**2023**

**Year 12 Integrated Science – Unit 3**

**Task 1: Abiotic factors of ecosystems**

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| **Assessment Type:** |  | Name: |  |
| Investigation |  |
| **Duration & Conditions:** |  | Teacher: |  |
|  |  |  |  |
| **Assessment weighting:**  5 % of year mark |  | Date: |  |

|  |  |
| --- | --- |
| **Section** | **Marks** |
| **Part one: Research** |  |
| **Part two: Analysis** |  |
| **Part three: Findings** |  |
| **Total Mark** |  |

*I acknowledge that all the information contained in this task is my own work and not taken from other sources. If other sources have been used they have been acknowledged in my references.*

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(Student Signature)

*Please see SEQTA for teacher feedback and comments.*

**Investigation – measuring and comparing the abiotic factors of two aquatic ecosystems.**

**Background information**

The abiotic (non-living) factors in an ecosystem include temperature, turbidity, pH, dissolved oxygen, nitrate levels and phosphate levels. These non-living factors can have considerable impact on aquatic ecosystems, particularly if they impact autotrophic organisms.

A summary of information relating to the abiotic factors found in ecosystems is below.

1. **Temperature**

Organisms have an upper and a lower temperature limit beyond which growth and reproduction will stop. There is an optimum temperature range within which maximum growth occurs. Water temperature decreases as the depth of the water increases. Temperature can also affect other abiotic factors, such as the amount of dissolved gases that can be held within the water body. Most local fish prefer temperatures of between 15°C and 25°C. Fish can survive warmer water, but only for short periods of time.

Temperature is measured with a thermometer.

1. **Turbidity**

Turbidity is the measure of the amount of finely divided solids suspended in the water. These suspended solids may consist of plankton, organic and inorganic detritus, sand, clay or silt. These occur naturally in bodies of water, but may be added to by human activity. Increased levels of turbidity can affect aquatic organisms in several ways. Turbidity can:

1. reduce the amount of light available to photosynthetic organisms, reducing aquatic plant growth
2. affect food available for consumers
3. affect gas exchange in organisms (silt blocking gas-exchange surfaces)
4. act as a transporting medium for pollutants such as pesticides and heavy metals.

Turbidity is measured with a turbidity tube.

1. **pH**

pH is the measure of how acidic or basic a solution is. The normal range of pH in a freshwater system is between 6.0 and 9.0. A change in pH can have serious effects on the life in an aquatic ecosystem. It can cause the death of fish, larvae and eggs and it may also reduce the productivity of organisms. Higher levels of carbon dioxide in the water will lower the pH of the water, making it more acidic. The ideal range for freshwater aquatic organisms is between 6.5 and 8.

pH is measured with universal indicator and a pH chart.

1. **Dissolved oxygen**

Most organisms require oxygen for survival. Oxygen is available in the water in a dissolved form. The oxygen is produced from photosynthetic activities of water-living autotrophs (producers), diffusion at the air-water surface and mixing by wind. The level of oxygen is also directly related to:

1. temperature – as the temperature of the water rises, the dissolved oxygen (DO) level falls and, as the temperature of the water falls, the DO level rises
2. the amount of living material in a water body – the more organisms, including bacteria and fungi, the higher the level of biochemical oxygen demand and the lower the level of dissolved oxygen. Organisms are particularly sensitive to oxygen levels in their juvenile stages.

DO is measured in units of mg/L. The ideal range of DO for stream fish is 7–11 mg/L.

DO is measured using a DO meter.

1. **Salinity**

Salinity is a measure of the content of salts in soil or water. Salts are highly soluble in surface and groundwater and can be transported with water movement.

1. **Nitrate**

About 80% of the air is nitrogen but most organisms cannot use it in this form. Nitrogen is needed to build proteins. Nitrogen found in the air can be converted into a useable form and released into the soil by organisms such as blue-green algae and some legumes. When an animal consumes a plant, it can then use this form of nitrogen. Nitrates contain nitrogen and usually enter aquatic ecosystems by the decomposition of dead plants and animals and their wastes. Humans introduce nitrates into these systems by sewage and excessive fertiliser use in gardens. The fertilisers end up in drains when sprinkler systems run onto roads and down drains. In some instances, it can lead to significant plant growth called algal blooms. These blooms initially produce greater quantities of DO; however, when they die, much more oxygen is consumed by the decomposers, leaving little oxygen available for other aquatic organisms. Nitrate levels are usually less than 1 mg/L. Concentrations over 10 mg/L will have an effect on any freshwater environment.

Nitrate levels are measured by nitrate probes.

1. **Phosphate**

Plants and animals require small doses of phosphorus (phosphates) for healthy growth and development. Freshwater ecosystems have very low supplies of phosphates compared with other ecosystems. Problems arise when there is a slight increase in these levels as this can also lead to algal blooms. Large streams have levels of phosphates around 0.1 mg/L while smaller streams have levels of only 0.01 mg/L. The impact is, therefore, much greater in smaller streams.

Phosphate levels are measured by the total orthophosphate test. The sample is added to chemicals and allowed to react. The chemicals turn dark blue when phosphate levels are high. A lighter shade of blue would indicate less phosphate in the sample.

**Task:**

This task requires the use of **three** different aquatic ecosystems (Beach, River, and Wetland), perform analysis on samples, and present your findings in a scientific report. The three aquatic ecosystems have different surrounding land or water use. One area is impacted my marine traffic, the second has been impacted by significant development of the surrounding the area, and the third has been impacted by development, but is in the process of being restored.

There are three phases to this assessment: research, analyse, and findings.

**Part one: Research and planning – 12 marks**

In your research, you will determine to what extent the abiotic factors may be impacted by the land use of the supporting the aquatic ecosystems.

1. Research the history of the three ecosystems. Research should include:
   1. The use of the land surrounding the ecosystem
   2. The possible effects of the land use on water quality
   3. Rainfall data for the ecosystem
2. Draw a landscape sketch of each of the aquatic systems, noting natural landforms and evidence of human activity. Use of Google Earth or any other suitable program/software is suggested.
3. To use the sampling equipment correctly, you will need to practice:
   1. Using the following pieces of equipment
      1. Thermometer (in air and water)
      2. Turbidity tube
      3. Universal indicator and a pH chart
      4. Dissolved oxygen meter
      5. Nitrate probe
   2. Conducting the orthophosphate test on known concentrates
4. The above pieces of equipment and tests will be used to measure the seven abiotic factors in the ecosystem.
5. A sample will be provided to you from each of the different locations. Discuss how your group will record the readings for each abiotic factor. Your readings will be shared with the class to collate data and calculate an average.
6. A table of your raw data and class averages needs to be drawn.
7. Each group must determine task responsibilities for each group member, to maximise the time available for the measurement of abiotic factors as you will only have one lesson to analyse the samples.

**Ecosystem History**

**Ecosystem one:** South Beach, Fremantle, Western Australia

Surrounding land use:

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Possible impacts of the land use on the water quality:

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Rainfall data for the ecosystem:

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Landscape sketch:

**Ecosystem History**

**Ecosystem two:** Deep water point, Mount Pleasant, Western Australia

Surrounding land use:

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Possible impacts of the land use on the water quality:

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Rainfall data for the ecosystem:

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Landscape sketch:

**Ecosystem History**

**Ecosystem three:** Mary Carroll Park, Gosnells, Western Australia

Surrounding land use:

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Possible impacts of the land use on the water quality:

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Rainfall data for the ecosystem:

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Landscape sketch:

**Part two: Analysis – 11 marks**

Mark the sample location on your landscape sketch. You will take readings of the six physical abiotic factors: turbidity, pH, dissolved oxygen, salinity, nitrate, and phosphate.

* Before you start, analyse the photos provided of the ecosystem. Has there been any disturbances to the landscape? Is there any evidence of human impact?
* At the first sample, test and record the results of the six factors measurements.
* Repeat abiotic factor testing for the second and third location samples.
* Record data on class spreadsheet.

Using an “X”, mark the sample locations on each of your landscape sketches.

Who will be conducting each of the six physical abiotic factor tests?

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Turbidity: |  | pH: |  | Dissolved  oxygen: |
| Salinity: |  | Nitrate: |  | Phosphate: |

**Materials:**

Outline the equipment used to test the abiotic factors (including quantities):

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
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**Ecosystem one: South Beach, Fremantle, Western Australia**

What disturbances are there to the landscape around the ecosystem? What evidence is there of human impact?

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|  |  |
| --- | --- |
| Abiotic factor: | Measurement: |
| Turbidity |  |
| pH |  |
| Dissolved Oxygen |  |
| Salinity |  |
| Nitrate |  |
| Phosphate |  |

**Ecosystem two: Deep Water Point, Mount Pleasant, Western Australia**

What disturbances are there to the landscape around the ecosystem? What evidence is there of human impact?

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|  |  |
| --- | --- |
| Abiotic factor: | Measurement: |
| Turbidity |  |
| pH |  |
| Dissolved Oxygen |  |
| Salinity |  |
| Nitrate |  |
| Phosphate |  |

**Ecosystem one: Mary Carroll Park, Gosnells, Western Australia**

What disturbances are there to the landscape around the ecosystem? What evidence is there of human impact?

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|  |  |
| --- | --- |
| Abiotic factor: | Measurement: |
| Turbidity |  |
| pH |  |
| Dissolved Oxygen |  |
| Salinity |  |
| Nitrate |  |
| Phosphate |  |

**Part three: findings**

Process, evaluate and communicate your findings.

* Results:
  + Collate all results for the abiotic factors measurements and land use observations
  + Represent all data in a table
  + Include appropriate titles and headings
  + Use a column to display the average of each of the sample ecosystems
* Discussion:
  + Identify any differences between the three ecosystems
  + Support your findings with data from the table
  + Relate these differences to the history and land use surrounding the three ecosystems
  + Account for any anomalous results
  + Suggest ways in which the collection of data could have been improved
* Conclusion:
  + Summarise your findings
  + Suggest why there were differences between the three ecosystems
  + Discuss how the differences in three physical abiotic factors can impact the organisms living in each ecosystem

**Results:**

Draw a table in the below space of the collated class data, including an average calculation for each physical abiotic measurement.

**Discussion:**

What are the differences between the three ecosystems?

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What does the collated data suggest about these differences?

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How are these differences influenced by the land use and history of the surrounding area?

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Are there any anomalies in the data?

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How could the data collection methods be improved?

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**Conclusion:**

Provide a summary of the findings at each ecosystem.

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Suggest why there were differences between the three ecosystems.

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Discuss how differences in three of the measured physical factors can impact the organisms living in each ecosystem.

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**END OF ASSESSMENT**

**Marking Key:**

1. Research:

* provide a brief history of the land use and development of the area surrounding each ecosystem
* discuss the possible effects of the land use on water quality
* include rainfall data for the **three** locations
* include a landscape sketch or photograph/s of each aquatic ecosystem

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Brief history of the land use and development of the area surrounding each ecosystem | 1–3 |
| Possible effects of land use on the water quality of each ecosystem | 1–3 |
| Impact of rainfall data on physical factors at each ecosystem | 1–3 |
| Landscape sketch or photograph/s of each ecosystem | 1–3 |
| **Total** | **/12** |

2. Materials: outline the equipment used (include quantities)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Provides a comprehensive list of materials and  quantities  List of materials and quantities included, but some omitted | 2  1 |
| **Total** | **/2** |

3. Analysis:

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Evidence of landscape disturbances around each ecosystem  Evidence of human impact to each ecosystem  Correct measurements of each abiotic factor taken for each ecosystem | 1-3  1-3  1-3 |
| **Total** | **/9** |

4. Results:

* collate all the results for the physical measurements and land use observations
* represent all the data in a table
* include appropriate titles and headings
* include a column for the average of the abiotic factors taken at each ecosystem

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Data included from all groups | 1 |
| Data represented in a well-constructed table | 1–2 |
| Appropriate titles for table | 1 |
| Column for each factor | 1 |
| Column for averages | 1 |
| **Total** | **/6** |

4. Discussion:

* identify any differences between the two ecosystems
* support your findings with data from the table
* relate these differences to the history and land use surrounding the two ecosystems
* account for any anomalous results
* suggest ways in which the collection of data could have been improved

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Lists differences between the two locations | 1–2 |
| Supports the trends with data from the table | 1–2 |
| Relates the differences to the land use history | 1–2 |
| Accounts for anomalous results | 1 |
| Suggests ways in which the collection of data could be improved | 1 |
| **Total** | **/8** |

5. Conclusion:

* summarise your findings
* suggest why there were differences between the **three** ecosystems
* discuss how the differences in **three** physical factors can affect the organisms living in each ecosystem

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Provides a summary of the findings at each ecosystem | 1–2 |
| Relates land use to the differences in physical factors | 1–2 |
| Relates differences in three physical factors to the organisms living in each ecosystem | 1–3 |
| **Total** | **5** |