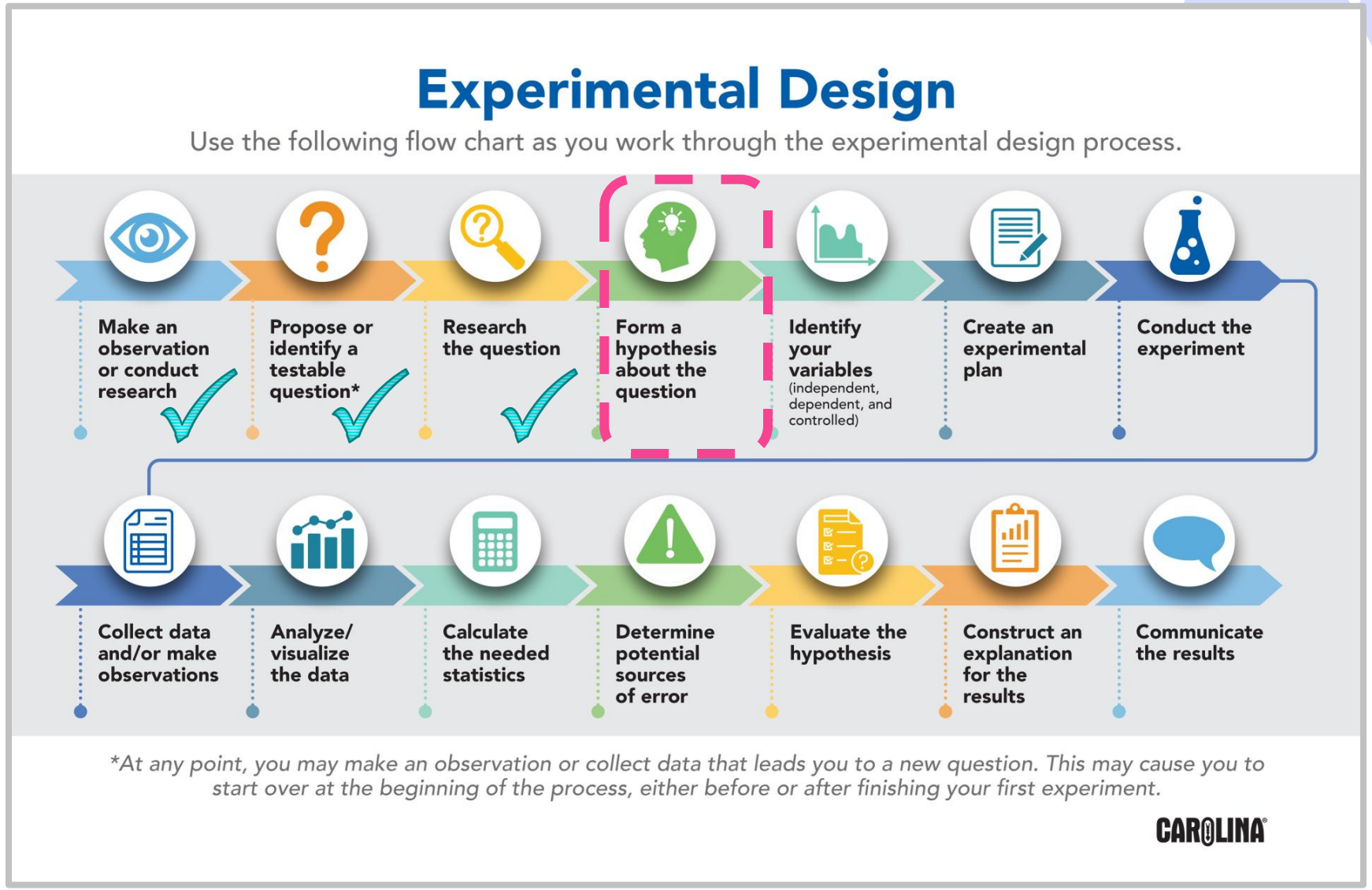
Write a Hypothesis



Prediction vs. Hypothesis vs. Theory

Prediction

- Informal statement of what they think will happen

Hypothesis

- Formal statement that can be rejected

Theory

- A unifying explanation of phenomenon based on the evidence of multiple studies

A Bad Answer
(courtesy of Microsoft® Copilot®)

Hypothesis

- A testable explanation for an observed phenomenon
- ~~Explains *why* something happens~~
- Based on prior knowledge, observations, and reasoning
- Often written as a cause-effect relationship between variables
- Guides the design of experiments and identifies variables
- Must be testable and falsifiable

Prediction

- A specific, testable statement about what will happen if the hypothesis is true
- Describes *what* will happen in a given scenario
- Based on the hypothesis and logical outcomes
- Often written as an “if...then...” statement
- ~~Tests the hypothesis by forecasting expected results~~
- Must be observable and measurable ?

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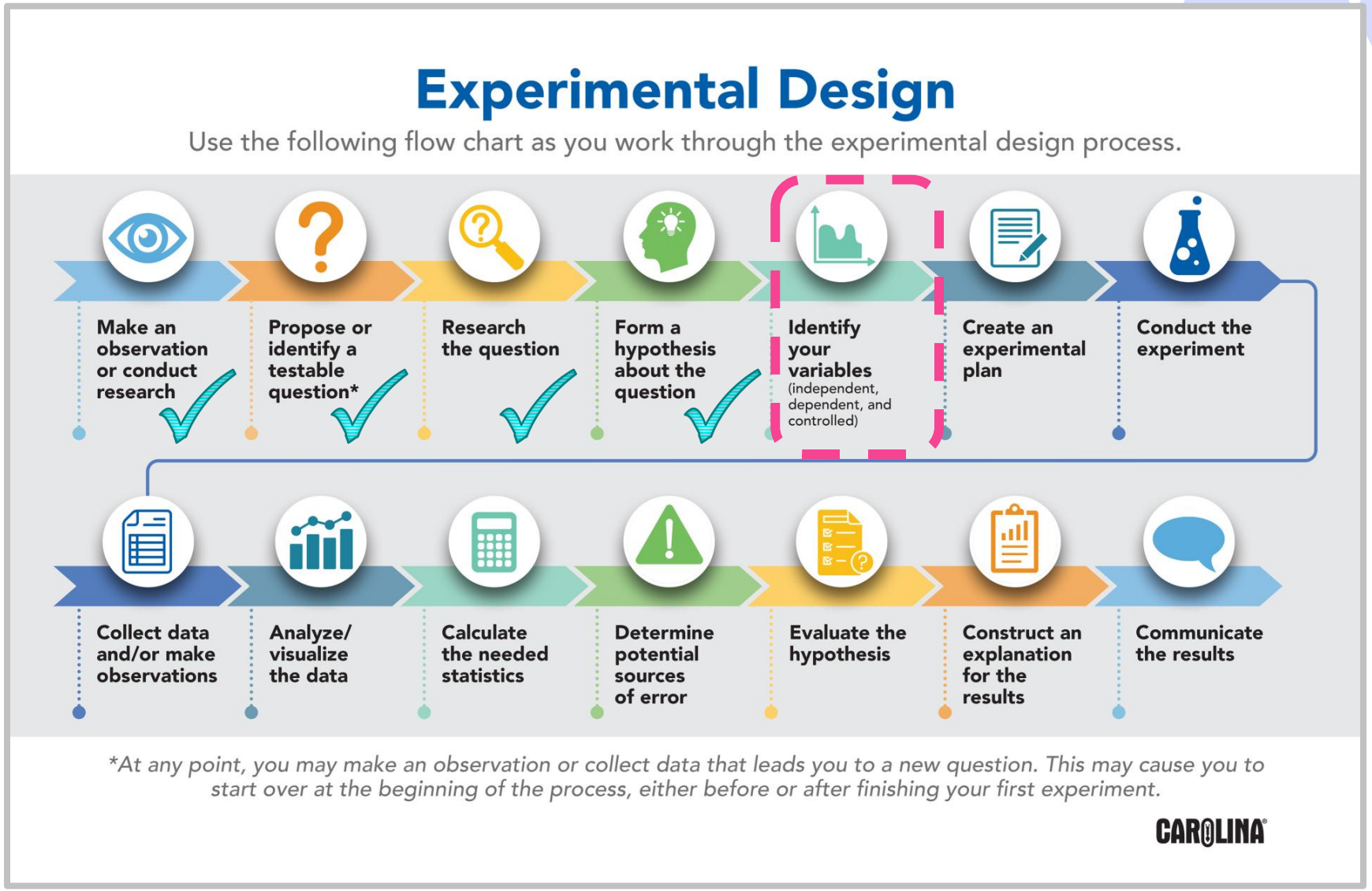
Identify Your Variables



Variables

Independent

- Manipulated
- Predictor
- Factor

Dependent

- Measured
- Outcome
- Response

Variables

Qualitative: Categorical or descriptive variables

- Color
- Health
- …

Quantitative: Numerical variables that represent measurable amounts

- Days/hours until germination
- Germination rate
- Length of…
- Days/hours until first leaf formation
- …

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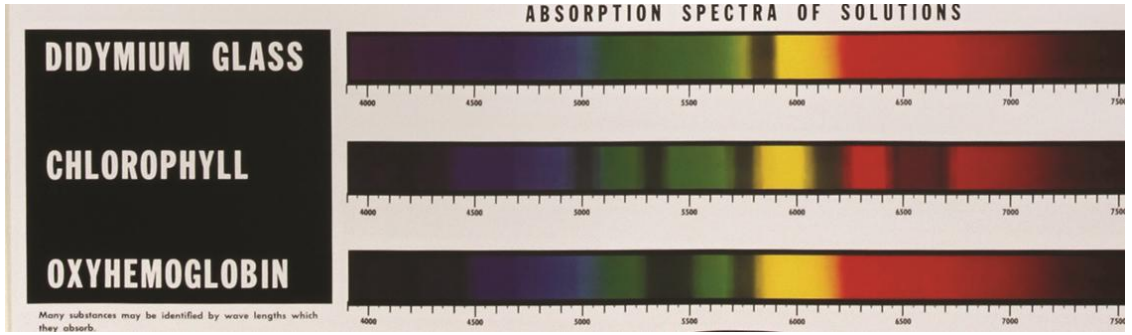
Variables: Qualitative

Color is a category

Unless you use a spectrophotometer

To get a wavelength

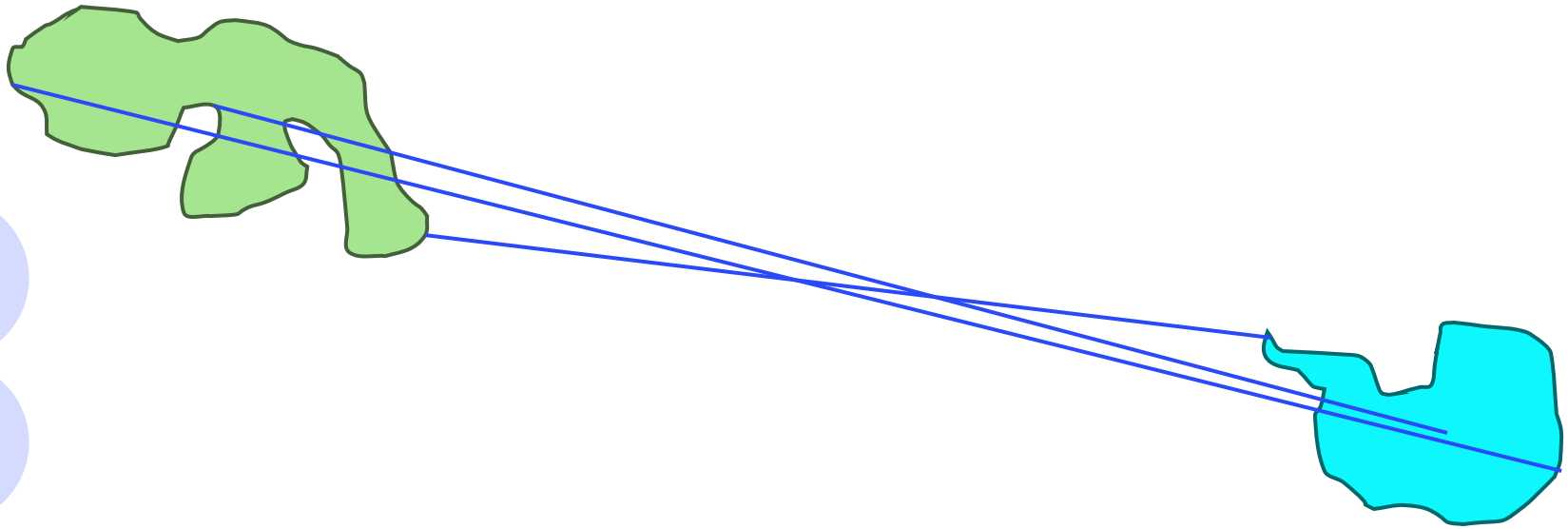


Variables: Quantitative

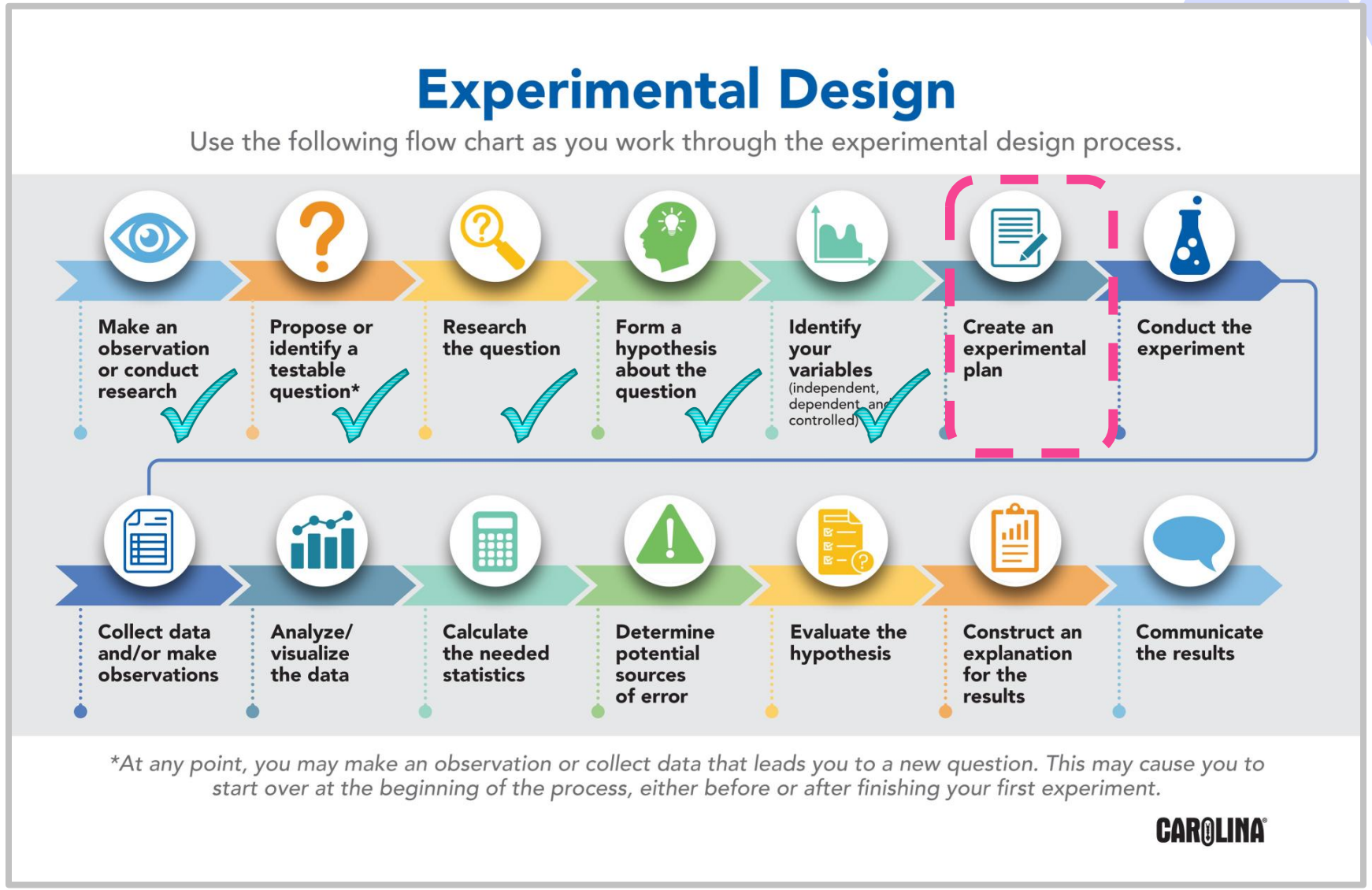
Communication is key. Developing a shared language enhances understanding, ensures consistent results, and enables others to replicate an experiment.

For example, how do you plan to measure things?

- What is the distance between these two objects?



Creating an Experimental Plan



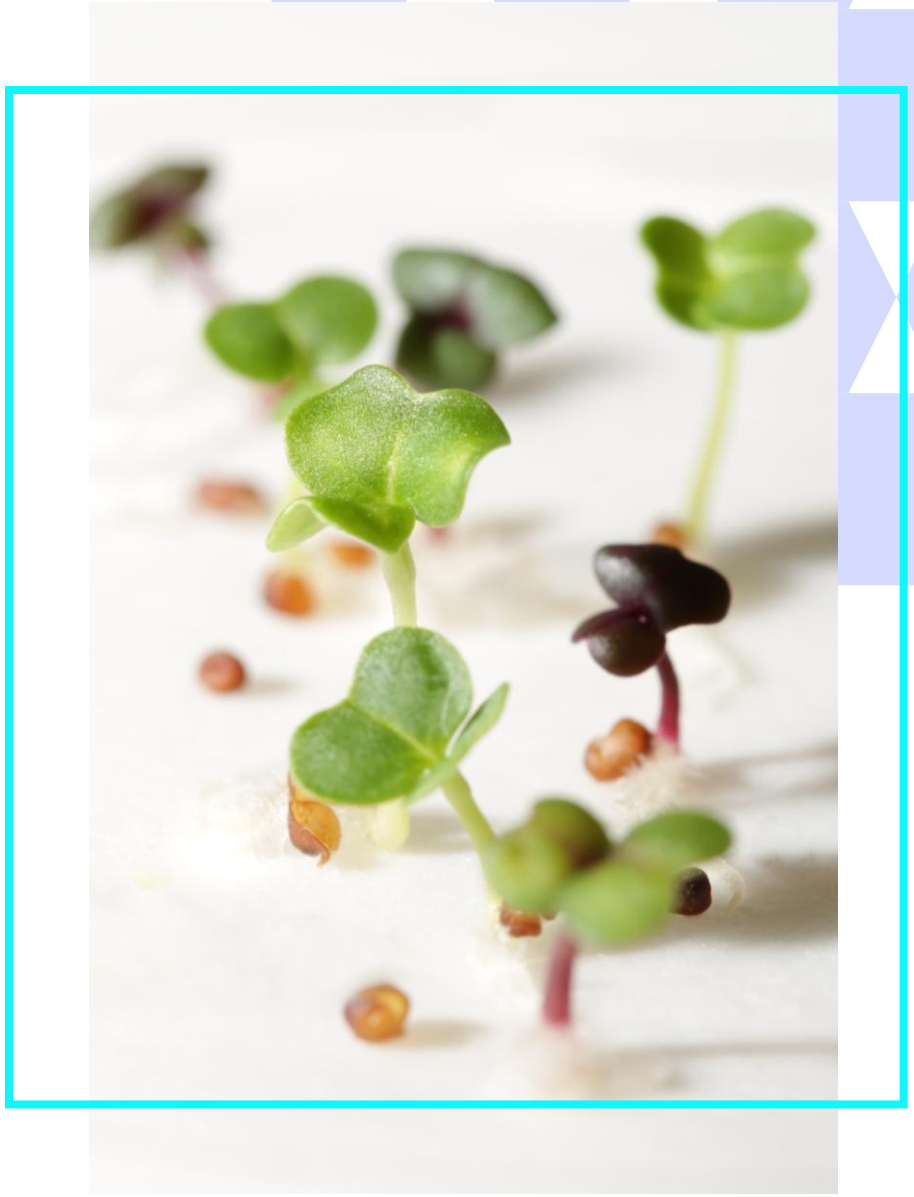
Experimental Plan

Controls (aka Constants)

- What is fair?
- What things need to be the same?

What about things you can't control?

- Variables you can't control become compounding variables.
- Sample size is important. A large sample size minimizes the impact of confounding variables.



Control Group/Treatment

Negative Control: A group that does not receive the experimental treatment(s)

- The “normal” or default state

Positive Control: A group that receives a treatment known to produce a specific effect

- Based on previous research

However:

- Not all experiments have clear controls; sometimes we are just comparing treatments.
- Controls help ensure the experimental conditions produce the expected outcome.

The Analysis

- How do you plan to interpret your data?
- Will you use descriptive statistics?
- Will you use a statistical test such as Chi-squared?

The Experiment

- Work with others at your table to design a single experiment that you all can conduct at home.

Conclusion

- We would like to see this experiment through to the end, so we are asking you to participate in a follow-up activity. We have created…

To Do This Activity with Your Students

Wisconsin Fast Plants®: Seed Disks

Item #158870

AND

Containers, Plastic, 240 mL (8 oz), Pack of 20

Item #974235

OR

Exploring Effects of Light and Gravity on Wisconsin Fast Plants® Seedling Development Kit

Item #158699

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