ASELL Advancing Science and Engineering through Laboratory Learning

ASELL for Schools Science Workshop

Laboratory Learning Activity Manual

Ringwood Secondary College

12 April 2016

ASELL Advancing Science and 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 AUSTRALIA

ACKNOWLEDGEMENTS

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WELCOME

Welcome to 2015 ASELL for Schools Science 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 Sciences. With the introduction of the new Australian Curriculum 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 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 Jim Norman and Jackie Quenette 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 Ringwood Secondary 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 me or 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

CONTENTS

PEOPLE

Teachers attending the workshop

Ian Bentley, Deakin University
Sonia Bhatia, Pakenham SC
Alison Brown, Deakin University
Cornelia Cefai
Jennifer Condylis, Ringwood SC
Tara Crowe, Horsham College
Suzie Doods, Ringwood SC
Miriam Glasby, La Trobe University
Liberty Hatzidimitriou, Lowther Hall Anglican Grammar School
Andrew Hansen, Ringwood SC
Elham Heidari Beni, Mentone Girls' Grammar School
Sarah Hill, Lowther Hall Anglican Grammar School
Kieran Lim, Deakin University
John Long, Deakin University
Josephine Lowe, Catholic Regional College St Albans
Irina Lumsden, Brentwood SC
Daniel May-Whitcombe, Stawell SC
Selda Mehmet, Lowther Hall Anglican Grammar School
Helen Myroforidis, Ringwood SC
Jim Norman, Ringwood SC
Hannah O'Connor, Brentwood SC
Helen Polymen, Carey Baptist Grammar School
Jackie Quenette, Ringwood SC
Jonathon Rogers, Ringwood SC
Leanne Strachan, Sherbrooke Community School
Lisa Wajngarten, Ringwood SC
Peta White, Deakin University
Karl Wild, Tarneit Senior SC

Students attending the workshop

Lara Asic, Ringwood SC
Baille Campbell, Ringwood SC
Zac Desiatov Cheuk, Sherbrooke Community School
Georgi Clarke, Ringwood SC
Ilesha Conroy-Welby, Ringwood SC
Damon Delaney, Ringwood SC
Alannah Denison, Ringwood SC
Callum Ewenson-Allan, Ringwood SC
Paige Kelly, Ringwood SC
Ashlee Korlaki, Ringwood SC
Jordan Lach, Ringwood SC
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Jake Smith, Ringwood SC
Jack Stewart, Ringwood SC
Maya Suidgeest, Ringwood SC
Callum Traplin, Ringwood SC
Emma Van Dijk, Ringwood SC

Technical Staff

Danielle Buttress, Ringwood SC
Robyn McLean, Ringwood SC

ASELL FOR SCHOOLS SCIENCE WORKSHOP SCHEDULE

ASELL for Schools Ringwood Secondary College *Tuesday 12 April 2016*		
All sessions in the *Ringwood Trade Training Facility (RTTF)*		
9:00 – 9:15	**Arrival/Registration**	
9:15 – 9:30	**Welcome and Introduction with A/Prof. Kieran Lim** • Introductions (of ASELL for School team and Students and Teachers) • Outline ASELL for Schools • ASELL for schools – host workshop as a Teaching Scholar • Longitudinal research – over the next three times	
9:30 – 9:45	**Science Inquiry with Dr Peta White** • What is ASELL for Schools about ○ Science Inquiry skills, direct inquiry, and contemporary science • Introduction to the slider • How can we incorporate more science inquiry into experiments?	
9:45 – 10:35	***Laboratory learning activity 1 – Energy transformations Dr Peta White***	
10:35 – 10:55	Discussion and feedback on Laboratory learning activity	
10:55 – 11:15	**Morning Tea**	
11:15 – 11:35	**Teachers:** Assessment of Inquiry Skills with Dr Peta White	**Students:** Interview with a scientist with Dr John Long
11:35 – 12:25		**Students:** Build model electric car with Mr Ian Bentley and Dr John Long
12:25 – 1: 05	**Lunch**	
1:05 – 1:55	***Laboratory learning activity 2 – Investigation - Electric cars A/Prof. Kieran Lim***	
1:55 – 2:15	Discussion and feedback on Laboratory learning activity	
2:15 – 3:00	**Teachers:** Overall debrief with A/Prof Kieran Lim and Dr Peta White Evaluation for the day	**Students:** Overall debrief with Dr John Long Evaluation for the day

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LABORATORY LEARNING ACTIVITY 1 - ENERGY TRANSFORMATION AND TRANSFER

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Energy Transformation and Transfer

Throughout this inquiry you will explore energy transformations and transfers. Potential to kinetic is the most common transformation although there are other forms of energy such as light, chemical, sound, and heat energies.

Risk Analysis

Practices to consider and potential hazards

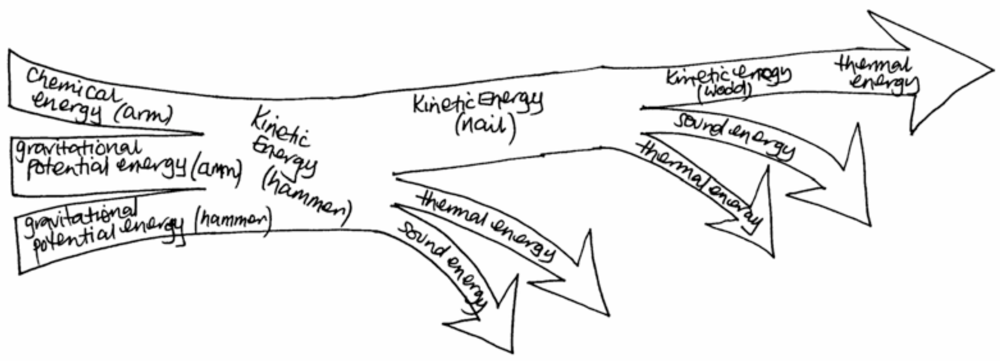
- The hammer hitting the nail into the wood will be demonstrated as there are several risks with hammers and the potential miss hitting of the nail.
- Balls must be bouncy and only dropped. Please do not throw the balls around the classroom or at each other.
- A variety toys will be used which use a variety of energy transformations and transfers. Care should be taken if any toys fly, spin, propel quickly, or move around the classroom.
- Take time to consider the skills in the correct use of magnifying glasses.

Materials

- Hammer and nail in wood (demonstration)
- Balls to bounce
- Toys
- Magnifying glasses
- Worksheet and pens/pencils

Inquiry

1: Watch a hammer hit a nail into wood and determine what this representation is communicating.



Mark on the diagram above the actions of the arm, hammer, nail, and the wood.

This representation is showing ____

____

____

____

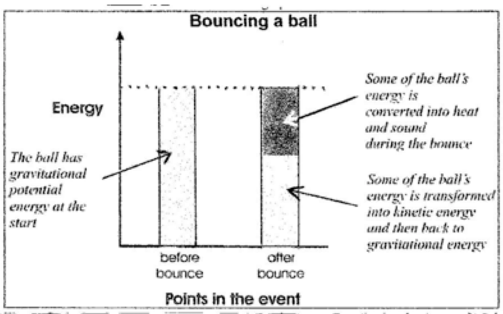
This representation is called a Sankey diagram. You will now create your own…

2: In your group, drop a ball from waist height onto the floor and allow it to bounce once (then catch it). Represent the energy transformations using a Sankey diagram.

What does the Sankey diagram allow you to illustrate and explain? What happens to the energy as it transforms or transfers? What happens to the total amount of energy?

What do you understand about energy transformation from this diagram? Can you provide definitions for kinetic and potential energy, energy transformation, and energy transfer?

There are many alternative ways of representing the energy transformations of the dropping ball. This diagram is a different representation.



Can you design one other representation on the energy transformations involved in dropping the ball and it bouncing once?

Challenge – energy transformations and transfers in a toy

3: You and your team have been given a toy to explore. What are the energy transformations and transfers used by this toy? Do not include you (and your energy) in the representations (start from when the toy is wound or pulled etc.). Discuss your thoughts with your team and then design a Sankey diagram or any alternative representation that will allow you to communicate your thoughts to others.

Further Challenge – mechanisms and principles of a toy

4: Can you and your team represent the mechanisms and principles by which your toy works? What are the mechanisms that propel the toy? These are not necessarily energy related. Discuss your thoughts with your team and then design a representation that will allow you to communicate your thoughts to others.

Science Concepts

- Energy is manifested in many forms. Different forms of energy include: thermal, chemical, light, gravitational, sound, elastic, movement / motion/kinetic, nuclear and electrical.
- Energy can be transformed from one form to another.
- Energy is neither created nor destroyed: When energy changes in form the total amount of energy remains constant.
- Energy degrades and dissipates but remains conserved.

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STUDENT ACTIVITY – CONSTRUCTING A PROPELLER-DRIVEN ELECTRIC CAR

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LABORATORY LEARNING ACTIVITY

CONSTRUCTING A PROPELLER-DRIVEN ELECTRIC CAR

Instructions for the building a propeller-driven electric car are provided here. The resulting car can be used to investigate the relationship between electrical energy input and kinetic energy output. Within the context the car provides, students can learn about and consolidate their understanding of series and parallel circuits as well as voltage and current. The design allows flexibility in the way four AA batteries are connected together to provide differences in voltage and current for driving an electric motor which is used to spin a propeller.

MATERIALS	**TOOLS**
Plastic bottle – preferably square section so that it has a flat base Soft drink bottle 1.25L Drinking straws Two bamboo skewers Light toy truck wheels or plastic screw tops from milk bottles 4 AA battery holders and batteries An electric motor (1.5 – 6V)	Ruler or measuring tape Scissors Craft knife or blade Hot glue gun Sandpaper Candle (and matches) Spiked tool

PROCEDURE

<u>Making a propeller</u>

1. Cut the top off a soft drink bottle as shown. Keep the screw top.

2. Cut the top of the bottle to produce 8 propeller blades of the same size.

3. Warm propeller blades over candle till slightly flexible and twist as shown. Practice with a couple of pieces of plastic cut from the rest of the drink bottle. Repeat with each blade so that each blade has approximately the same slight twist. All twists must be in the same direction.

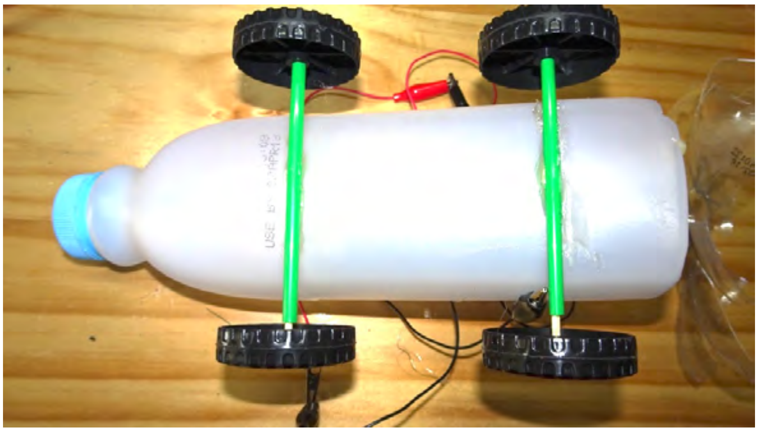
4. The length of the propeller blades may need to be trimmed. Blades of 6cm in length seem to work well

5. Remove the screw top. Using a spike tool, poke a hole in the centre of the bottle top. The drive shaft of the motor will be pushed into this hole. Be careful not to push the spike into your hand or the

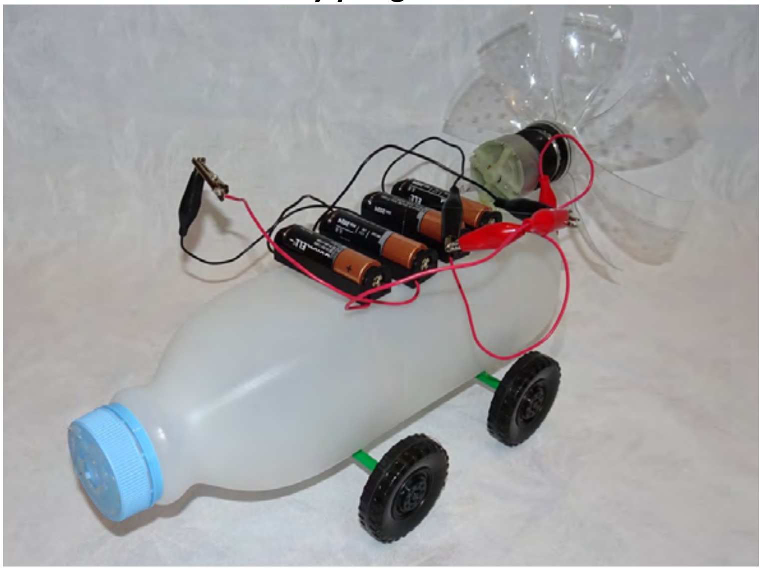
furniture. Use a scrap piece of wood to support lid.

<u>Assembling Car</u>

1. Layout all of the parts.
2. Cut two straws 8 cm in length and skewers to 10 cm in length with scissors or blade.
3. Shave blunt ends of skewers with sandpaper and check that the skewers push into the axel holes of the wheels.
4. Push the skewers through the straws and attach the wheels
5. Glue straws to bottle as shown.



6. Glue the battery holders to the bottle. Note: Alligator clips have been soldered to the wires on the battery holder.
7. Glue the motor to the centre and as close as possible to theend of the bottle so that the propeller is clear of the end of the bottle.
8. Attach propeller to motor drive shaft using the hole in the bottle cap.
9. **Connect wires and away you go.**



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LABORATORY LEARNING ACTIVITY 2 - ELECTRIC CARS

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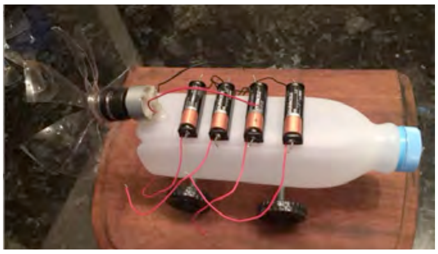
LABORATORY LEARNING ACTIVITY

Electric cars

Introduction

Electric devices are a part of our everyday lives. However, electric cars are widely used as because of limitations in battery technology.

A model electric car has been assembled in a previous session.



Photos by Ian Bentley (Deakin University)

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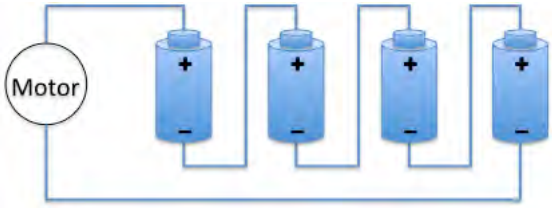
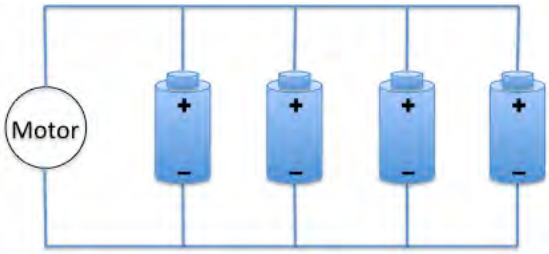
In this activity, you will investigate how car performance changes if batteries are connected differently.



Batteries connected in series



Batteries connected in parallel

Your group needs to plan your investigation, conduct the investigation, record your results and make conclusions (findings) about your investigation.

In a future lesson, you will learn more about electric components connected in series and in parallel, so you should also make measures of the electric current and potential for the various ways you connect the batteries.

Available equipment

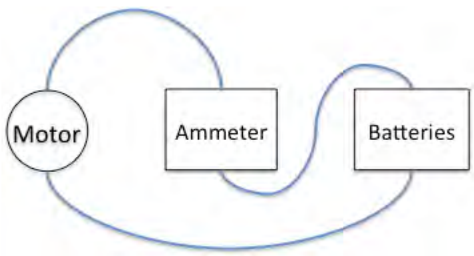
- Fan-driven vehicle;
- Rulers;
- Stopwatches;
- Measuring tapes;
- Ramps – planks of wood;
- Voltmeters (or multimeters);
- Ammeters (or multimeters);
- Leads with alligator clips;
- Safety glasses.

Hazards

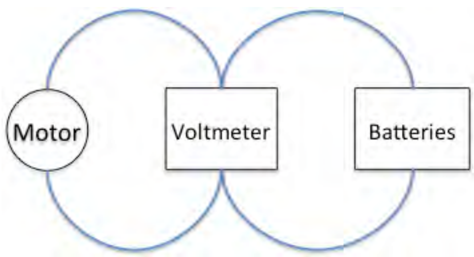
The main hazard is the spinning propeller, which may be hard to see. You must wear safety glasses/goggles, and also keep faces and hands away from the spinning propeller.

Experimental method

- You and your group members need to decide how to measure car performance. You may use all or some or none of the available equipment;
- You might investigate some or all of the following:
  - how car performance changes as the number of batteries is changed;
  - how car performance changes as the number of batteries in series (head to tail) is changed;
  - how car performance changes as the number of batteries in parallel (all heads together and all tails together) is changed;
- Your group should measure electric current and potential for the various ways you connect the batteries. Electric current is measured by putting the ammeter *in series*. Electric potential is measured by putting the voltmeter *in parallel*.



Connecting the ammeter *in series*



Connecting the voltmeter *in parallel*

My group will measure car performance by doing the following. You can decide to use sentences in paragraph(s), picture(s), or some combination of these.

Results

My group made the following measurements. 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.

Extension

If your group has finished this activity, then you should try drawing a **Sankey diagram** for the model electric car.

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Discussion

In a scientific report, this section discusses the meaning of the results and data that have been collected. What are your conclusions? In this section, "conclusions" means deductions, inferences, interpretations, or judgements based on your results and data.

As the number of batteries was changed, the car performance:

As the number of batteries in series was changed, the car performance:

As the number of batteries in series was changed, the electric current and potential:

As the number of batteries in parallel was changed, the car performance:

As the number of batteries in parallel was changed, the electric current and potential:

Conclusions

In a scientific report, the "conclusions" section is the end or final part of the report. The "conclusions" section is a summary of your entire investigation.