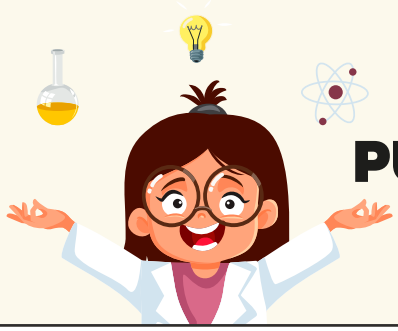


PUFFING BILLY RAILWAY NATIONAL SCIENCE WEEK

POWERING THE FUTURE

LEVEL

Year 5 – Year 8

ACTIVITY DESCRIPTION

One of the seven key strategic aspirations at Puffing Billy Railway is to "Commit to Environmental Sustainability" which emphasises the importance of the stunning Dandenong Ranges that the rail Corridor passes through. Puffing Billy Railway is committed to minimising the impact on the environment in which it operates and has been collaborating with the community and key stakeholders in supporting the conservation of native wildlife and healthy ecosystems in the area. Puffing Billy Railway is committed to improving its environmental footprint and actively pursues sustainable outcomes as a matter of priority.

Puffing Billy Railway's steam engines use coal to operate, an energy source that is now known to be a major source of greenhouse gases and air pollution. In an attempt to lower emissions, coal mines around Australia, and the world, are closing down. Heritage Steam Railways, such as Puffing Billy Railway, are finding it harder to source high quality, low pollution coal, and are therefore needing to look at alternative fuel sources to power the trains.

To celebrate the 2023 National Science Week theme of "Innovation: Powering Future Industries" we are asking you to design an alternative, sustainable power source for Puffing Billy Railway's steam engines. You will need to share your design via email with Puffing Billy Railway.

You can produce a poster, video, PowerPoint, Google Doc, or any form of presentation to showcase your idea. You will send your sustainable design via email to the Education Crew at Puffing Billy Railway.

The best design will receive a family pass to visit Puffing Billy Railway!

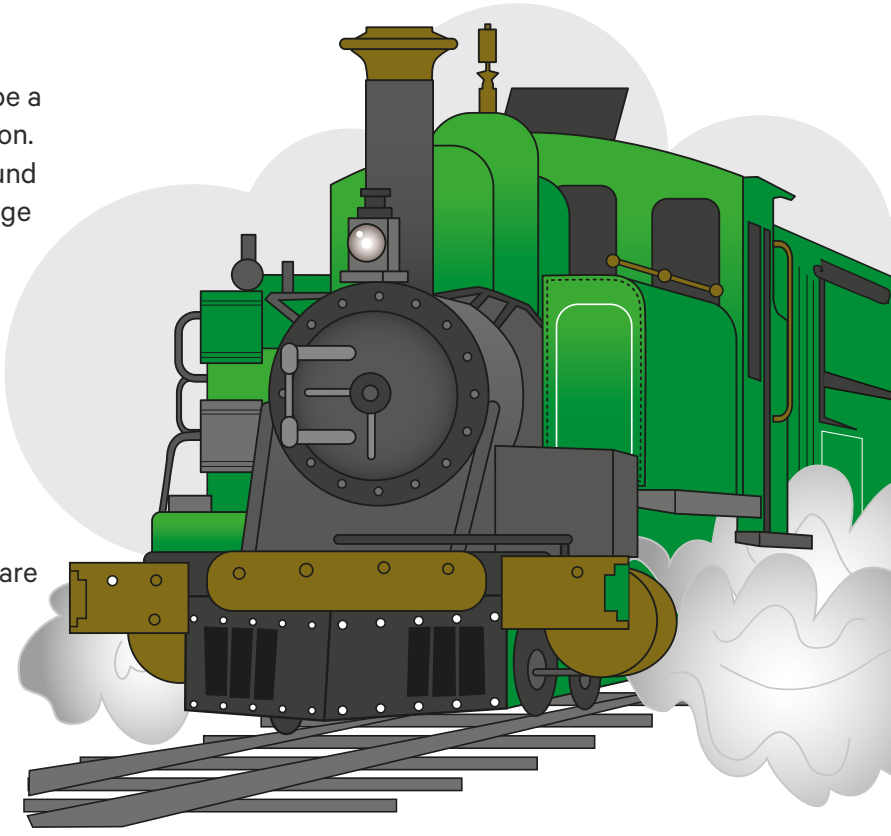
To inform your learning, examples of alternative energy sources at railways are shared in the background information below.

THEME

- Design and Technology
- Innovation
- Energy sources

MATERIALS REQUIRED

- Access to a computer for research and email
- Access to computer presentation programs
- Writing materials



INSTRUCTIONS

1. Where is Puffing Billy Railway (PBR)? Research the temperate rainforest habitat that Puffing Billy Railway passes through (**Link:** https://www.parks.vic.gov.au/places-to-see/parks/Dandenong-Ranges-National-Park)

2. What is a steam engine? Is it sustainable? Research sustainability and the progress in sustainable transport over time. Use the background information to discover what type of trains we use now.

3. As Puffing Billy Railway is a heritage steam railway it must commit to a certain amount of historical operation e.g., using coal. As such PBR's impact on the environment has been drastic over the last century. Using your prior knowledge, list the negative environmental impacts that PBR has had over its 123 operating years.

4. Steam trains consume coal, an energy source that is now known to be a major source of greenhouse gases. To lower emissions coal mines around Australia, and the world, are closing. Heritage Steam Railways, such as Puffing Billy Railway, are finding it harder to source high quality, low pollution coal, and are therefore needing to look at alternative sources to run the trains. Read the articles and watch the videos below to see how other railways are continuing to operate:

- https://www.youtube.com/watch?v=k8TEuMqj4Sc
- https://byronbaytrain.com.au/service/
- https://puffingbilly.com.au/news/workshop-blog/would-you-rather/

See more examples in Background Information on the next page.

5. Using the examples above and in the background information, you will design an alternative, sustainable power source for Puffing Billy Railway's steam engines. You will need to share your design via email with Puffing Billy Railway. You can produce a poster, PowerPoint, Google Doc, or any form of presentation to showcase your idea. **Remember** – The train needs to remain heritage and still needs to appear to be producing steam.

Send your sustainable design to peta.howard@pbr.org.au.

The best design will receive a family pass for Puffing Billy Railway.

SUGGESTIONS FOR ASSESSMENT

Using the examples for inspiration, you will create a presentation of your sustainable energy design to power Puffing Billy Railway's steam trains in the future. You can submit a poster, video, PowerPoint, google doc, or any form of presentation to showcase your work.

BACKGROUND INFORMATION

STEAM LOCOMOTIVES

Creating a steam engine is spectacular. When water is heated it produces steam and the volume occupied by the steam is enormous compared to the volume occupied by the water. When we boil water in a kettle if we let it continue it will produce enough steam to fill the whole room. Puffing Billy uses the power of steam to create enough energy to move the train.

Firstly, the fireman builds a fire out of wood in the first locomotive, that pulls the train, the wood fire creates hot coals which heat the water boiler. The fireman controls the blower to raise pressure slowly, attaining working pressure/a 'head of steam'. Steam is piped from the boiler into the cylinder and used to power the pistons, driving the locomotives wheels.

It usually takes about 3-4 hours to build up a 'head of steam' to get the first engine ready for departure. You need water and heat to create steam power. The coal-loading and fire-making goes on all day, particularly in the busy summer months, when up to six trains leave Belgrave Station each day.

COAL USE

A NA (Narrow Gauge) locomotive at Puffing Billy Railway uses approximately 400 kgs of coal to complete the 2-hour, return, trip Belgrave- Lakeside. At maximum there are 4 trains a day doing the return trip Belgrave-Lakeside, which equates to approximately 1.6 tonnes (1600 kgs) of coal used to power the steam engines on a busy day.

Coal is a fossil fuel. Burning coal produces air pollution. Coal releases more carbon dioxide per unit of energy then other fossil fuels. For more than a century burning fossil fuels has generated most of the energy required to propel our cars, power our businesses, and keep the lights on in our homes. Even today, oil, coal, and gas serve about 80 percent of our energy needs.

But what is a fossil fuel? Coal, crude oil (petrol) and natural gas are all considered fossil fuels because they were formed from the fossilized, buried remains of plants and animals that lived millions of years ago. Because of this they have a high carbon content and when released into the atmosphere create carbon dioxide which is driving global warming. Carbon emissions trap heat in the atmosphere and lead to climate change.

ALTERNATIVES TO COAL USE IN THE RAILWAY INDUSTRY

Use the links below to research what other Railways are doing around the world to eliminate the use of coal:

- https://www.stuff.co.nz/environment/climate-news/130283075/time-to-put-old-steam-trains-back-in-the-museum-say-clean-air-activists
- https://www.nbcnews.com/tech/tech-news/classic-1937-steam-engine-soon-run-carbon-free-flna793578
- https://www.birmingham.ac.uk/research/climate/climate-publications/clean-transport/decarbonisation-and-heritage-railways.aspx
- https://nrri.umn.edu/news/biocoal-train
- https://woodresidues.events/solid-biofuel-powered-tractors-being-developed/

OTHER TYPES OF LOCOMOTIVES:

- Diesel Locomotive https://science.howstuffworks.com/transport/engines-equipment/diesel-locomotive.htm
- Maglev/magnetic train- https://www.energy.gov/articles/how-maglev-works#:~:text=The%20front%20corners%20have%20magnets,design%20creates%20a%20smooth%20trip.
- Electric Locomotive - https://www.metrotrains.com.au/energy-efficiency/

CURRICULUM LINKS

DESIGN AND TECHNOLOGIES

Investigate characteristics and properties of a range of materials, systems, components, tools and equipment and evaluate the impact of their use. (VCDSTC037)

Generate, develop, communicate and document design ideas and processes for audiences using appropriate technical terms and graphical representation techniques. (VCDSCD039)

ENGLISH

Use comprehension strategies to analyse information, integrating and linking ideas from a variety of print and digital sources. (VCELY319)

TERMS & CONDITIONS:

Puffing Billy Railway's National Science Week Competition will run from Monday 14th August to Sunday 20th August 2023. All entries will be reviewed by Wednesday 23rd August and the winner informed via email on Thursday 24th August 2023. The best design will win! Selection of the winner is at Puffing Billy Railway's discretion and the decision if final. The winner will receive 1 x Puffing Billy Excursion Train voucher for travel from Belgrave to Lakeside station return, valid for 2 adults and 2 children. The voucher is valid for 12 months from the date of issue and cannot be extended. The voucher must be redeemed before the expiry date. It is non-refundable, non-transferrable and cannot be exchanged or redeemed for cash.