ASELL SCHOOLS
Advancing Science & Engineering through Laboratory Learning

ASELL for Schools Science Workshop

Laboratory Learning Activity Manual

Maribyrnong College

1 September 2016

ASELL SCHOOLS Advancing Science & Engineering through Laboratory Learning
Australian Council of Deans of Science
ReMSTEP
Australian Government Department of Education and Training Office for Learning and Teaching
DEAKIN UNIVERSITY

ACKNOWLEDGEMENTS

We would like to thank:

WELCOME

Welcome to ASELL for Schools Science Workshop!

ASELL (Advancing Science and Engineering through Laboratory Learning) has developed over the last 16 years. This project developed from its physical chemistry APCELL predecessor and then expanded to incorporate all of chemistry (ACELL). After successful trials of using ASELL principles at workshops in physics and biology, the project has now expanded to include biology and physics, and more recently engineering, hence the name change.

The ASELL project has been designed to help address challenges in student learning which arise in science laboratories. By bringing together diverse expertise and resources, it is possible to develop a collection of experiments, which can facilitate student learning, whilst also taking into account variations in student differences. In 2010, the first national ASELL Science Workshop was held at the University of Adelaide.

This ASELL for Schools workshop is run under an Australian Mathematics and Science Partnership Funding Grant, which was awarded to ASELL in 2014. This phase of the project has been initiated by Deakin University in conjunction with the University of Sydney with support from ReMSTEP and the Australian Council of Deans of Sciences. With the introduction of the new Australian Curriculum now in place an with a new Victorian Curriculum to start in 2017, an opportunity exists to address current school-based experimentation and incorporate science inquiry. ASELL for Schools will provide the following three outcomes:

- A resource, a repository of experiments with all associated documentation necessary to run them, ranging from health and safety notes, necessary equipment and resources, notes for technical staff to the science learning objectives and how the experiment achieves them.
- Authentic professional learning workshops on experimentation in schools.
- An interface and interaction between school and university staff.

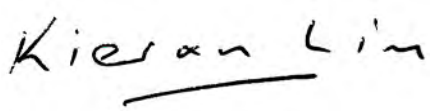
Today, you will be participating in laboratory activities and discussion sessions to expand your understanding of issues surrounding learning in the laboratory environment. In particular, it is important to be able to experience the experiments as learners.

In addition to the formal program, please take the opportunity to exchange ideas about science and education and get to know each other, as an additional aim of the ASELL for Schools project is to build a community of educators interested in laboratory-based education and other aspects of science education.

We would like to gratefully acknowledge the input of Laura Brockway and Geraldine Brooks in designing the laboratory learning activities, as well as the assistance of technical staff and others in making this workshop possible. A very big thank you to the team at Maribyrnong College, for hosting this Workshop. Each person has put in a lot of hard work to get this workshop set up and running. I want to thank everyone!

If you have any questions about the project, please speak with one of the Victorian ASELL for Schools team, who are present.

Sincerely,



Kieran Lim
ASELL for Schools Victorian Leader on behalf of the ASELL for Schools Team

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CONTENTS

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ASELL for Schools Victoria Team

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John Long, Deakin University
Peta White, Deakin University
Ian Bentley, Deakin University

Teachers attending the workshop

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Technical Staff

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ASELL FOR SCHOOLS SCIENCE WORKSHOP SCHEDULE

ASELL for Schools Maribyrnong College Thursday 1 September, 2016		
9:00 – 9:15	**Arrival/Registration** ***Social Staff Room***	
9:15 – 9:30	**Welcome and Introduction** with Dr Peta White • Introductions (of ASELL for Schools team and Students and Teachers) • Outline ASELL for Schools project – how to be involved? • Short-term and long-term research ***Venue B4/B5***	
9:30 – 10:00	**Teachers: Inquiry in Science** with Dr Peta White • How can we incorporate more science inquiry into experiments? • Introduction to the inquiry slider ***Venue B4***	**Students:** Pre Lab Session with Ian Bentley • "The Forces of Nature" ***Venue B5***
10:00 – 10:50	***Laboratory Session 1 – Exemplar Laboratory Activity Composite Materials with Dr Peta White*** ***Venue B4/B5***	
10:50– 11:00	Discussion and feedback on Laboratory learning activity ***Venue B4/B5***	
11:00 – 11:20	**MorningTea** ***Social Staff Room***	
11:20 – 11:30	Discussion and feedback on Laboratory learning activity ***Venue B4/B5***	
11:30 – 12:15	**Teachers: Unpacking GREAT ASELL for Schools LLAs** with Dr Peta White What does a great ASELL for Schools Laboratory learning activity look like? Science Inquiry skills, direct inquiry, representation construction pedagogy, and contemporary science ***Venue B4***	**Students: Sugar rock cycle** with Ian Bentley and Dr John Long ***Venue B5*** Discussion and feedback on activity ***Venue B5***
12:15 – 12:45	***Laboratory Session 2: Rocks (part A)*** ***Venue B4/B5***	
12:45 – 1:25	**Lunch** ***Social Staff Room***	
1:25 – 1:55	***Laboratory Session 2: Rocks (part B)*** ***Venue B4/B5***	
1:55 – 2:15	Discussion and feedback on Laboratory learning activity ***Venue B4/B5***	
2:15 – 3:00	**Teachers:** Overall debrief and Evaluation for the day with Ian Bentley ***Venue B4***	**Students:** Overall debrief and Evaluation for the day with Dr John Long ***Venue B5***

SCHOOLS

Advancing Science & Engineering through Laboratory Learning

LABORATORY SESSION 1
COMPOSITE MATERIALS

Contact: Peta White
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Composite Materials

What could be the same between the materials used a modern racing car and surfboard?

Racing car

http://www.tuvie.com/jaguar-xjr-19-lmp1-concept-race-car-for-the-year-of-2020/

Surfing

https://en.wikipedia.org/wiki/Surfing

Hint: focus on the how each is made (manufactured).

Today's Laboratory unpacks how composite materials can respond differently to unbalanced forces.

Change to an object's motion is caused by unbalanced forces, including Earth's gravitational attraction, acting on the object (ACSSU117)

A composite material is made from two or more materials with different physical or chemical properties that, when combined, produce a material with characteristics different from the individual components.

The individual components remain separate and distinct within the finished structure.

The new material may be preferred for many reasons: common examples include materials which are stronger, lighter, or less expensive when compared to traditional materials. More recently, researchers have also begun to actively include sensing, actuation, computation and communication into composites, which are known as Robotic Materials.

Typical engineered composite materials include:

- Composite building materials, such as cements, concrete
- Reinforced plastics, such as fiber-reinforced polymer
- Metal composites
- Ceramic composites (composite ceramic and metal matrices)

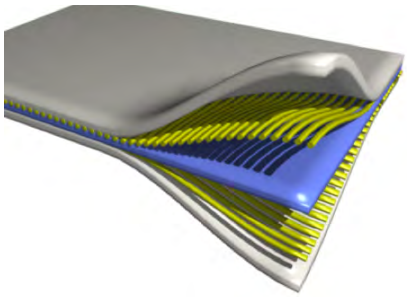
Composite materials are generally used for buildings, bridges, and structures such as boat hulls, swimming pool panels, race car bodies, shower stalls, bathtubs, storage tanks, imitation granite and cultured marble sinks and countertops. The most advanced examples perform routinely on spacecraft and aircraft in demanding environments.

https://en.wikipedia.org/wiki/Composite_material

Why do we make composite materials?

Consider the similarity between these two pictures.

http://www.grotecompany.com/applications/sandwich-production/



https://en.wikipedia.org/wiki/Composite_material

How do you think “sandwich structure” composite materials are made?

Your challenge…

Today you are a scientist who has been paid to design a stronger composite product for as little cost as possible. The following demonstration is to prepare you for the task.

Demonstration of the effectiveness of sandwich structures:

1. A polystyrene plank is not very strong.
2. When additional materials are layered onto the polystyrene it becomes a composite material and its properties change – it becomes stronger.

Draw and label the equipment and what happened

TASK 1

Re-do the demonstration with your group. You will need to work out a way of measuring the rigidity or how much bending there is for each individual weight added. Talk with your partner to decide how you will measure the amount of bending and record the data in the table below. Your support structures need to be 21cm apart.

Mass (gms)	Amount of bending for Polystyrene (cm)	Amount of bending for Sandwich Structure (cm)

Graph the data to show the difference between the polystyrene and the composite material.

Can you represent why you think the sandwich structure works to alter the strength and rigidity?

What is the role of the tape and what properties make it work well?

Would one piece of tape above or below the polystyrene be as effective?

TASK 2 - Challenge

Your job as a Scientist is to create a stronger composite material using the least amount of material (polystyrene and tape) to reduce cost.

Work with your group to design to strongest sandwich structure composite material using the least tape. Test each design for strength and rigidity to decide the best design.

Decide how you will collect your data for each trial and produce a report that describes the design that works best. Include evidence (data) and an explanation as to why (using diagrams and words).

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STUDENT ACTIVITY
SUGAR ROCK CYCLE

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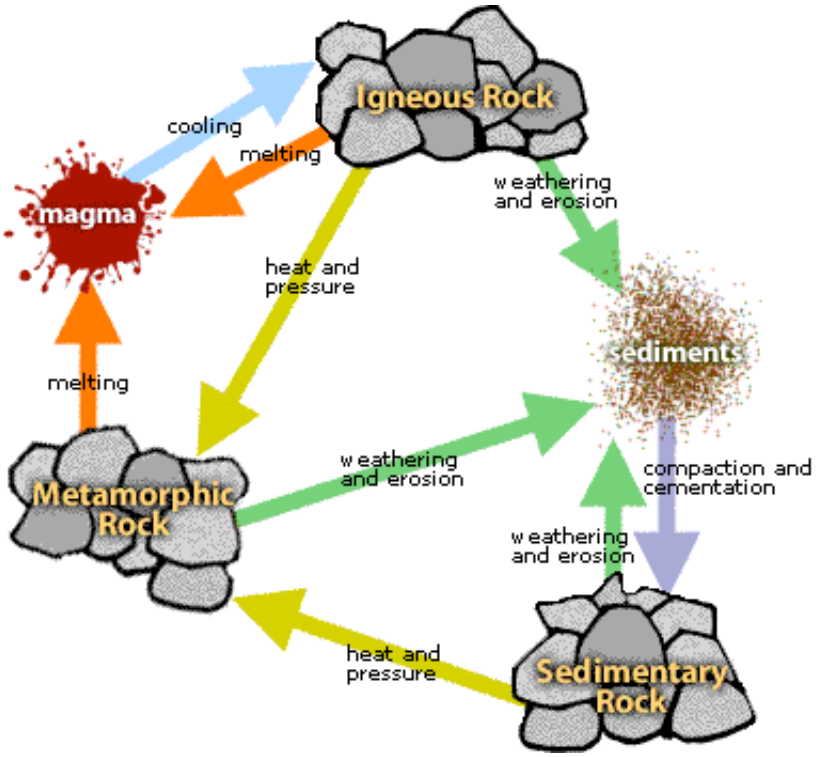
LABORATORY LEARNING ACTIVITY

Sugar rock cycle

Introduction



The rock cycle.
© 1997-2003, Wheeling Jesuit University/NASA Classroom of the Future™.
<www.cotf.edu/ete/modules/msese/earthsysflr/rock.html>

The rock cycle is a diagram that shows the slow, continuous process of rocks changing from one type to another. The rock cycle is a series of changes. Igneous rock can change into sedimentary rock or into metamorphic rock. Sedimentary rock can change into metamorphic rock or into igneous rock. Metamorphic rock can change into igneous or sedimentary rock.

The rock cycle is an illustration that is used to explain how the three rock types are related to each other and how earth processes change a rock from one type to another through geologic time. Plate tectonic movement is responsible for the recycling of rock materials and is the driving force of the rock cycle.

A trip through the rock cycle takes millions of years.

Available equipment

- Sugar cubes
- Candle or burner
- Test tube clamp or metal tongs
- Aluminium foil or small aluminium pie tray
- Hand lens
- Safety goggles

Hazards

You must wear safety glasses/goggles.

Activities and Results

Examine the sugar cube with a hand lens. How is the sugar cube like sedimentary rock?

Crush the sugar cube into a powder. What part of the rock cycle does this represent?

Make a “boat” with your foil. Pour the crushed sugar into the foil boat. What part of the rock cycle does this movement represent?

Use the test tube clamp or metal tongs to hold the boat over the candle flame. Observe as the sugar begins to melt. What part of the rock cycle does this represent?

Set the foil boat aside and let the sugar cool and harden. What part of the rock cycle does this represent?

Break the hardened sugar into pieces. What part of the rock cycle does this represent?

Findings

Describe how the rock cycle works.

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LABORATORY LEARNING ACTIVITY 2 - ROCKS FROM ANOTHER WORLD

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Contact: John Long
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LABORATORY LEARNING ACTIVITY

Rocks from Another World

Introduction

In 2016, scientists have just discovered a new planet near the star Proxima Centauri, which is the star closest to our solar system [Footnote *].

Artist's impression of the planet orbiting Proxima Centauri.
Credit: ESO/M. Kornmesser
<www.eso.org/public/images/eso1629a/>

It is now the year 3032. The Earth's natural resources are becoming scarce. An expedition is sent to an Earth-like planet near the star Proxima Centauri, four light-years away. You are in a scientific exploration team on this expedition to investigate whether there are any useful minerals, ores, gems, or rocks on the planet. After collecting samples you

* G. Anglada-Escudé et al., "A terrestrial planet candidate in a temperate orbit around Proxima Centauri", *Nature*, 25 August 2016 <nature.com/articles/doi:10.1038/nature19106>.

return to your base. At the base, you unload the collection of rocks that you collected. One by one you investigate the rocks by studying their appearance and some basic properties. Promising specimens will analysed further.

The location of Proxima Centauri in the southern skies. Credit: Y. Beletsky (LCO)/ESO/ESA/NASA/M. Zamani <www.eso.org/public/images/eso1629b/>

The aim of your team is to identify new sources of minerals and metals. Since different types of minerals and metals are associated with various types of rocks, the goal of this initial survey is to characterise and classify rock types, in order to predict the likelihood of finding economically valuable metals, minerals, gemstones, and ores, based on the presence of particular rocks at particular locations.

Available equipment

- Hammers and pounding boards (a plank or some plywood, or outside on the concrete)
- Safety glasses for each student
- Miscellaneous Rocks Collection
- Lab scales
- Magnifying glasses
- Coins for scratching rocks (copper is good, otherwise use 5 and 10 cent pieces)
- Nails for scratching rocks
- Glass pieces for scratching rocks
- A low-power optical microscope (optional)
- Unglazed ceramic tiles for streak plates
- 500-ml beakers
- 1000-ml beakers
- 500-ml graduated cylinders
- Glad wrap for wrapping rocks when measuring the volume in water
- Plastic ice-cream containers
- White vinegar
- Disposable eye droppers
- Worksheet and pens/pencils
- Coloured pencils
- Standard set of igneous rocks
- Standard set of metamorphic rocks
- Standard set of sedimentary rocks

Hazards

You must wear safety glasses/goggles.

- Rocks are heavy and can hurt when dropped on hands and feet;
- Water used to measure rock volumes can splash on the floor, causing slipping hazard;

- Hammers used to test the rocks for brittleness and hardness can cause damage or injury when used improperly;
- Flying rock fragments can enter the eye;
- Vinegar is a mild acid.

Experimental method

In this activity, you will use observations and simple tests to sort and group rock types. You also predict the possible occurrence of minerals and metals in a particular location, based on the presence or absence of some common rocks.

- Visual observations of grain size, uniformity, porosity, colour (using a streak plate)
- Measurements of density
- Relative hardness, compared with common materials like fingernails, coins, glass, nails
- Chemical reactivity towards acid
- Use of classification key(s).

When recording or reporting observations, data and other results, you can decide to use sentences in paragraph(s), table(s), graph(s), or some combination of these. You can include other pages if necessary.

Activities and Results

My group discussed the properties that rocks might have (for example, colour, hardness). Here is a list of properties.

I examined one rock sample in detail, looking for interesting features like colour, whether it appears uniform (composed of similar bits), or whether it appears to be composed of various bits, whether it has any regular or irregular features, shapes of the pieces that make up the rock, whether it is solid all the way through, or if there spaces/holes (like Swiss cheese)? Here is a sketch of my rock sample:

I used a magnifier or microscope to study my rock sample, looking for features that are clearer with the magnifier or features that were not visible without the magnifier. This is what I saw:

I investigated the hardness of the rock sample by using a fingernail, a coin, a piece of glass, a metal nail, and found that:

It is hard to see the colour of some rocks because they are shiny, so a streak test is useful to see the colour by rubbing the rock sample against a streak plate. A streak test is only useful for soft rocks because:

Only do this test if you have a soft rock

I did a streak test by rubbing the rock against the streak plate and compared the streak colour to the colour of the rock.

Only do this test at the direction of your teacher

While wearing safety glasses, I tried to break the rock with a hammer. I observed that:

I determined the density of the rock by:

a) Measuring the mass of the rock (in grams).

Hint: choose a container that is just big enough to hold the rock sample.

b) Wrapping the rock in plastic food wrap.
c) Measuring the volume of a container by measuring the volume of water (in millilitres using a measuring cylinder) that is required to fill the container.
d) Emptying the container, placing the rock in the container and then measuring the volume of water that is required to fill the container with the rock in it. The volume of the rock is the difference between the two water volumes.
e) The density is the mass of the rock divided by its volume.

I found that:

Only do this test at the direction of your teacher

I tested the sensitivity of the rock sample to acid, by using an eyedropper to put a drop or two of vinegar on the rock. I observed that:

Findings

I compared my rock sample to the known rocks in the class set of standard rocks and rock types, and also consulted the rocks identification key. I classified my rock as:

Igneous / metamorphic / sedimentary

I identified my rock sample as:

The reasons for my classification and identification are:

Remember to give reasons for your judgement or recommendation.

Based on my rock sample, I think the possibility of finding useful minerals, ores, gems, or rocks near where my rock sample was collected are:

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