**Concepts:**

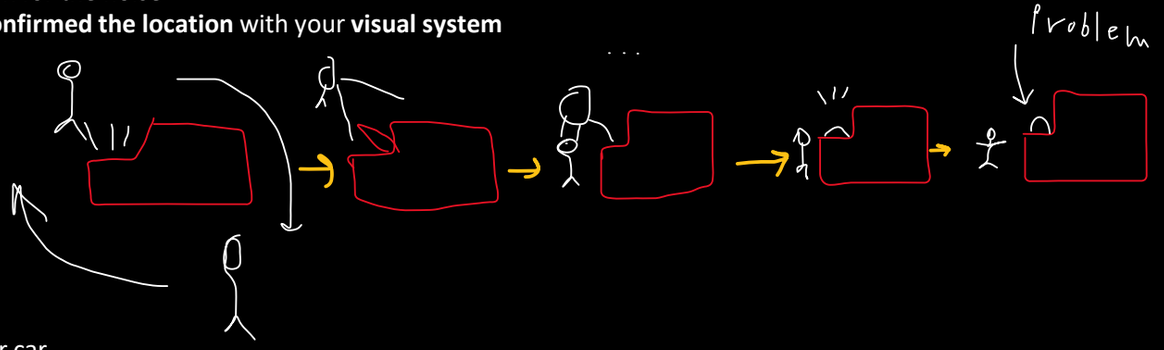
- 1. Experimental design
- 2. reproducible procedures
- 3. independent variable to be manipulated
- 4. Cellular respiration in plants (DONE IN PREVIOUS LO)
- 5. Energy release (DONE IN PREVIOUS LO "how does ATP store enegy")
- 6. Photosynthesis (DONE IN PREVIOUS LO)
- 7. Capture of energy and production of carbon dioxide.
- 8. Impact of variables on photosynthesis and cellular respiration
- 9. temperature
- 10.amount of light
- 11.Chemical indicators

## EXPERIMENTAL DESIGN

Is a way to isolate and identify the cause of something

For example: your car isn't moving and producing a weird noise, so you go around the car **trying to see where the problem is)** and then you find that **a part that is ~wiggling around~,** you think that the moving part is the reason for the noise

So you **isolated** the problem with your **auditory system** and **confirmed the location** with your **visual system**




So you hold the part, and the noise stops

You let the part, and the noise continues

now that you identified the problem, you just replace it and fix the problem

Here is what you did

- **Observe :** as you observe the that there is a problem in your car
- **Describe :** as you pinpointed the location of the problem
- **Hypothesis :** you hypothesized that the moving part is the reason
- **Test** : you tested the theory by holding the moving part, you tried
  - **Controlled test :** where you held the moving part
  - **Experimental test :** by letting it be
- **Conclusion :** you conclude that the moving part, is the reason for the noise, so you stop the movement, so no movement, no noise

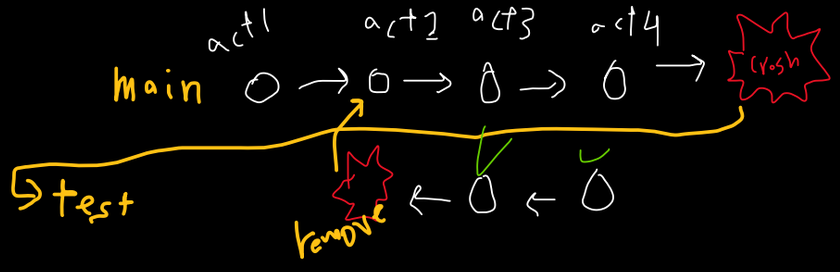
## Reproducible procedures

Repeating certain events to get to the root cause

For example: you are coding a program and you ran into an issue where your program crashes

You make a new simpler program and try to do the thing you did before the crashing error occurred, if its not the cause, you go back to the thing you did before it, and so on and so on, until you add an action that causes the new program to crash, let us say, a broken function

So you remove that function and the problem is fixed, you then go to the main program and fix the problem by removing the function

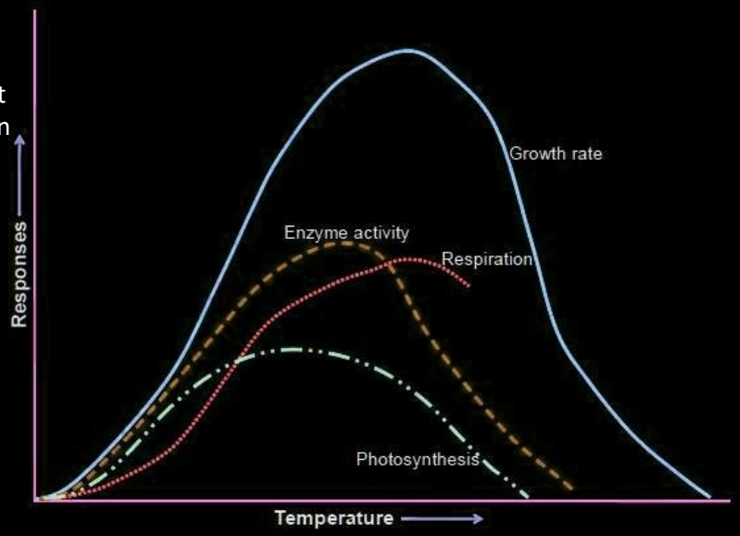



## DEPENDENT/INDEPENDENT/CONTROLLED REACTIONS (in biology)

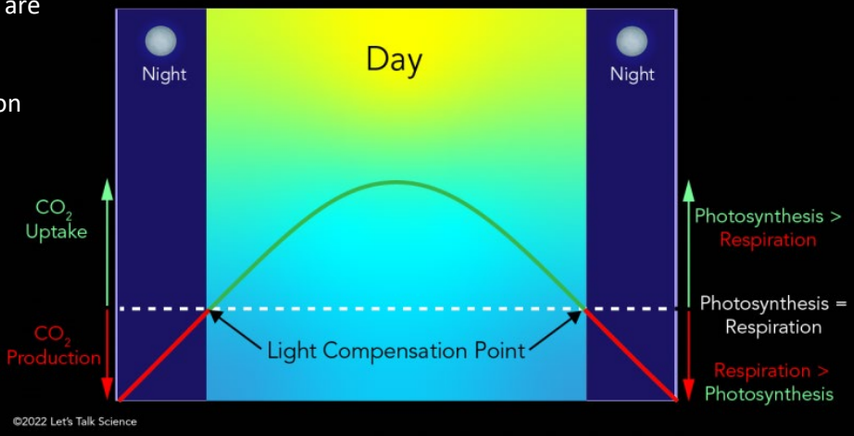
| INDEPENDENT | DEPENDENT | CONTROLLED |
|---|---|---|
| Variables that we change to see what is going to happen | Variables that change with the change of the independent variables | Variables that we always keep the same and do not care about the other two variables |
| **Temperature/acidity/ amount of $CO_2$/amount of light** | **rate of photosynthesis/cell resperation** | **Type of plant/amount of water fed to plant** |

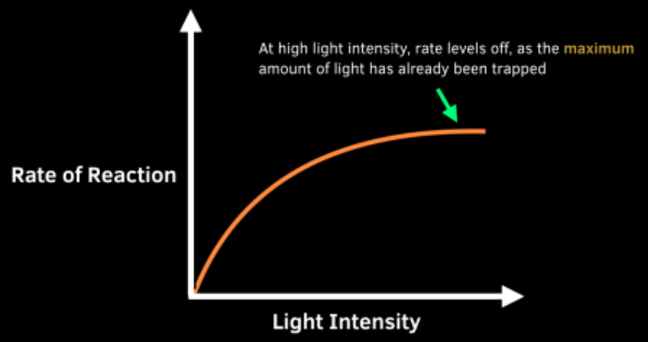
**Impact of variables on photosynthesis and cellular respiration (temperature, light amount, carbon dioxide amount, oxygen amounts)**

- **TEMPERATURE**
  - Temperature will increase the rate of photosynthesis until the 20th to 40th degree, then it will plumet because of denaturalization
  - Unlike photosynthesis, respiration can withstand much larger temperatures and it is not a smooth curve like photosynthesis, the maximum temperature for optimum respiration is between 34 and 35 degrees

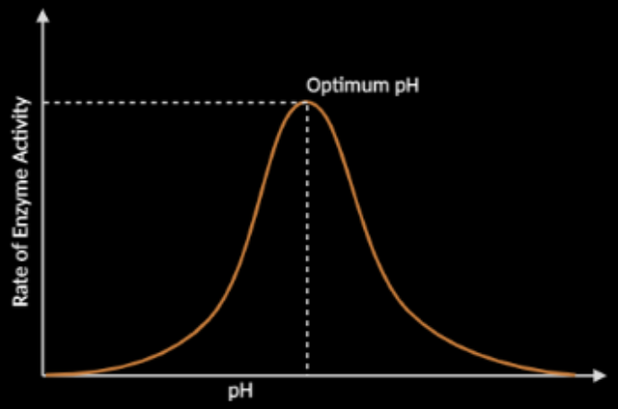



- **Light intensity**
  - Photosynthesis rate will increase with the light intensity until all the chlorophylls are filled with light, so the rate will hit a ceiling
  - Cell respiration will increase with the decrease of the light intensity, because of the absence light will lead to no photosynthesis which is replaced by respiration
  - So in night time
    - $CO_2$ production will increase, because of the increase in respiration
    - Photosynthesis rate will decrease
  - So in day time
    - $O_2$ production will increase, because of the increase in photosynthesis
    - Respiration rate will decrease




- **Acidity (PH)**
  - In both reactions, the optimum pH is 7



**Emergy release**

Same thing for ATP is for NADH, NADPH, and $FADH_{2,}$, bonds being broken release the potential energy, or it is transported through the electrons like in the transport chain

**Capture of energy and production of carbon dioxide.**

Capture of energy refers to **photosynthesis** which is captures light energy

$$6CO2+6H2O+\text{light energy}\rightarrow C6H12O6+6O2$$

Production of carbon dioxide refers to **cellular respiration** which produces $CO_2$

$$C6H12O6+6O2\rightarrow 6CO2+6H2O+\text{energy (ATP)}$$

**CHEMICAL INDICATORS**

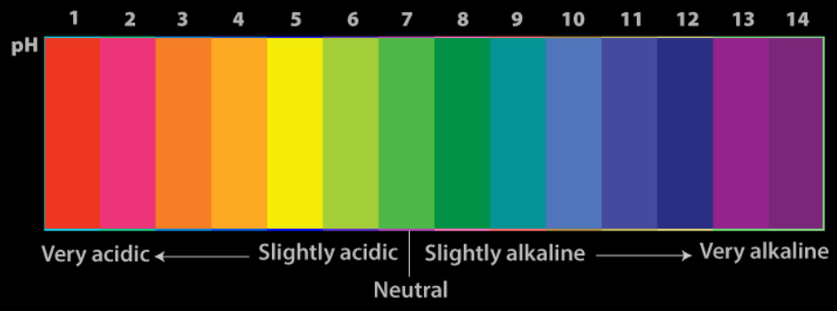
You can measure chemical reactions quantitively like a pH Meter, we can measure stuff qualitatively too, those are the use of indicators

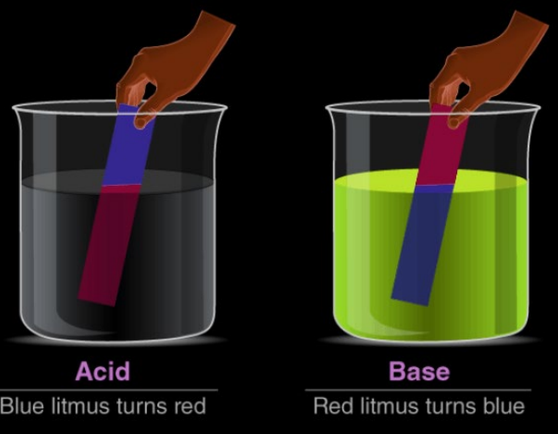
An **indicator** is something that changes color based on the pH of a solution, it can measure pH in all ranges of pH

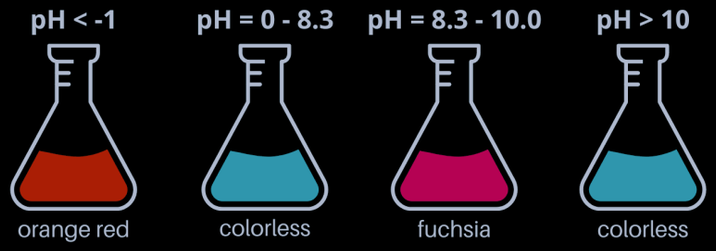
**Litmus** is another indicator represented by **litmus paper**

**Blue litmus paper** turns **red** under acidic conditions

**Red litmus paper** turns **blue** under basic conditions




**Phenolphthalein** is an indicator used to determine the endpoint of a strong acid – weak alkali titration, or weak acid – strong alkali titration

- **Goes from colorless** to fuchsia pink at a pH of 8.2

**Methyl orange** is an indicator used to determine the endpoint of a strong acid – weak alkali titration, or weak acid – strong alkali titration