Green Grunge – Teacher Notes

By: Louise Lopes

Introduction:

This investigation has been designed to engage students with open inquiry, while teaching laboratory skills and separation techniques. Students will be required to plan and conduct their own experiment with the equipment that is provided. Students are asked to analyse what separation techniques were successful or not, as well as evaluate their experiment for any errors.

This investigation is appropriate for students in grades 7-8. Ideas for extension are provided that could suit advanced students. Students will benefit from identifying key terms such as pure substances, mixtures, solvent, solute and sediment. Students will also be exposed to multiple separation techniques, such as filtration, decantation, evaporation and crystallisation (if the extension activity is chosen). References to how these techniques are used in the home will allow students to connect the dots about how common they are. Year 8 students will be able to identify whether physical or chemical changes are taking place.

This experiment has been planned to have various physical changes occur that students will delight in observing, such as colour changes and liquid-solid transitions. Students are asked to record these observations so that they can understand what occurred by applying scientific knowledge. Topics for discussion that incorporates classroom theory are suggested.

Question:

An aim has been provided to students. They are to be given a container with a mixture of pebbles, ground chalk and copper sulphate crystals. Students are asked to separate the mixture into three individual containers.

Students are to write a hypothesis. To assist them in making informed predictions, they are asked to examine what they have been given. Students must classify each component that they can see into three layers – what is likely to be sediment, what will be suspended and what is a solute? This step is to help students predict what the appropriate separation technique for each will be.

Plan:

Students are provided with a materials list and are asked to write their own method. Allow students time to explore the materials and to write a plan, as there is an order to when things must happen for each component to be successfully separated into its own container. **Copper sulphate is an irritant, so gloves must be worn when handling it.**

Students may require guidance when planning their experiment. The correct procedure is provided below:

Sediment: add water to the mixture contained in the large beaker. The water acts a solvent to copper sulphate crystal. When the mixture is stirred, the light chalk particles will be suspended. The high-density pebbles will settle to the bottom of the beaker.
Decanting: carefully pour the liquid into another container without disturbing the pebbles.
Filtration: place filter paper in the funnel by folding into quarters. Place funnel in a conical flask. Pour the liquid slowly into the paper so that it doesn't run over the sides. The pure copper

sulphate solution will flow out. The ground chalk will be sitting on the filter paper. It can be collected and placed in a separate container.
Evaporation: boil the copper sulphate solution so that the water content will evaporate.

If more structure is required in this investigation, a table such as the following could be provided to students:

Substance that you will separate and collect	Name of the process you will use	List of Equipment you will use	List of any risks with substances or equipment or process being used	Labelled sketch of Equipment (use pencil please)
1.				
2.				
3.				

If students don't have the required laboratory skills, then class demonstrations on how to use filter paper and Bunsen burners should be performed. Alternatively, the heating element could be removed from the investigation and an evaporative dish provided only. Students can sit the solution in-front of a window for over 24 hours in order to still use evaporation as a separation technique.

Teachers can include a tea strainer or a cheese cloth in the materials list. Students will find that these items will not remove the chalk from the solution, while the filter paper can. This is because the pores of the filter paper are small enough to prevent the chalk from passing through it.

Conduct:

As the students work in the lab, they are asked to record their observations. As these will be used to explain what is happening later on, students should add as much detail as possible.

Likely observations are as follows:

Students will see that when water is added to the mixture and stirred, the blue copper sulphate crystals readily dissolve and are no longer perceivable. The mixture will look like sludge and the colour will depend on the colour of the chalk. Students may note that the pebbles will settle to the bottom quite quickly as they are much heavier. They will note that during the filtration process, the chalk will appear like a layer of scum on the filter paper that can be scraped off. They will note that the solution that drips out of the filter paper will be blue and transparent. Students should see that as the water is evaporated out of the solution, it will become a darker shade of blue. Eventually the copper sulphate will be seen in a separate solid state.

Extension: Students may take extra precautions to ensure their substances are completely separated in each container and with minimal losses. Students may wash the pebbles with a strainer and leave to dry. The chalk can also be allowed to dry. Students can measure these dried substances with a scale. These measurements can be used later for analysis.

Analyse:

Students must analyse the results of their experiment by stating whether they believe the separation techniques were successful. They will have to explain their reasoning. Students will be able to know that their separation techniques were successful when they see physical changes occur, such as changes in colour, texture and consistency.

Extension: For a more advanced analysis, teachers may adapt the investigation so that an exact amount of each substance is put into the mixture before class. These numbers could be kept secret from students until they have completed the experiment and taken measurements of the separated substances. The lab group which have numbers closest to the initial measurements have performed the experiment the most effectively and with the least amount of wastage.

Problem-Solving:

In this section, students are asked to look back on their observations and explain what has happened using scientific knowledge. Encourage students to use scientific terms in their explanations. The key terms that can be applied here are: Solute, Solvent, Sediment, Solution, Suspension, Decanting, Evaporation, and Filtering.

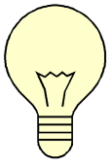
If students require more guidance in explaining what occurred, then they may be provided with the following theory:

When a substance **dissolves** it is a **solute**. The liquid which a solute dissolves into (usually water) is called a **solvent**. The process of **sedimentation** is when a heavier component of a **mixture** settles to the bottom of the container. The process of **decantation** is when a solution is carefully poured so that sedimentation is left behind. The **solution** that is collected by decantation is called the **decantate.** Fine particles that do not **dissolve** in the water, but are too light to settle to the bottom of the container, remain **suspended** in the solution. Filter paper has small pores that fine particles cannot pass through. The solution that is collected after **filtration** is called the **filtrate**. During **evaporation**, any dissolved substances are left behind.

Discussion: Some separation techniques are more efficient than others. Discuss with students why filtering is better than decanting. Discuss with students why the various colour changes occurred. Students can be asked to think of any activities done at home that also use the same separation techniques. These can be shared with the class. One example is wine bottles: As they contain sediment, wine should be allowed to settle in the bottle for 24 hours. It is then decanted into a specially shaped glass container, called a decanter.

Extension: Crystallisation is another separation technique, where a solid is formed within a liquid. Under specific conditions, the atoms or molecules of a chemical will organise into a tight structure which produces a crystal. Copper sulphate can be turned into blue crystals that look like jewels. This is done by saturating water with copper sulphate. Add enough copper sulphate to

very hot water, until it stops dissolving, and then allow the solution to cool very slowly. See a video of a large crystal being formed here: https://www.youtube.com/watch?v=FKCS1DvORug



In the home: Copper sulphate is sometimes added to pools to control algae, but it can cause stains. To remove this chemical from the water we can't use evaporation to remove it because there is so much water! People instead use a chelating agent, which binds to the copper sulphate, stopping it from being dissolved, thereby allowing it to be picked up in the pool's filtration system.

Evaluate: Students are required to evaluate their experiment. They can answer the following questions:

1. Was the method that you planned the most suitable for this experiment? Why, why not?
2. What were the factors/variables that influenced your results? Was there any human error?
3. What improvements would you make if you were to re-do this experiment?

Conclusion:

Students are provided with a framework in order to write a conclusion. Students will fill out the blanks to say whether their aim was achieved and why. They will answer how their hypothesis compared to their actual results, making mention of any differences and similarities. Students will then conclude the investigation by stating what has been proven.

Image Reference:

OpenClipart-Vectors, https://pixabay.com/en/bottle-milk-bottle-decanter-35498/
CC0 Creative Commons: https://pixabay.com/en/service/terms/#usage