**Investigating the effects of chemical elements on the growth of algae**

**Teacher / Technical Guide**

**Curriculum links**

**National 4 Unit 3, Life on Earth**

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| **Key areas**  | **Suggested learning activities**  | **Exemplification of key areas**  |
| 4 Fertiliser design and environmental impact of fertilisers.  | Explore the use of natural and artificial fertilisers and the advantages/disadvantages of each eg cost, specificity, purity, NPK composition.  | Nitrogen can be added to the soil in the form of nitrate fertilisers, manure or compost. When crops are harvested, nitrogen is taken out of the cycle so needs to be replaced.  |

**National 5 Unit 3, Life on Earth**

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| Mandatory Course key areas  | Suggested learning activities  | Exemplification of key areas  |
| c. Nitrogen in EcosystemsAnimal and plant proteins are produced from nitrates.5 Human impact on the environment b. Fertilisers can leach into fresh water, causing algal blooms.  | Construct simple flow diagrams that illustrate the cyclical activities in the Nitrogen cycle. Investigate the importance of minerals such as nitrates and magnesium for plant growth.  | Fertilisers supply nitrates to increase yield. There are opportunities throughout this topic for learners to investigate and debate ethical issues. |

This practical activity is based on a method of investigating the effects of minerals on plant growth suggested by the Nuffield Foundation / Biosciences Federation:

[www.nuffieldfoundation.org/practical-biology](http://www.nuffieldfoundation.org/practical-biology) (accessed 28th October, 2012)

As an alternative to setting up mineral deficiency experiments with plants, the suggestion here is to use algal cultures.

The **purpos**e of this practical activity is to:

* investigate how lack of particular chemical nutrients affects the growth of green algae (this can then be related to similar effects on the growth of plants)
* find out which elements are most important for healthy growth and, later, link this to the role of fertilisers in plant / crop cultivation and PKP values for fertilisers

*Scenedesmus quadricauda* is a common freshwater alga. In this investigation algal cultures are set up in Sach’s water culture solutions and allowed to grow for several weeks. Sach’s water culture solutions are available from school science educational resource suppliers.

*Scenedesmus* is available from Darwin Biological: <https://www.darwinbiological.co.uk/products/scenedesmus>.

A litre of algal culture is required. Results can be collected at any time from 1 – 4 weeks (or longer).

Flasks should be left close to a light source. The lamp can be turned off at night, or left on constantly.

Algae are considered to be level 1 microorganisms (see *Safety in Microbiology A Code of Practice for Scottish Schools and Colleges,* SSERC, 2012) having little, if any, known risk. However, hands should be washed prior to and on completion of the activities involved in this practical work. Similarly, benches should be swabbed with 1% bleach prior to and on completion of the work

Discard jars containing the appropriate concentration of VirkonTM  should be made available for sterilising used pipettes and microscope slides.

Used algal samples should be sterilised by autoclaving before they are discarded.

Algal population growth can be assessed by:

* Comparing colour and turbidity by eye. Pupils could photograph the cultures and note changes over time.
* Comparing absorbance using a colorimeter set at 665 nm and calibrated using distilled water.
* Observing and comparing hanging drops of the algal cultures using a microscope. See the Preparing a Hanging Drop Help Card.
* Comparing algal cultures using a microscope and haemocytometer. A method for enumerating microorganisms using a haemocytometer is available on the SSERC website: [www.sserc.org.uk](http://www.sserc.org.uk)

In conjunction with the practical work, pupils could research:

* How mineral deficiencies affect plants (mineral deficiency symptoms)
* The composition of fertilisers and PKP values
* The role of fertilisers in crop cultivation and food production
* The benefits of fertilisers in world food production
* Problems fertiliser use can cause

**Materials and chemicals**

***For each group of pupils***

* Small bottle containing a culture of *Scenedesmus*
* 5 x 250 cm3 conical flasks which have been numbered, labelled and fitted with loose fitting foil covers, or cotton wool plugs. Each flask containing 100 cm3 of growth medium (see table).
* 1 cm3 plastic pipette
* Marker pen
* 1% bleach
* Access to a discard jar

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| **Flask** | **Growth medium** |
| 1 | Distilled water |
| 2 | Complete medium |
| 3 | Medium without nitrogen |
| 4 | Medium without phosphorus |
| 5 | Medium without potassium |

**Materials for preparing the hanging drop**

Using the hanging drop method for observing the algae under the microscope avoids the use of fragile coverslips and avoids the expense of cavity slides.

***For each group of pupils***

* Microscope
* Two glass
* Lens tissue
* Pipette
* Blu-takTM
* Paper towels