**IB Foundation Years (9 & 10) Lab Report**

**1) Writing a fully focused research question**

o Must include the range of the independent variable with units

o Must include the dependent variable

o Method of measuring the dependent variable

what is the effect of different temperatures (0, 25, 45 degrees celcius) on the permeability of the memberane measured by putting 3 different slices of beetroot in different temperatures, and then measuring the colour shade on a colour meter?

1. **Scientific background** 
   * Research your independent variable
   * Research its effect on your dependent variable
   * Research the method of measuring the dependent variable
   * Include citation

* **Research of the independent variable (Temperature):**  
    
  Temperature is a physical element that can influence cell membrane permeability. As the temperature rises, molecules gain kinetic energy and travel faster. This increased movement has the potential to alter the structure and integrity of the cell membrane, leading to greater permeability.  
  Temperature increases can cause the lipids in the cell membrane to become more fluid, resulting in gaps or abnormalities in the membrane structure. These spaces allow molecules like betacyanin to leak out more easily, resulting in a more intense color.
  + **Temperature effects on the dependent variables (permeability and color shade):**Temperature has an effect on the permeability of the cell membrane. Temperature increases may lead the structure of the lipid bilayer of the membrane to be obstructed, resulting in increased permeability and leaking of components.

In the case of beetroot, the betacyanin pigment is found within the cells' vacuoles. The betacyanin leaks out into the surrounding solution when the membrane is broken or becomes more permeable due to temperature changes, resulting in a more intense red color.

* **Study the method of measuring the dependent variable (Color Shade):**  
  A color meter can be used to measure the color shade of the beetroot slices. A color meter measures a substance's absorbance or transmission of light of specific wavelengths. The color meter will measure the absorbance of light by the betacyanin pigment in this case.  
  The color meter measures the amount of light absorbed by the betacyanin by passing light through a solution containing beetroot extract. A more vivid color shade corresponds to a higher absorbance or reduced light transmission, indicating a higher concentration of broken betacyanin pigment.

1. **Hypothesis:** Outline a hypothesis to predict the outcome of the experiment and

explain it using logical scientific *reasoning (what do you think is going to happen*

If the temperature of the beetroot slices increases

(State the IV) (increase, decrease, or change)

then the then the color shade measured by the color meter will increase

(State the DV) (increase, decrease, stay the same, or change)

**Scientific explanation for hypothesis (**This is the explanation to the previous hypothesis. Why do you think that your hypothesis is correct? Explain it in detail with reasons and causes. You may also find research at this point if allowed).

Because: Cell Membrane Structure: The cell membrane is composed of a lipid bilayer with embedded proteins. It acts as a barrier to control the movement of substances in and out of the cell.

Membrane Permeability: Temperature influences membrane permeability by affecting the fluidity and integrity of the lipid bilayer. Higher temperatures increase membrane fluidity and can enhance permeability.

Impact on Pigment Release: In beetroot, betalain pigments are stored in the vacuole within cells. Temperature changes can disrupt the cell membrane, leading to the release of pigments into the surrounding solution. Absorbance measurements can indicate the concentration of released pigments.

1. **Manipulating the variables:**

**What is your independent variable ?**

* What are the units ?
* How will it be changed stating the instruments that you will be using
* Will you be doing a control experiment ?
* Why did you choose this range ?

**Discuss your dependent variable [ the method of measurements + units+ time frame]**

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| --- | --- | --- |
| **Controlled Variable** | **How will you keep this controlled? Stating the values and the equipment that you will be using** | **How could it affect your results if not controlled?** |
| Mass of beetroot used | Weight balance (grams) | The mass of the beetroot can impact the surface area-to-volume ratio of the slices, potentially influencing the rate and extent of betacyanin leakage |
| Volume of Water | Graduated cylinder (ml) | Variations in water volume can result in different rates of temperature change, affecting the beetroot membrane permeability differently |
| Beetroot source | Collecting same batch of beetroot or using the same type of beetroot | Different beetroots have different baseline permeability and this can affect the response to temperature changes |

Units: The units for temperature are degrees Celsius (°C).

Temperature Range Choice: The temperature range chosen (0°C, 25°C, and 45°C) allows a variety of temperatures to observe the influence on the permeability of the beetroot membrane. 0°C suggests a low temperature, while 45°C denotes a comparatively high temperature. The addition of room temperature (25°C) allows for a comparison of the experimental and control groups.

1. **Materials and Method**:

State your materials [ number needed + units] (Be descriptive, example: 10cm3 graduated cylinder) include the uncertainties for each piece of apparatus

**Method : What are the steps of the investigation?**

1. Cut 5 pieces of beetroot using a cork borer, 1 cm long, from the cylinders provided.
2. Wash under running water to remove the pigment released from cells during cutting.
3. Place a test tube containing 5 cm3 of distilled water into each water bath to equilibrate (For 5 minutes)

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1. Place 1 piece of beetroot into each test tube for 30 minutes.
2. shake the test tubes gently to make sure any pigment is well-mixed into the water, then remove the beetroot cores. (After 30 minutes)
3. Describe the depth of colour in each test tube. A piece of white card behind the tubes will make this easier to see. Arrange the tubes in order of temperature of the water bath.
4. If you have access to a colorimeter, set it to respond to a blue/ green filter (or wavelength of 530 nm) and to measure absorbance. Check the colorimeter reading for distilled water.
5. Measure the absorbance/percentage transmission of each tube and plot a graph of absorbance/percentage transmission against temperature.  
   9.repeat to ensure accuracy
6. **Safety, Ethical and Environmental issues**

**No animal were harmed , and minimal amount of beetroot wasted**

1. **Results**

**Add a table for qualitative results e.g. Variation within the organism/biological material being are dealt with; Color, texture, shape, size, heat changes; Anything you notice that might affect results.**

**Raw Data**

* Construct a table to add your raw data , add a fully detailed title to your table .
* Label your table ( table 1, table 2…)
* Add suitable headings with units and uncertainties to your table.
* Unify your decimal points

|  |  |  |  |  |  |  |  |  |  |
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|  | |  |  | | --- | --- | | Temperature **(°C)** | Color shade | | 0 | Dark | | 25 | Medium | | 45 | Medium |   **Processed data**   * Justify the reason for data processing * Add screenshots from excel to provide evidence for your work, or provide a sample calculation * Construct a table to add your results * Add a title for your table and label it * Unify your decimal points   Y=color shade / absorbance  x=temperature  in the experiment we can observe that there is a human error so it best if we repeat the test |