YEAR 5–6

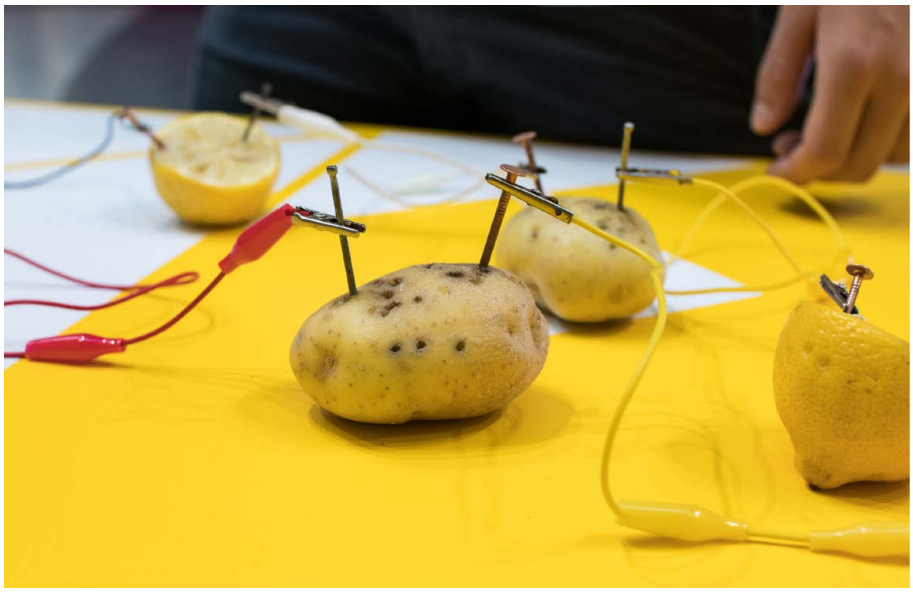
Veggie Voltage

Hands-on Horticulture

In collaboration with Hort Innovation, Primary Industries Education Foundation Australia (PIEFA) has developed a series of practical scientific investigations exploring Australian grown fruit and vegetables.

The **Hands-on Horticulture** resources have been designed to engage students in hands-on Australian Curriculum aligned investigations that explore Australian grown fruit and vegetables. The resources incorporate science understanding and science inquiry skills to provide meaningful learning experiences for primary-aged students. Each resource contains guidance for a teacher-led lesson to be completed in the classroom, along with a '**Take me Home!**' extension activity for students to consolidate their scientific investigation and explore the production of fruits and vegetables.

During this practical activity students will construct a circuit using fruits or vegetables to learn about the required components to allow the flow of electricity.



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Background information

An electrical current is the flow of electric charge through a conductor. This flow is typically carried by moving electrons in a wire.

An electrical circuit is a path through which an electric current can flow. For a circuit to work and allow current to flow, it needs:

1. **A Power Source:** This could be a battery, a generator, or any device that provides the electrical force (voltage) needed to move the electrons through the circuit. The power source is like the pump that pushes water through a pipe.
2. **Conductors:** Conductors are materials that allow the flow of electrical current. In most circuits, these are made of metal wires (like copper) because metals have free electrons that can move easily through them.
3. **A Load:** The load is any device or component that uses the electricity to do work, such as lighting a bulb, powering a motor, or heating a wire. It's where the electrical energy is converted into another form of energy (light, heat, motion, etc.)
4. **A Complete Path:** The circuit must form a loop that electrons can flow through. If there's a break anywhere in the loop (an open circuit), the current will stop flowing.

Fruits and vegetables can act as conductors for batteries due to their electrolytic properties. In a simple organic battery two different metals (typically zinc and copper) are inserted into the fruit or vegetable. When the metals react with the electrolytes present in the fruit or vegetable (such as the citric acid in lemon or the phosphoric acid in potato), they undergo a chemical reaction that releases electrons. These electrons flow through an external circuit, generating an electric current.

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LESSON

Veggie Voltage

RISK ASSESSMENTS

Note: Schools are responsible for generating their own risk assessments for activities. Risk assessments should address the potential hazards associated with using fruits and vegetables in the classroom, including food-borne illnesses, allergies, slips/falls, and cross-contamination, and propose control measures such as proper cooking, allergy awareness, accident prevention, and hygiene practices to ensure a safe learning environment for students.

LESSON OBJECTIVE

Students will follow a procedure to demonstrate how acidic fruits or vegetables can be used to generate electricity.

SUCCESS CRITERIA

- I can describe the necessary components for an electric circuit.
- I can follow the procedure to make a fruit or vegetable battery.

ACTIVITY LENGTH

60 minutes

Materials (per student)

- A citrus fruit (lemon or orange) or potato
- Copper coin or strip
- Zinc nail or galvanized nail (zinc-coated)
- Two alligator clip wires
- A small light bulb that operates on a low voltage
- Gloves (optional, for handling metals)
- **Veggie Voltage** student worksheet

Instructions

1. Play the video How Electricity Works (1:20) to observe the transfer of electrons through an electric circuit. Explain that electricity is made of many small particles called electrons. When electrons move through an electrical circuit they can power different objects such as lights, toasters and televisions.

2. Distribute the first page of the **Veggie Voltage** student worksheet and read the information as a class. Allow students to complete the labelling activity on the worksheet before reconvening to discuss the necessary components for an electric circuit. Explain that when these components are connected it creates the potential for an electrical current to flow. The power source pushes electrons through the conductor. As these electrons flow through the load, they transfer energy to it, making it perform its function (like lighting a bulb). The circuit must be closed (meaning there are no breaks) for this process to happen. If the circuit is open (broken), the flow of electrons stops, and the device will not work.

3. Play the video Potato Battery Experiment (2:43) to provide students with a simple explanation of the process of chemical energy conversion in an organic battery. Explain that the copper and zinc create a chemical reaction with the acids in potatoes or citrus fruits which releases electrons. These electrons flow through an external circuit, generating an electric current.

4. Allocate students into pairs and distribute the required materials. Students work in their pairs to follow the instructions on the student worksheet, or complete each of the following steps with teacher instruction.

5. Roll the fruit or vegetable gently on a table to soften it without breaking the skin. This process helps release the juices inside, which are needed for the production of electrons.

Instructions (cont'd)

6. Insert a copper coin or strip into one side of the fruit or vegetable. This will act as the positive electrode (cathode).

7. Insert a zinc nail or galvanised nail into the other side, but not so close that they touch. This will act as the negative electrode (anode).

8. Connect the exposed part of the copper coin/strip to the positive terminal of the lightbulb and the exposed part of the zinc nail to the negative terminal using the alligator clips.

9. If the lightbulb does not light up, check the connections and make sure the metals are firmly inserted into the fruits or vegetables. Pairs may need to add more fruits or vegetables to increase the voltage.

10. Observe whether the lightbulb lights up. Discuss why this happens, focusing on the chemical reaction between the acid in the fruit or vegetable and the metals, which creates an electrical current.

11. Students complete the remaining activities on the **Veggie Voltage** student worksheet.

LEARNING AREA

Science (Year 5–6)

AUSTRALIAN CURRICULUM CONTENT

Investigate the transfer and transformation of energy in electrical circuits, including the role of circuit components, insulators and conductors (**AC9S6U03**)

Investigate how scientific knowledge is used by individuals and communities to identify problems, consider responses and make decisions (**AC9S5H02**, **AC9S6H02**)

Pose investigable questions to identify patterns and test relationships and make reasoned predictions (**AC9S5I01**, **AC9S6I01**)

Plan and conduct repeatable investigations to answer questions, including, as appropriate, deciding the variables to be changed, measured and controlled in fair tests; describing potential risks; planning for the safe use of equipment and materials; and identifying required permissions to conduct investigations on Country/Place (**AC9S5I02**, **AC9S6I02**)

Use equipment to observe, measure and record data with reasonable precision, using digital tools as appropriate (**AC9S5I03**, **AC9S6I03**)

Construct and use appropriate representations, including tables, graphs and visual or physical models, to organise and process data and information and describe patterns, trends and relationships (**AC9S5I04**, **AC9S6I04**)

Compare methods and findings with those of others, recognise possible sources of error, pose questions for further investigation and select evidence to draw reasoned conclusions (**AC9S5I05**, **AC9S6I05**)

Write and create texts to communicate ideas and findings for specific purposes and audiences, including selection of language features, using digital tools as appropriate (**AC9S5I06**, **AC9S6I06**)

References

ABC. (2021, October 15). How electricity works. ABC Education. https://www.abc.net.au/education/how-electricity-works/13577178

Sustainable Energy Authority of Ireland. (2020). Potato Battery Experiment. In YouTube. https://www.youtube.com/watch?v=RMtRc_6FMsw

Veggie Voltage

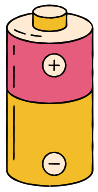
Electricity is the movement of electric charges through a material called a conductor. **Electrons**, tiny particles that carry electric charge, are responsible for this movement. It can be compared to water flowing through a pipe.

An **electrical circuit** is a path that an electric current can flow through.

For a circuit to work and allow current to flow, it needs:

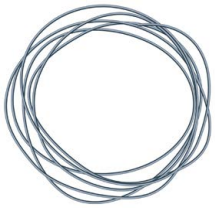
A Power Source:

This could be a battery, a generator, or a device that provides the electrical force (voltage) required to move the electrons through the circuit. The voltage is like the pump that pushes water through a pipe.



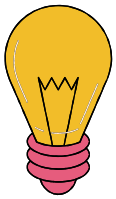
Conductors:

Conductors are materials that allow the flow of electrical current. In most circuits, these are made of metal wires (like copper) because metals have free electrons that can move easily through them.



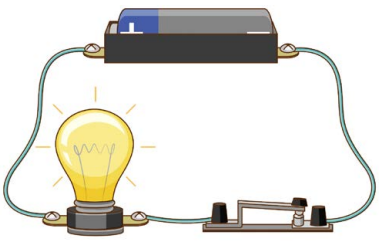
A Load:

Electricity is used to power many devices that do different tasks, such as lighting bulbs, powering motors, and heating wires. These devices are called loads. When electricity flows through a load, it is converted into different forms of energy, such as light, heat, or motion.



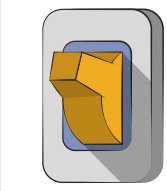
A Complete Path:

The circuit must form a loop that electrons can flow through. The current will stop flowing if there is a break anywhere in the loop (an open circuit).



A Control Device (optional):

Many circuits also have a control device, like a switch, to turn the electricity on and off. This allows control over when the circuit is active or inactive.



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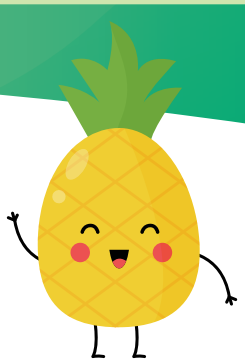
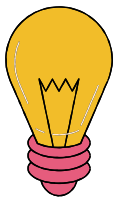
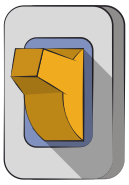
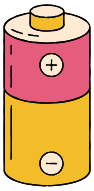
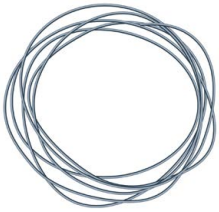
Veggie Voltage (cont'd)



1.

Match the words to each of the pictures.

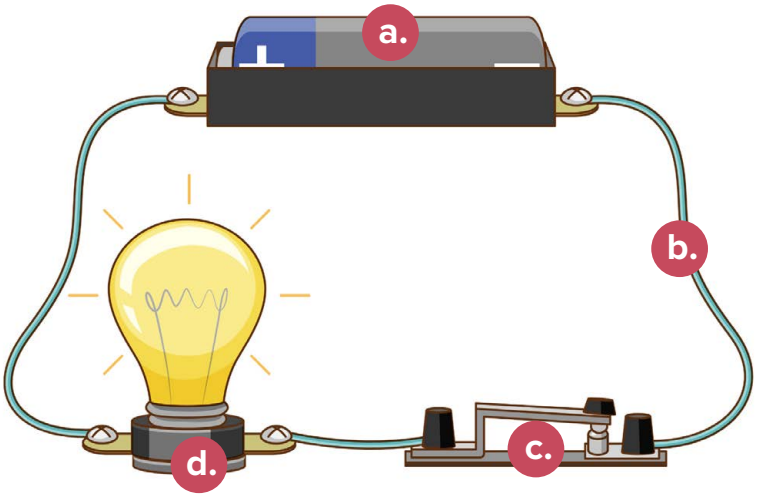
Switch	Battery	Wire	Bulb

_____ _____ _____ _____

2.

Record the components of the electric circuit below.



a. _____

b. _____

c. _____

d. _____

Veggie Voltage (cont'd)

EQUIPMENT

Collect these materials before you start the experiment:

An acidic fruit or vegetable

Gloves

A copper strip

A zinc or galvanized nail

Two alligator clip wires

Small light bulb

INSTRUCTIONS

1. Roll the fruit or vegetable gently on a table to soften it without breaking the skin. This process helps release the acidic juices needed for the battery to function.
2. Insert a copper coin or strip into one side of the fruit or vegetable.
3. Insert a zinc nail or galvanised nail into the other side, but not so close that they touch.
4. Connect one of the alligator clips to the copper piece in the fruit or potato and the other alligator clip to the zinc nail.
5. Connect the exposed part of the copper coin/strip to the positive terminal of the lightbulb and the exposed part of the zinc nail to the negative terminal using the alligator clips.
6. If the lightbulb does not light up check your connections and make sure the metals are firmly inserted into the fruit or vegetable. You may need to add more fruits or vegetables to increase the voltage.
7. Record your answers to the questions on the next page.

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Veggie Voltage (cont'd)

3. **Draw and label a diagram of your complete electric circuit.**

4. **What happens to the electrons in this circuit when all of the parts are connected?**

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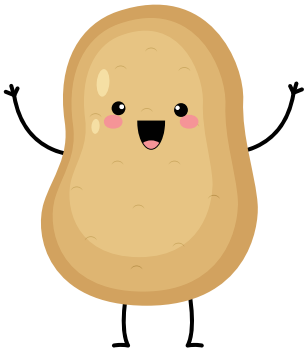
(PAGE 5 OF 6)

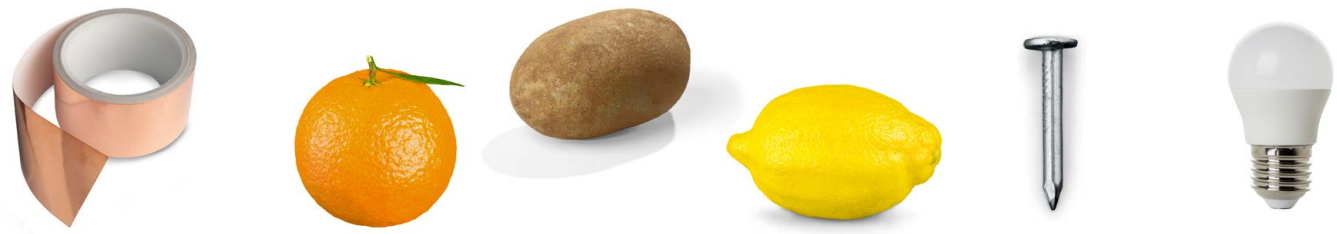
When a potato or fruit is used in a battery, a chemical reaction occurs between its acidic juices and two different metals — copper and zinc. This reaction releases electrons. The metals and wires connected to the electrodes allow the electrons to flow from the zinc electrode to the copper electrode, powering the light as they travel through the circuit. To make sure the battery works, the electrodes must be connected through the potato or fruit and external wires to the lightbulb, forming a complete circuit.



5. Use the word bank to complete the cloze passage explaining how each of the parts worked together to generate an electric current.

potato	**lightbulb**	**coin**	**nail**
electrons	**metals**	**wires**	

The _____ or fruit is the power source for this battery. When the chemical reaction between the acidic juices and the _____ occurs, _____ are released. The conductors in this electric circuit are the zinc _____, the copper _____ or strip, and the _____ that connect them. The load is the _____, which is powered by the electrons as they move through the electric circuit.



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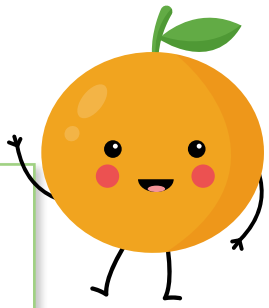
The symbols below can be used to represent each of the parts of an electric circuit.

Wire	Battery	Voltmeter	Buzzer
Closed switch	Open switch	Ammeter	Lamp/bulb

6.

Create a diagram of the potato or fruit battery electric circuit using the following symbols if necessary:

Wire	Battery	Lamp/bulb



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