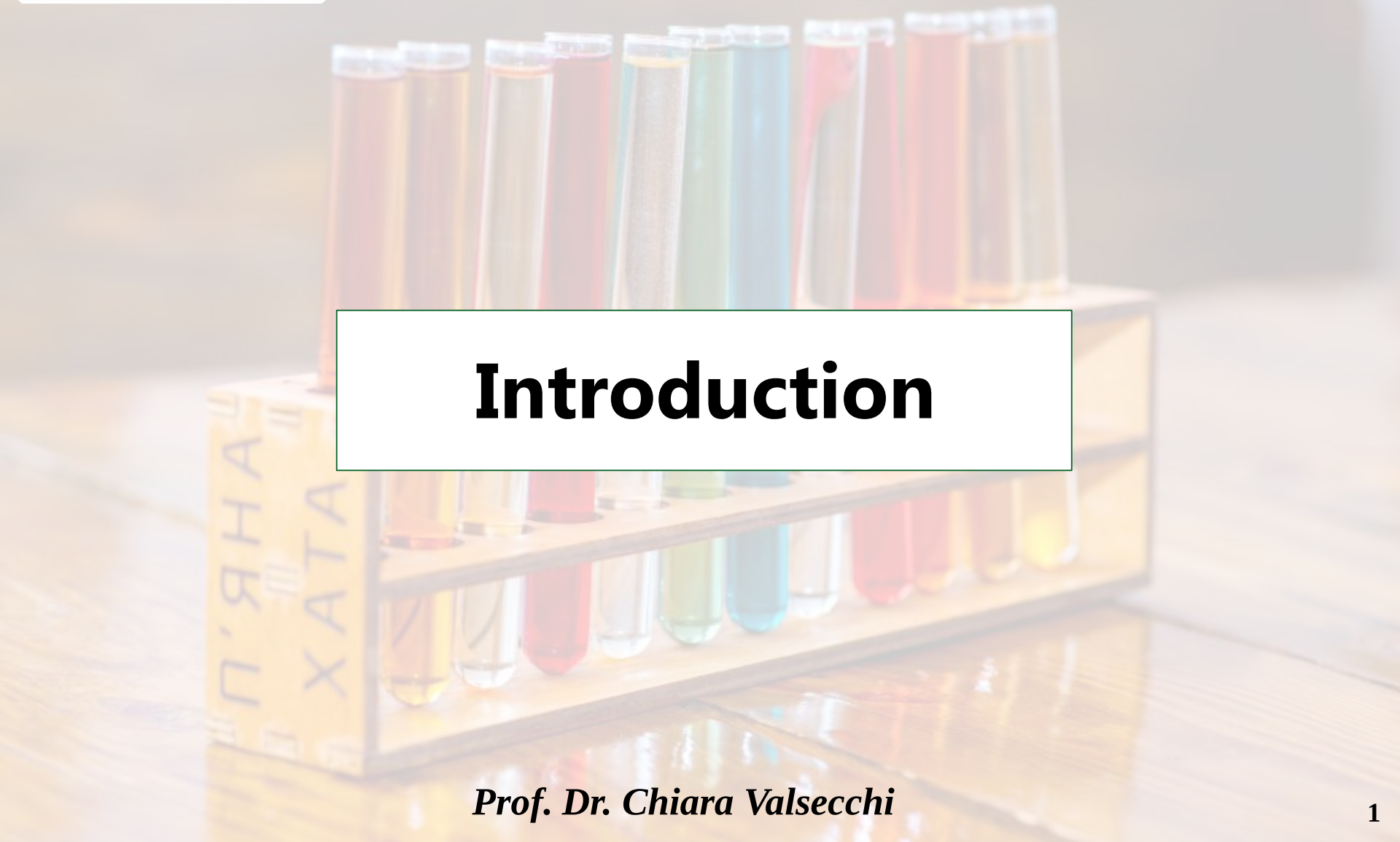


Introduction

Prof. Dr. Chiara Valsecchi

HI everyone,

I am Professor Chiara.

I am from Italy, but I live and work in Brazil

I do not speak Chinese very well, but I will try to learn while I am here in Chengdu

Contacts

I am available to answer quick questions and doubts anytime.

Send an email first to reserve a time if you require more time

Email: chiaravalsecchi@unipampa.edu.br

Office:

Use Weixin !

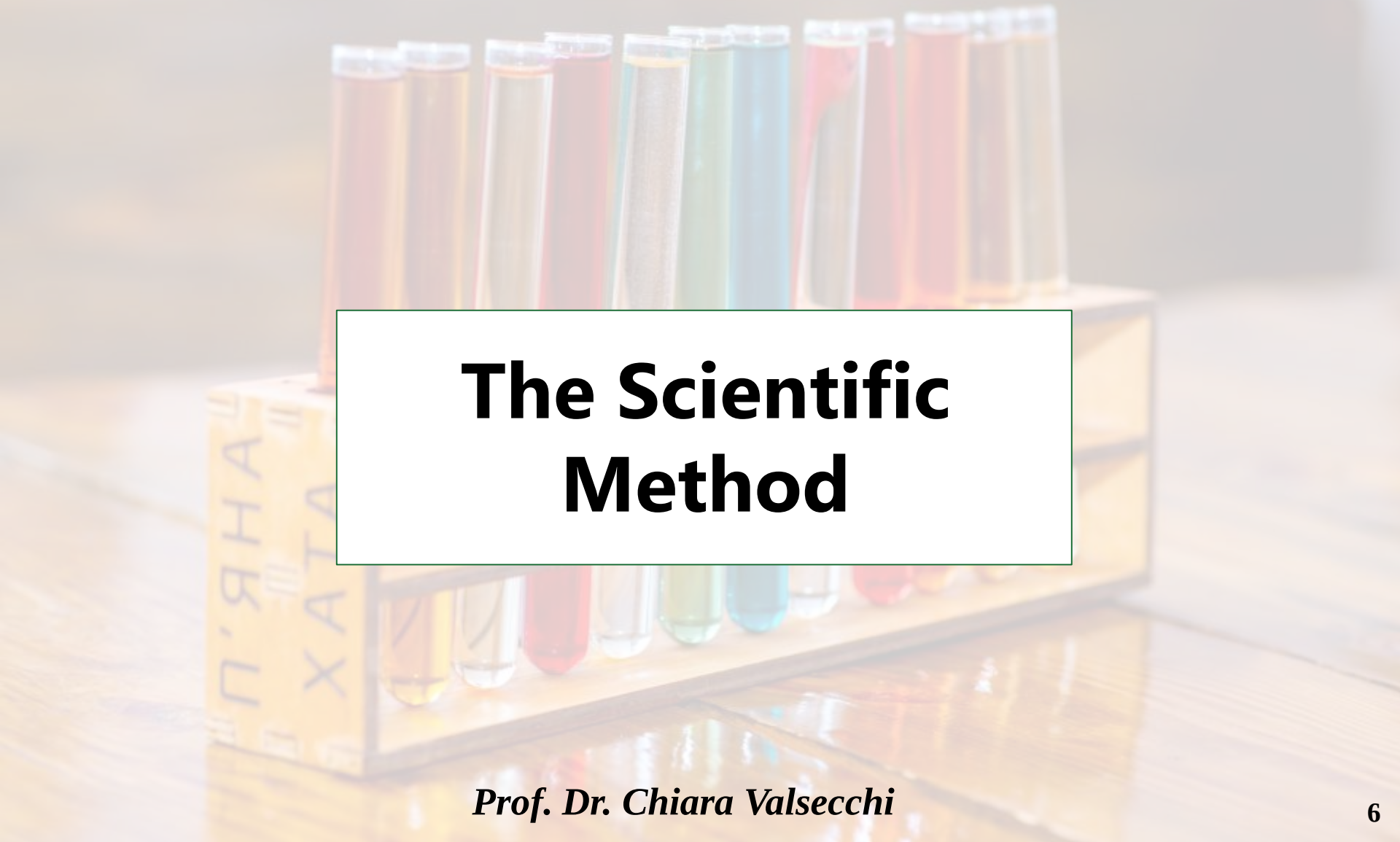
Calendar

	hours	Date
Introduction / The Scientific Method	1	02/27
Chemistry of life	2	02/28
Cell structure and Function	2	03/05- 06
Energy production	1	03/06
Cellular Respiration	1	03/12
PART 1 QUIZ	1	03/13
Photosynthesis	1	03/13

- TWO Assignment during the course: due the following class

Course Goals – Part 1

- Understand the basics of the chemistry of life
- Recognize the building block of biological molecules
- Describe cell types and organels funcitons
- Understand energy exchange processes and how cells produce it



The Scientific Method

Prof. Dr. Chiara Valsecchi

Class Goals

- The Scientific Method:

  Understand how to study Nature in an objective way, **without bias**, in order to create Theories and Laws

What is the Scientific Method?

The Scientific Method is the backbone to every science experiment.

It is a methodical framework to solve problems and determine answers in a step-by-step logical format.

What is the Scientific Method?

It is a **process** that is used to find **answers** to questions about the world around us.

One “scientific method” ?

Is there only one “scientific method”?

No, there are several versions of the scientific method.

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Some versions have more **steps**, while others may have only a few.

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No, there are several versions of the scientific method.

Some versions have more **steps**, while others may have only a few.

1.

However, they all begin with the identification of a **problem** or a **question** to be answered based on **observations** of the world around us.

2.

Why Do We Need It?

Everyone has different beliefs, values, and perceptions of the world.

These differences, in Science, they make it difficult to determine what is true and what's not.

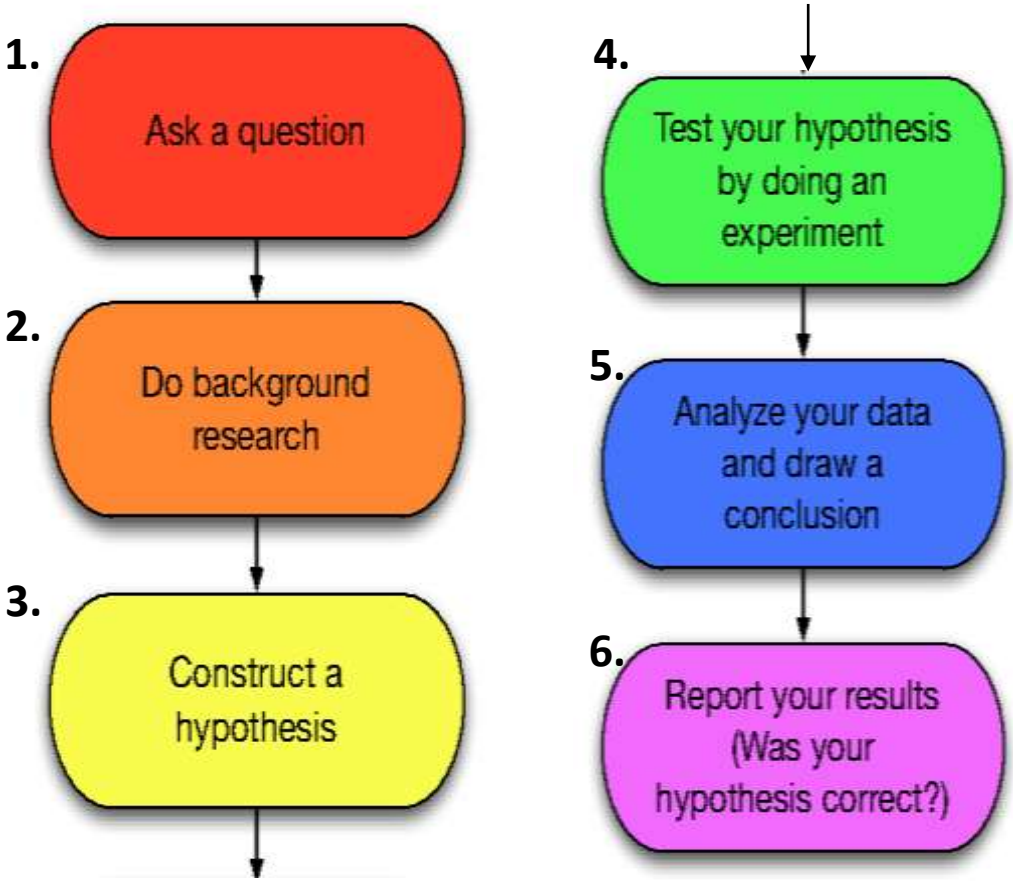
Scientists over centuries have faced this issue, so to solve the problem they created the Scientific Method.

Do You Already Use It?

You probably use the scientific method in everyday life without even realizing it.

The scientific method is not mysterious or difficult, although you can use it to work through some difficult problems.

The Scientific Method



Steps of the Scientific Method

1. **Choose a problem**: State the problem as a question.

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Steps of the Scientific Method

1. **Choose a problem**: State the problem as a question.
2. **Research your problem**: Read, get advice, and make observations.
3. **Develop a hypothesis**: Make a prediction about what will happen.

4a. **Design an experiment**: Plan how you will test your hypothesis.

… Steps of the Scientific Method

4b. **<u>Test your hypothesis</u>**: Conduct the experiment and record the data.

… Steps of the Scientific Method

4b. <u>Test your hypothesis</u>: Conduct the experiment and record the data.

5. <u>Organize your data</u>: Create a chart or graph of your data.

… Steps of the Scientific Method

4b. Test your hypothesis: Conduct the experiment and record the data.

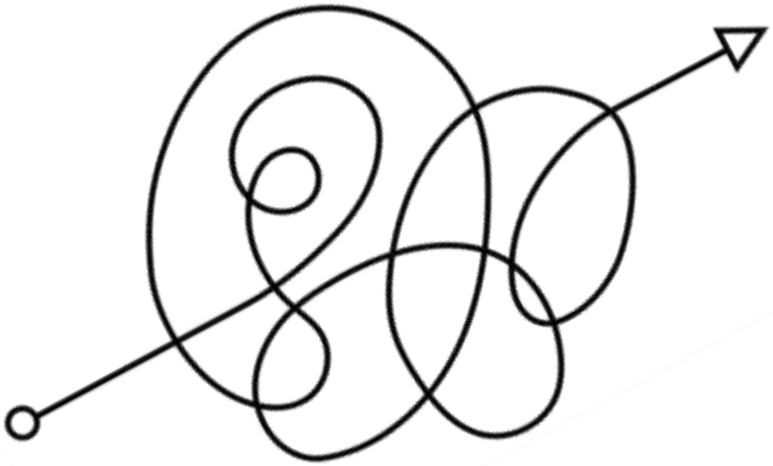
5. Organize your data: Create a chart or graph of your data.

6. **Draw conclusions**: Analyze your data and summarize your findings.

NOT a linear process

The scientific method is NOT a linear process.

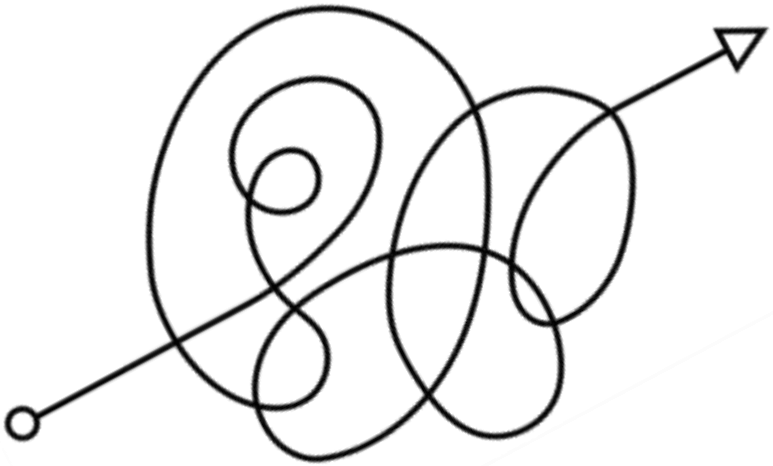
You will not make it all the way through from start to end, but rather loop back many times to revise parts of the experimental design, depending upon how well the data collection is proceeding.



NOT a linear process

You must pay close attention all along the way.

All parts of the scientific method involve making continuous observations and inferences!



Scientific Method Steps

1. Problem

State the problem that you are attempting to solve:

Be specific, it will be easier to solve the problem!

- Ex: Broad Statement – "In what conditions do plants grow best?"
  - This statement is too general that it is almost impossible to design an experiment.

- Ex: Specific Statement – "Do bean plants grow better in direct sunlight, indirect sunlight, or in the shade?"
  - The problem is one plant and one factor (sunlight) that affects its growth, making the problem easily solved through experiments

2. Research

After stating your problem it is important to **research** your topic.

This allows you to form an intelligent **hypothesis**.

Document your research well by citing all sources used to formulate your ideas.

3. Hypothesis

A **hypothesis** is an educated guess about the outcome of your experiment, based on your knowledge and research conducted.

Your hypothesis should be a clear and simple **statement** (Not a question)
It should only state what you think your results will be, not *why* you think you will get those results.

Ex: “Bean plants will grow better in direct sunlight than in indirect sunlight or shade.”

Use the words “**if**” and “**then**” to create your statement.

3. Hypothesis

Example 2:

IF I water three plants with different sodas, **THEN** the plant that receives Sprite will grow the tallest.

What If My Hypothesis is Wrong?

Guessing incorrectly does NOT make your experiment wrong!

Do not change your hypothesis if it turns out to be incorrect. Changing your hypothesis defeats the purpose of the scientific method.

Your hypothesis can be right or wrong, it's all a part of the scientific method.

4. Experiment

Develop a procedure to test your hypothesis.

It is important to list and have all materials needed to conduct the experiment properly.

Accurate measurements must be taken to ensure valid experimental results: be very **specific** about how you will measure results.
You should include a regular timetable for measuring results or observing the projects

Be sure to address safety concerns, too !

4. Experiment

Write a procedure to follow, and control your variables

A variable is anything that can change during an experiment. So each time you test, everything should be the same ***except* the one variable** that you are testing.

Independent Variable (IV): The variable that is controlled or *manipulated* by the experimenter.

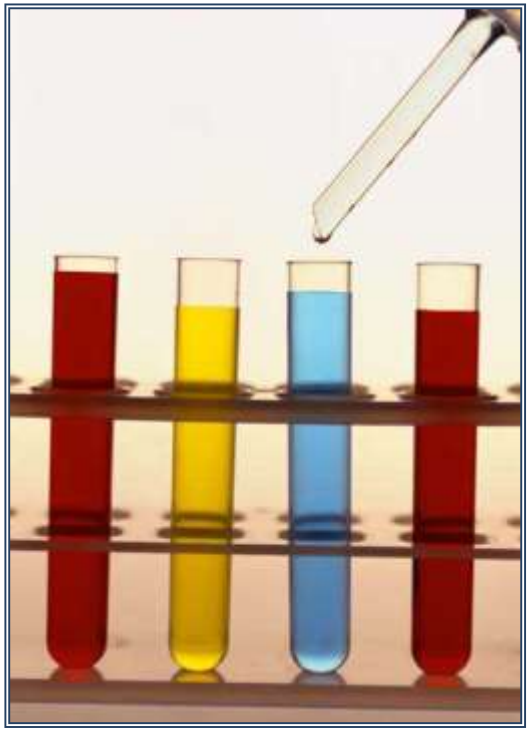
Dependent Variable (DV): The variable that is *measured* by the experimenter. The **data** collected during the investigation.
Ex: how tall the plant grew, how far the paper airplane flew

Control Variable (CG): a variable that is not changed. Also called **CONSTANTS**

4. Experiment

<u>Control Group (CG)</u>: The group that is not exposed to the independent variable.

Example: In a medicine study, the group of people who don't get the medicine are the *control group*



5. Analysis

Record the results of the experiment, in a data table or chart.

Organize data well so that finding results and trends is easier.

Make connections about the experiment and your results.

6. Conclusion

Compare the hypothesis to the experiments conclusion.

State if you proved or disproved your hypothesis.

Name any errors that could have been made during the experiment that could have affected your outcome.

6. Conclusion

Before accepting conclusions, scientists **retest** their hypotheses several times.

Later other scientists repeat the experiment until the hypothesis and the conclusion are supported or rejected.

6. Conclusion

When a hypothesis explains **how** "facts of nature" occurs, it becomes scientific principle or law. Ex: Law of Gravity

When a hypothesis explains **why** "natural" events occur through investigations over a long period of time, it becomes a theory. Ex: Theory of Evolution

Let's Practice !

A researcher is studying the effect of sleep on aggression, thinking that less sleep will lead to more aggression. She has some people sleep 6 hours per night, some people sleep 3 hours per night and some people sleep as much as they want.

She then monitors aggressive behavior during basketball games among participants.

Let's Practice ! #1

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Indipendent Variable ?

Dependent Variable ?

Control group ?

Let's Practice ! #1

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She then monitors aggressive behavior during basketball games among participants.

Indipendent Variable ? Number of hours of sleep

Dependent Variable ? The aggressive behavior

Control group ? The people that slept without limits

Let's Practice ! #2

Students of different ages were given a jigsaw puzzle to put together. The scientist wanted to see if the students' ages affected how long it took to put the puzzle together.

Indipendent Variable ?

Dependent Variable ?

Constant Variable ?

Let's Practice ! #2

Students of different ages were given a jigsaw puzzle to put together. The scientist wanted to see if the students' ages affected how long it took to put the puzzle together.

Independent Variable (IV):

Ages of the students

Dependent Variable (DV):

The **time** it took to put the puzzle together

Let's Practice ! #2

Constant Variable ?

(1) Same puzzle: It would not have been a fair test if some had an easy 30 piece puzzle and some had a harder 500 piece puzzle.

(2) same **location**,

(3) same **stopwatch**

(4) same person **timing** the experiment