ASELL for Schools Workshop

Laboratory Learning Activity Manual

Gippsland Grammar School Sale

24 May 2017

CONTENTS

ACKNOWLEDGEMENTS

We would like to thank:

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WELCOME

Welcome to an ASELL for Schools Workshop!

ASELL (Advancing Science and Engineering through Laboratory Learning) has developed over the last 10 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 the second Victorian workshop to be run under the 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 Science. With the introduction of the new Australian and Victorian Curricula now in place, 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 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 assistance of technical staff and others in making this workshop possible. A very big thank you to the team at Gippsland Grammar School Sale, 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

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

ASELL FOR SCHOOLS WORKSHOP SCHEDULE

	ASELL for Schools **Gippsland Grammar School** **Wednesday 24 May 2017**	
8:50 – 9:05	**Arrival/Registration** ***Lecture Theatre Foyer***	
9:05 – 9:15	**Welcome and Introduction with Ian Bentley and John Long** • Introductions (of ASELL for School team and Students and Teachers) • Outline ASELL for Schools • Outcomes for the day • How to use the booklet ***Lecture Theatre***	
9:15 – 9:30	Introduction to Laboratory Learning Activity ***Lecture Theatre***	
9:30 – 10:55	***Laboratory Learning Activity 1 – Materials Testing: Plastics*** *Ian Bentley and John Long* ***Rooms 26 and 27***	
10:55 – 11:15	**Morning Tea** ***Lecture Theatre Foyer***	
11:15 – 12 noon	**Teachers: Learning in the Laboratory** Inquiry Scaffolding Tool Discussion and feedback on LLA 1 Ian Bentley ***Room 27***	**Students:** Discussion and feedback on LLA #1 Demo the tensile strength testing equipment. Talk about engineering as a discipline and career. John Long ***Room 26***
12:00 – 12:35	**Lunch** ***Lecture Theatre Foyer***	
12:35 – 1:15	**Teachers:** Analysis of Laboratory Learning Activities Planning a science program with laboratory learning and inquiry skill development in mind. Ian Bentley ***Room 27***	***Students: Laboratory Learning Activity 2*** ***Rolling Cylinders*** ***John Long*** ***Room 26***
1:15 – 1:35		**Students:** Discussion and Feedback on LLA *2*
1:35 – 1:45	**Teachers:** Introduction to LLA 2 Ian Bentley ***Room 27***	**Students:** Workshop Evaluation John Long ***Room 26***
1:45 – 2:40	***Teachers: Laboratory learning activity 2*** ***Rolling Cylinders*** *Ian Bentley and John Long* ***Room 27***	**Students go to normal classes for remainder of day.**
2:40 – 2:55	**Teachers:** Discussion and feedback on Laboratory Learning Activity 2 ***Room 27***	
2:55 – 3:15	**Teachers:** Overall debrief and Evaluation for the day Ian Bentley and John Long ***Room 27***	

LABORATORY LEARNING ACTIVITY 1
MATERIALS TESTING: PLASTICS
PART A: STRENGTH

Contact: Ian Bentley
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Materials Testing: Plastics Investigation 1: Strength

Introduction

Plastics are everywhere. They have an extraordinary range of uses, from soft drink bottles and packaging to car panels and building materials. The plastic that is used for an object has been selected because of its properties including its strength, its flexibility, its durability and its cost.

Supermarket bags are extremely convenient but also environmentally damaging. Researchers and industry continue to search for cost-effective environmentally friendly biodegradable plastics. To replace traditional supermarket bags, the new bioplastics will have to be as strong and resilient as the plastics used currently. Just how strong will these new plastics need to be to match the plastics used in the current supermarket bags? Are the biodegradable and recyclable bags being used as good as the traditional bags?

In this activity, you will work out just how strong the plastic is in different supermarket bags. The principles in the testing procedure you will use are the same as those used by materials scientists in their labs.

Key ideas

Force

A force is a push or a pull. When a load is applied to a material a pulling force equal to the weight of the load is applied to the material.

Strength

Strength can be thought about in many ways. In this activity, strength will be taken to mean the load that the material can hold before it breaks.

'Fair test'

When testing different materials all the variables except the one being tested need to be kept the same.

Variable

Something that can change.

Independent variable

Variable that is deliberately changed.

Controlled variables

Variables that are kept constant.

Dependent variable

Variable that changes in response to changes in the independent variable and that is observed or measured.

Available equipment

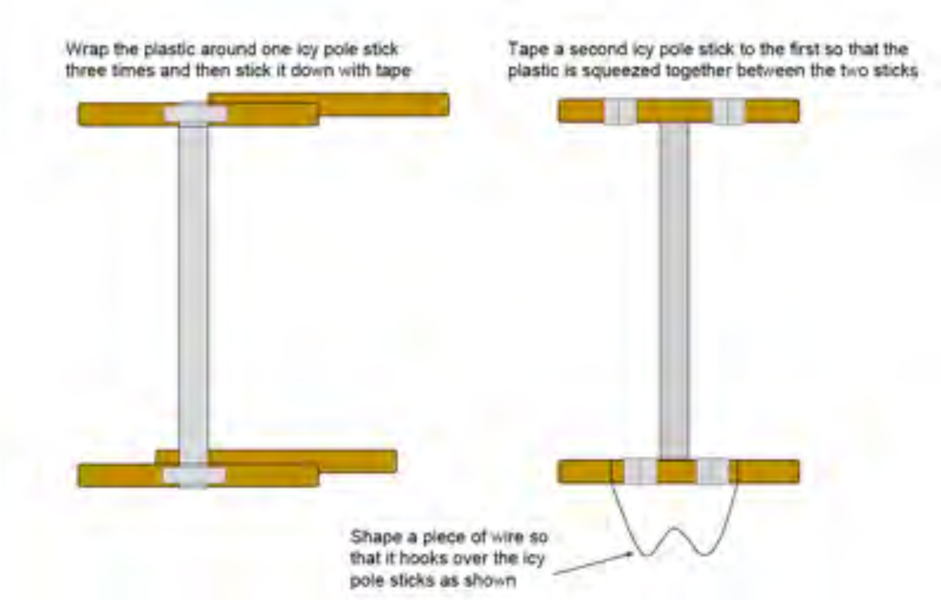
- Different plastic bags (3)
- Scissors
- Sticky tape
- Icy pole sticks
- Paper clips or wire to make hook from which to suspend weights
- Weights
- Ruler

Hazards

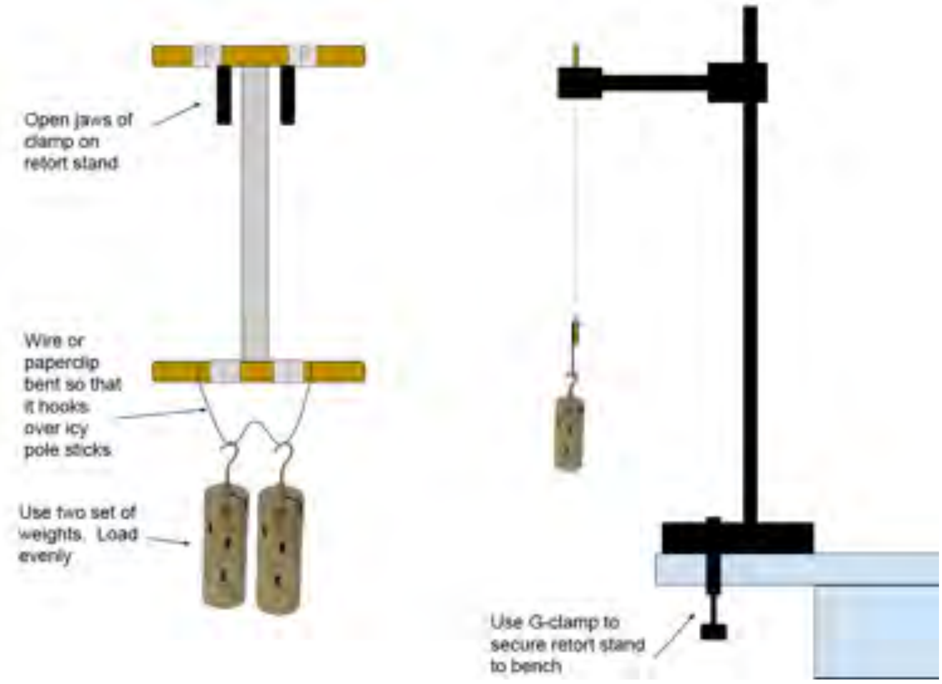
The main hazard will arise when samples of plastic give way under load. Things may fly in unpredictable directions. You must wear safety glasses/goggles, and also keep faces well away from the plastics when they are heavily loaded. Keep clear if you think the plastic is about to snap.

Investigation Instructions

From the samples of plastic bags for testing, cut strips 30 cm long and 2 cm wide. Wind the plastic strip around the the one icy pole stick as shown leaving 20 cm between the the sticks. Use sticky tape to hold the plastic in place. Tape a second icy pole stick



Suspend the top icy pole sticks from a clamp on a retort stand as shown below. Add weights to increase the load on 50 – 100 g at a time initially and 50 g at a time when you think the plastic is about to snap. Place something soft underneath the weights so that when the plastic breaks the weights do not crash to the ground. The supports on brass weights can be easily broken. Each time you add the load measure the distance between the top and bottom icy pole sticks i.e. the length of the plastic and also measure the width of the plastic at the midpoint of the length of plastic. Continue to add weights until the plastic test strip breaks.



As well as the measurements, note other observations you make while the weights are being added.

Results

Record your results in the spaces below.

	Plastic Bag 1		Plastic Bag 2		Plastic Bag 3	
Source						
Load	Length	Width	Length	Width	Length	Width

Analysis

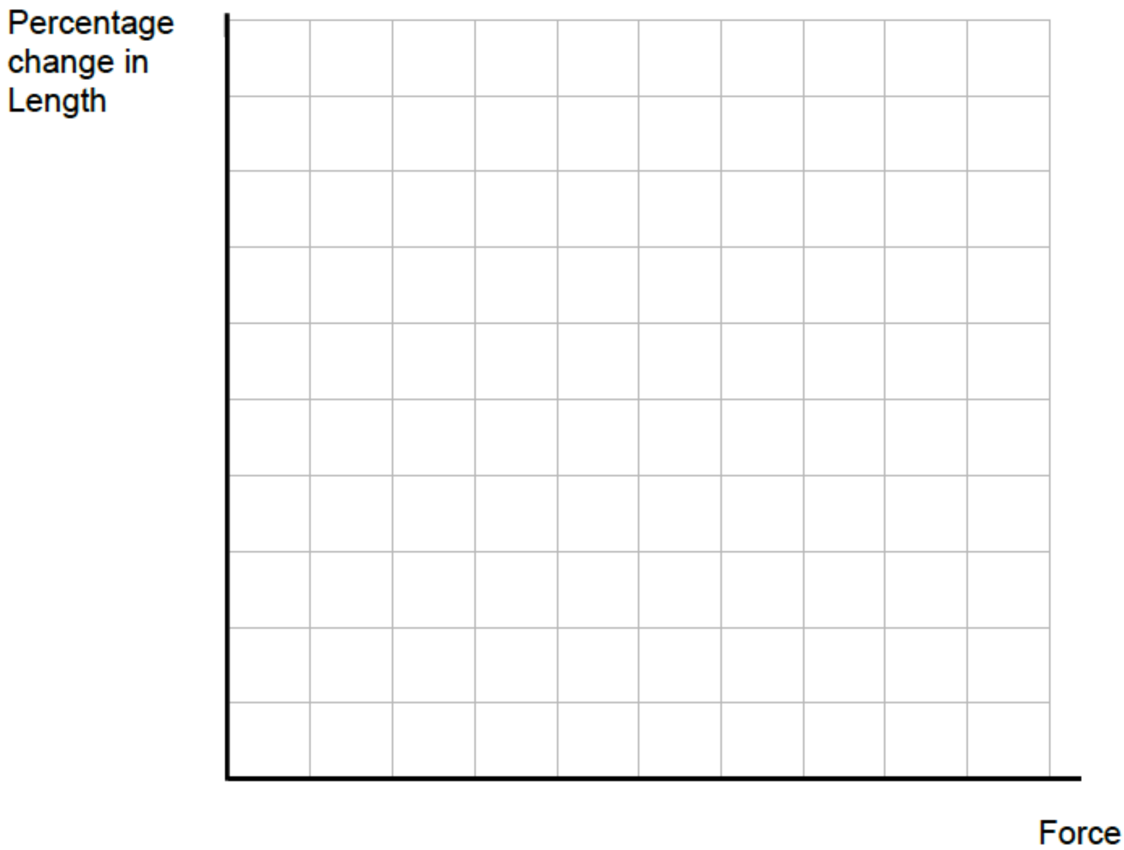
Calculate the percentage change in length versus load.

Plastic 1: percentage change in length versus load			
Load	Length	Change in length	Percentage change in length

Plastic 2: percentage change in length versus load			
Load	Length	Change in length	Percentage change in length

Plastic 3: percentage change in length versus load			
Load	Length	Change in length	Percentage change in length

Draw graphs of the change in length versus load and percentage change in length versus load. Put your different graphs on the same set of axes.



Discussion and Conclusions

How did the plastics compare? Which one is strongest? What is the evidence?

How did each of the plastics behave as the load was increased? Were there differences?

Represent what you think is happening at the particle (molecular) level as the plastic is stretched and eventually breaks. Represent the elastic phase, the plastic phase and the point of failure.

Are there variables you have not controlled in your tests? How might these variables affect your conclusions?

Suppose you had to increase the strength of the handles of the plastic bag what could you do? Describe a test you could do to gain evidence for your proposal.

What other investigations could you undertake with the plastics and equipment used?

Extension

Stress vs strain

What extra measurements do you need Make the appropriate measurements and calculate the engineering stress and strain at different loads till failure. Design a table and record your measurements. Plot a stress vs strain curve for each plastic tested.

How do the shapes of the curves compare?

What do the shapes of the graphs suggest about the plastics used in supermarket bags?

Independent investigation

What question do you intend to investigate?

Do you have a hypothesis? Briefly state it.

Outline the procedure for conducting your test.

Record your measurements.

Present data.

Analyse your data.

What conclusions can you draw? Did the experiment produce evidence to support your hypothesis? Are there improvements you would make in your experimental method?

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LABORATORY LEARNING ACTIVITY 1: MATERIALS TESTING: PLASTICS PART B: CUTTING AND TEARING

Contact: Ian Bentley
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Materials Testing: Plastics
Investigation 2: Cutting and tearing

Introduction

Not only are items purchased from the supermarket heavy requiring supermarket bags to be strong but they also often come in packages with sharp edges and corners. Bags may be punctured or cut and eventually tear.

In this activity, you use the materials and your own improved version of the suggested testing technique provided to compare the resistance of the bags to puncturing.

Materials

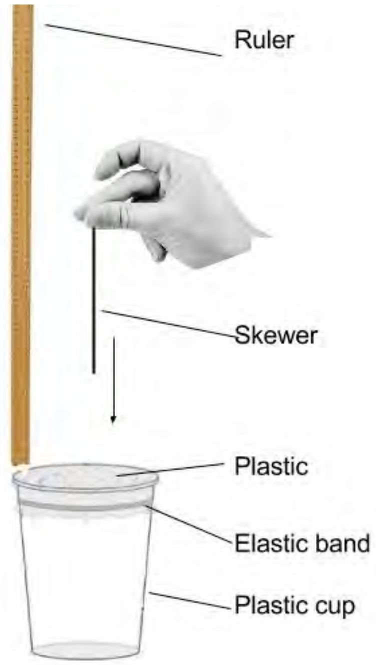
- Plastic cup or beaker
- Plastic bags from different supermarkets
- Rubber bands
- Scissors
- Bamboo skewers
- Ruler

Hazards

There are hazards in this activity from sharp objects. Care should be used with scissors to keep fingers clear while cutting. Both scissors and the bamboo skewers are sharp and care that they are not poked into skin or eyes. Wear eye protection.

Preliminary investigation

Stretch a sheet of plastic bag over the top of a plastic cup or beaker and secure it with a rubber band as shown. Drop a bamboo skewer, point down, from a height of about 1 cm above the plastic bag onto the plastic.



What do you observe?

Repeat this from 20 cm above the stretched plastic bag. What do you observe this time?

Using this technique compare three different plastic bags for their resistance to puncturing. What needs to be done to ensure that the tests are fair?

Investigation

Your task is to use the preliminary investigation above to work out which of the plastics has the greatest resistance to puncture with the skewer. Work with your partner or your group to decide which variables you will keep the same (controlled variables) which variable/s you will change (independent variable) and which variable you will measure (dependent variable).

Controlled variables

Independent variable

Dependent variable(s)

Record your testing procedure. How many tests will you do on each plastic?

Results

Record your results. What units will you be using?

Analysis

Summarise your results in a form that visually displays the differences in resistance to puncturing.

Why did you choose to use this particular representation? Hint: what are the advantages of using this way of visually summarising your results?

Discussion and Conclusions

What do your results tell you about the resistance to puncture of the plastic from the different supermarket bags?

Do you think your results are reliable when making a judgement about which plastic bag will resist cutting by sharp objects? What are the strengths and weaknesses of the testing procedure you used?

How could you have improved your testing?

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LABORATORY LEARNING ACTIVITY 2 - ROLLING CYLINDERS

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Rolling Cylinders

Introduction

In this laboratory activity, you will be investigating movement. When an object moves, it has **kinetic energy** – the energy of movement. Another type of energy and one that often gets transferred and transformed into movement is **potential energy**. A compressed or stretched spring has potential energy. A moving object will usually stop moving because of friction. Friction causes the kinetic energy of the moving object to be transformed into **heat energy**.

Equipment and materials

You will be given a postal cylinder similar to the one in photograph.

Part A – Rolling Cylinder

Individually, predict what will happen when the cylinder is rolled on the desk/bench. Write your predictions here.

Observe what will happen when the cylinder is rolled on the desk/bench. Write your observations here.

In pairs, develop an explanation for what you observed and write it here. Try to use the words **kinetic energy**, **potential energy**, **friction** and **heat energy**. Your explanation can include a labelled diagram.

Share your explanations with the class.

Part B – Testing the explanations

For this part of the inquiry, you will work in groups of four. Each group will be handed a cylinder. For five minutes, your group will need to test your explanations using the cylinder but do not open the cylinders yet.

Discuss explanations within your group and write down your modified explanation if you have one.

As a group open the cylinder by pulling one of the ends off. Rethink your explanations of what is happening. Any modifications or additions to the previous explanations should be added here.

Share your modified explanations in a class discussion.

Additional equipment and materials for Part C

- open cylinder
- some materials (similar to)
  - weights
  - scales
  - rubber bands
  - etc

Part C – Private Investigations

Using the provided materials investigate ways of making the rolling cylinders travel the greatest distance and still return.

In your investigations, you will change somethings and observe others.

List some of the things you could change in your investigation. **These things we change are called independent variables.**

List one or more things you might observe after you have changed an independent variable. **The things you observe or measure in an experiment are called the dependent variables.**

To really see if the thing we are changing is the thing that is making the difference we have to keep other things the same. **These things we keep the same are controlled variables.**

Choose one thing to change at a time and carry out some tests (experiments) to find out more about the rolling cylinders. **Each time you change a variable and see what happens you are conducting a new experiment.**

Part C – Experiment 1

Thing changed (independent variable)

Things kept the same (**controlled variables**)

Thing being observed (**dependent variable**)

What we observed (**Observations** or **Results**)

A brief statement of what we think has occurred (**Conclusion**)

How what we think is linked to a scientific idea (**Explanation**)

Part C – Experiment 2

Thing changed (independent variable)

Things kept the same (**controlled variables**)

Thing being observed (**dependent variable**)

What we observed (**Observations** or **Results**)

A brief statement of what we think has occurred (**Conclusion**)

How what we think is linked to a scientific idea (**Explanation**)

Part C – Experiment 3

Thing changed (independent variable)

Things kept the same (**controlled variables**)

Thing being observed (**dependent variable**)

What we observed (**Observations** or **Results**)

A brief statement of what we think has occurred (**Conclusion**)

How what we think is linked to a scientific idea (**Explanation**)

Part C – Experiment 4

Thing changed (independent variable)

Things kept the same (**controlled variables**)

Thing being observed (**dependent variable**)

What we observed (**Observations** or **Results**)

A brief statement of what we think has occurred (**Conclusion**)

How what we think is linked to a scientific idea (**Explanation**)

Part C – Experiment 5

Thing changed (independent variable)

Things kept the same (**controlled variables**)

Thing being observed (**dependent variable**)

What we observed (**Observations** or **Results**)

A brief statement of what we think has occurred (**Conclusion**)

How what we think is linked to a scientific idea (**Explanation**)

Part C – Conclusion

Following all your experiments what is your overall conclusion. How can you make the rolling cylinder travel furthest and still return? Suggest an explanation.

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