**IB BIOLOGY Name:**

**Step 1- Internal Assessment Topic Selection & Research Question Development**

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| Before completing this task:   1. Read the [overview about the Internal Assessment](http://www.biologyforlife.com/internal-assessment.html) (click links within the page for additional information) 2. Think about what you would like to investigate:    * Choose a topic that is interesting to you; you’ll be working on this for a long time!    * Search for ideas on the internet, but be careful about plagiarizing or copying    * Think about issues your family deals with; maybe there are personal reasons why a topic might interest you    * Flip through a textbook, magazine or newspapers for inspiration    * Think about lab skills you’ve already learning or skills you’d like to try    * View the [list of available equipment](https://docs.google.com/document/d/1YUKoLAS4pILxVBRkcEDMDfZgyhEKZAIttxIOb70JEYk/edit?usp=sharing) 3. Be aware of ethical and safety considerations    * Read the [IB Animal Experimentation policy](https://drive.google.com/file/d/0B7EoydxcWA7pQXk5cDlTd0lBdlk/view?usp=sharing)    * See a [sample informed consent form](https://docs.google.com/document/d/1qmuP9YDpooVIITo1_M3aV6x5z9f0uXVYw1Pppm8e0NI/edit?usp=sharing) for human subjects 4. Watch out for common mistakes    * Not collecting enough data or having a large enough sample size    * Designing too simple or too complex an experiment    * Wanting to do an experiment that [another student has already selected](https://docs.google.com/document/d/1KuChvRJtfoIQvkUcSAzRBBj33mxFaE008ffA_5ZEr58/edit?usp=sharing)    * Not following microorganism, human or animal experimentation guidelines (read the [IB Animal Experimentation policy](https://drive.google.com/file/d/0B7EoydxcWA7pQXk5cDlTd0lBdlk/view?usp=sharing) and see a [sample informed consent form](https://docs.google.com/document/d/1qmuP9YDpooVIITo1_M3aV6x5z9f0uXVYw1Pppm8e0NI/edit?usp=sharing)) |

1. **Which** [**IB TOPIC or OPTION**](http://www.biologyforlife.com/syllabus.html) **do you want to investigate in your internal assessment?**

*For example, topic 1: cell biology*

1. **Which subtopic do you want to investigate in your internal assessment?**

*For example, subtopic 1.4: membrane transport*

1. **Are you going to do a:** *(select one)*
   1. Experiment
   2. Database analysis
   3. Simulation analysis

\*\***If you are doing a database or simulation, provide a link to the dataset or simulation you will be using:**

1. **In general, what are you thinking about investigating?**

*This doesn’t have to be a formal problem question, but should indicate that you’ve done some thinking about an experiment, simulation or database analysis that you could do for the internal assessment.*

1. **What variable(s) are you going to manipulate, change or correlate?** *(Independent variable)*
2. **What responding variable are you going to measure?** *(Dependent variable)*
3. **What is your research question?**  *It must clearly include a biological manipulated and/or responding variable. Good formats are:*

* *“What is the effect of \_\_\_indepedent variable\_\_\_ on \_\_\_dependent variable\_\_\_\_. “*
* *“What is the relationship between \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.”*
* *“Is there a significant difference between \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_.”*

1. **Why does this research question/topic interest you?**

*Write 3-5 sentences that explains why you gravitated towards this topic. “Personal engagement” in the topic is a component of the IA scoring so it is important to communicate an authentic connection to your topic. Why are you curious about this? Does it relate to your life outside of school? Future career path? Don’t make something up*.

**RESEARCH QUESTION APPROVED BY TEACHER:**

**APPROVAL DATE:**

**Step 2 - Background Information**

You should do some background research from reliable, scientific resources. You are expected to include scholarly research resources; writing based on original research or experimentation. Scholarly research is usually published in research journals and is highly respected because the writing had to be peer-reviewed by experts in the same field before publication. Some possible free, open access resources are:

* [Directory of Open Access Journals](https://doaj.org/)
* [Google Scholar](https://scholar.google.com/)
* [InfoMine](http://www.infomine.com/)
* [Infotopia](http://www.infotopia.info/science.html)
* [Medscape Reference](http://reference.medscape.com/)
* [National Science Digital Library](https://nsdl.oercommons.org/)
* [Public Library of Science](https://www.plos.org/)
* [Science Direct](http://www.sciencedirect.com/)
* [Wiley Online Library](http://onlinelibrary.wiley.com/)
* [OAIster](http://www.oclc.org/oaister.en.html)
* [WorldCat](https://www.worldcat.org/)

1. **Your Clearly Stated Research Question:**
2. **Background Information and Works Cited:**

*Complete the table below with a summary of information for each of the items to research. For each item to research, find at least two sources of relevant information. Reference at least five different sources total.* [*EasyBib*](http://www.easybib.com/) *is a great tool for quickly and accurately citing information.*

|  |  |  |
| --- | --- | --- |
| **Suggested Items to Research** | **Summary of Information**  (avoiding plagiarism) | **Works Cited List**  ([MLA documentation](https://owl.english.purdue.edu/owl/resource/747/01/)) |
| Biological process being investigated   * What is the process? * Where does it occur? * When does it occur? * Why does it occur? * How does it occur? |  |  |
| Type of organism or molecule being studied.   * Its scientific name * Its structure * Its function * Its handling / care/ safety / ethics |  |  |
| Independent Variable (manipulated)  (or correlation variable #1)   * Its structure * Its function * How it can safely and ethically be manipulated |  |  |
| Dependent Variable (responding)  (or correlation variable #2)   * Its structure * Its function * How it can best be measured, recorded and observed |  |  |
| Expectations   * What is already known about the relationship between the variables? * Why would these variables have a relationship? * What have other similar investigations found? |  |  |
| Techniques   * How has this topic been studied in the past? |  |  |

IB Biology Year 2 – Homework CONTINUED:

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Period \_\_\_\_\_\_

**Mesocosms**

**AIM: Setting up sealed mesocosms to try to establish sustainability. (Practical 5)**

Mesocosms are small experimental areas that are set up as ecological experiments. Fenced-off enclosures in grassland or forests could be used as terrestrial mesocosms; tanks set up in the laboratory can be used as aquatic mesocosms. Ecological experiments can be done in replicate mesocosms, to find out the effects of varying one or more conditions. For example, tanks could be set up with and without fish, to investigate the effects of fish on aquatic ecosystems. Another possible use of mesocosms is to test what types of ecosystems are sustainable. This involves sealing up a community or organisms together with air and soil or water inside a container.

**Research Question**: What elements are needed to create a sustainable mesocosm?

**You will design and construct a mesocosm. Record data in a lab notebook for 4 weeks and write a lab report.**

**Both the lab notebook and lab report will be due Monday August 31st**

The following sites may help with the setup of your mesocosm:

* [www.youtube.com/watch?v=VPog7W7J5ps](http://www.youtube.com/watch?v=VPog7W7J5ps)
* [www.whoi.edu/oceanus/feature/mesocosm-lab](http://www.whoi.edu/oceanus/feature/mesocosm-lab)
* [www.sumanasinc.com/webcontent/animations/content/winogradsky.html](http://www.sumanasinc.com/webcontent/animations/content/winogradsky.html)
* [freegame3.com/virtual-ecosphere/](http://freegame3.com/virtual-ecosphere/)
* [lhicks2015.weebly.com/design-process.html](http://lhicks2015.weebly.com/design-process.html)
* <https://www.philpoteducation.com/mod/book/view.php?id=829#/>
* <https://ib.bioninja.com.au/standard-level/topic-4-ecology/41-species-communities-and/mesocosms.html>
* magzinr.com/user/D\_Faure/mesocosm

You should consider these questions before setting up either aquatic or terrestrial mesocosms.

• Large glass jars are ideal but transparent plastic containers could also be used.

o Should the sides of the container be transparent or opaque?

o Which type of container will trap more heat?

o Which type of container will provide a better seal?

• Which of these groups of organisms must be included to make up a sustainable community: autotrophs, consumers, saprotrophs and detritivores?

o How many organisms should be included from each group?

• How can we ensure that oxygen supply is sufficient for all the organisms in the mesocosm as once it is sealed?

o Oxygen should not be able to enter, and carbon dioxide or water should not escape.

• How can we prevent any organisms suffering as a result of being placed in the mesocosm?

o What kind of information will you need to research about the tolerances of each organism that you plan to use?

**Here are some components you should consider while planning your mesocosm:**

Soil – The productivity of soil depends on mineral content, drainage, water-holding capacity, air spaces, biota (animals present e.g. larvae) and the potential to hold organic matter.

Seeds/plants – As you have a limited growing space, your plants will need to be small. There will be a limited selection of seeds from the lab, or you can see what is available to purchase.

Organic matter – A mix of leaves, grass, and easily decomposed food such as fruit (do not include citrus fruit or peelings) could be used but you should think carefully about what proportion of each of these components you should use.

Invertebrate Organisms – Insects such as fruit flies and larvae can help decompose the detritus. Snails are also effective decomposers.

Water – Tap water may be treated with chemicals and so should not be used in the aquatic chamber. What would be a good source of water? Local pond water will already have microorganisms in it.

Substrate – You should put gravel or sand at the bottom of this chamber. Organisms you put in this chamber may need this substrate as part of their life cycle, or as a refuge.

Organisms – Invertebrates could be used in your mesocosm, but you should be careful to select them carefully, and limit the number of larger organisms in this chamber. Vertebrate organisms should be avoided if possible, but could include fish or frogs. Add only the number of consumers that the chamber will support.

**Data Gathering:**

**You will maintain a lab notebook. (40 points total)** This can be a physical bound composition notebook like you used for last summer’s plant experiment or you can maintain digital lab notebook using something like a Google Doc or Google Slides (it might be easier to upload and organize pictures)

Date and document all phases of your research, experimental design, data collection, conclusions, errors or problems encountered and suggestions for possible future research. Do not erase content put into lab notebooks, in order to make corrections, draw a line through what needs to be changed (make sure you can still read the old hand writing) and rewrite near, above, or on the side of what was crossed out.

You will need to record data 2-3 times a week. In addition you must take pictures along with your written qualitative and quantitative observations.

You must record data for a minimum of 4 weeks.

**\*If the mesocosm fails within a few days, start over with another idea (it is not an excuse to stop doing the assignment)\***

Each observation should include:

• The date of your observations.

• The number of days the ecosystem has been running.

• Qualitative observations (e.g. decomposition rate, turbidity of water, and status of the species present).

• Quantitative observation (e.g. plant height and numbers of organisms)

Additional observations can include the following if you have the materials to do so:

• pH of the soil/water - You can do a before and after test since the mesocosm is sealed.

• Temperature – You can use a stick-on thermometer sold at most aquarium stores or record ambient room temperature.

• Dissolved oxygen content of the aquatic chamber – You can do a before and after test since the mesocosm is sealed. Be aware! The chemicals for this test are hazardous and expensive!

• Additional measurements (e.g. Analysis of nutrients – NPK content, etc) – You can do a before and after test since the mesocosm is sealed. Most aquarium stores sell cheap dip-strip kits that will give a good analysis of relevant nutrients.

**Lab Report (40) pts total:** In order to facilitate the scientific process of sharing data with other colleagues, you will write a lab report with the following information about your mesocosm:

1. Introduction (5 pts):

A. Introduce the concept of a mesocosm.

B. Give at least one specific example of how mesocosms are useful for actual scientific research, and how mesocosms are used to establish an ecosystem’s sustainability.

C. Discuss our research question: What elements are needed to create a sustainable mesocosm?

D. Hypothesis: Will your mesocosm be sustainable? Discuss why or why not.

E. Variables - Ideally in an experiment one variable is changed (the independent variable) and one is measured (the dependent variable). In ecosystems, there are many different variables operating at the same time. What variables will you be measuring in your mesocosm? You may want to try and change one variable and record the effect on a linked dependent variable. Which variables will you be aiming to keep the same (control variables)? It is possible that you will not be able to control other variables – these should therefore be recorded.

2. Design (5 pts):

A. Describe in detail why you choose the materials and organisms for your mesocosm. Include any pertinent background research information.

B. Give a brief outline of how your mesocosm was assembled. Photos are very helpful for this!

C. Discuss your background research in relation to the tolerances of the organisms you included in your mesocosm.

3. Diagrams (4 pts):

A. Draw a diagram (or label a picture) that shows your mesocosm and the contents in each section if there is more than one chamber.

B. List the abiotic and biotic components. Each member of the class will have different components in their ecosystems – this will make comparisons between different mesocosms possible.

4. Food Webs (for organisms placed in your chamber) (4 pts):

A. In a diagram, draw the food web you expect to see in your mesocosm.

i. Draw each organism as a circle and give the names (scientific or common name).

ii. Identify the role of each organism using appropriate letters. For example; producer – P; primary consumer (or herbivore) – C1; secondary consumer (omnivore/carnivore) – C2; tertiary consumer (carnivore) – C3; decomposer – D.

iii. The arrows should be directed from the energy source towards the organism that gets that energy (the arrows represent energy flow). Be sure to include the source of energy for your mesocosm, sunlight!

iv. Arrange the food webs so producers appear at one level (the bottom of the figure), primary consumers at the next level, and so on.

5. Presentation and Analysis of Data (8 pts):

A. Present a record your data either in titled tables or a descriptive narrative. Make sure you include all qualitative data and quantitative data with relevant units.

B. Analyze at least two of the types of quantitative data you collected through graphing. Make sure you label axes and include relevant units.

i. State whether the variables change over time.

ii. Discuss the trends are shown through the graphs.

6. Discussion and Conclusions (12 pts): Be sure to address the following points

A. What were the main limitations of your study (include at least five)?

B. How may these limitations have affected your experiment?

C. How could you avoid these limitations if you were to do the experiment again?

7. References (2pts): List at least two references you used in your research. Use APA format.