STEAMING STEM PROGRAM

TOOLS FROM THE PAST

LEVEL

Level 5 – Level 6

ACTIVITY DESCRIPTION

Puffing Billy Railway Museum and Workshop at Menzies creek provides a window into the past, containing over 80 exhibits including rare operational steam and diesel locomotives, carriages, fluid pumps and 500 brake horsepower generators. Students learn about the tools of the past, the restoration, maintenance and repairs of our heritage machinery, and the engineering skills required to develop new tools for the future.

THEME

- Machinery and Engineering

MATERIALS REQUIRED

- Pens
- Workbook
- 1 copy of the Electric Staff Instrument information sheet – attached
- 1 copy each of Victorian Railways C2N Type Trolley, Day 's Petrol Rail Tractor, NKS Motor Trolleys information sheets for each table – attached.
- 1 copy of the Tools and Machinery worksheet for each student – attached.
- Poster Paper
- Access to computers

INSTRUCTIONS

On the recent excursion to the Puffing Billy Railway Museum and Workshop students explored the machinery and tools that were used in the past.

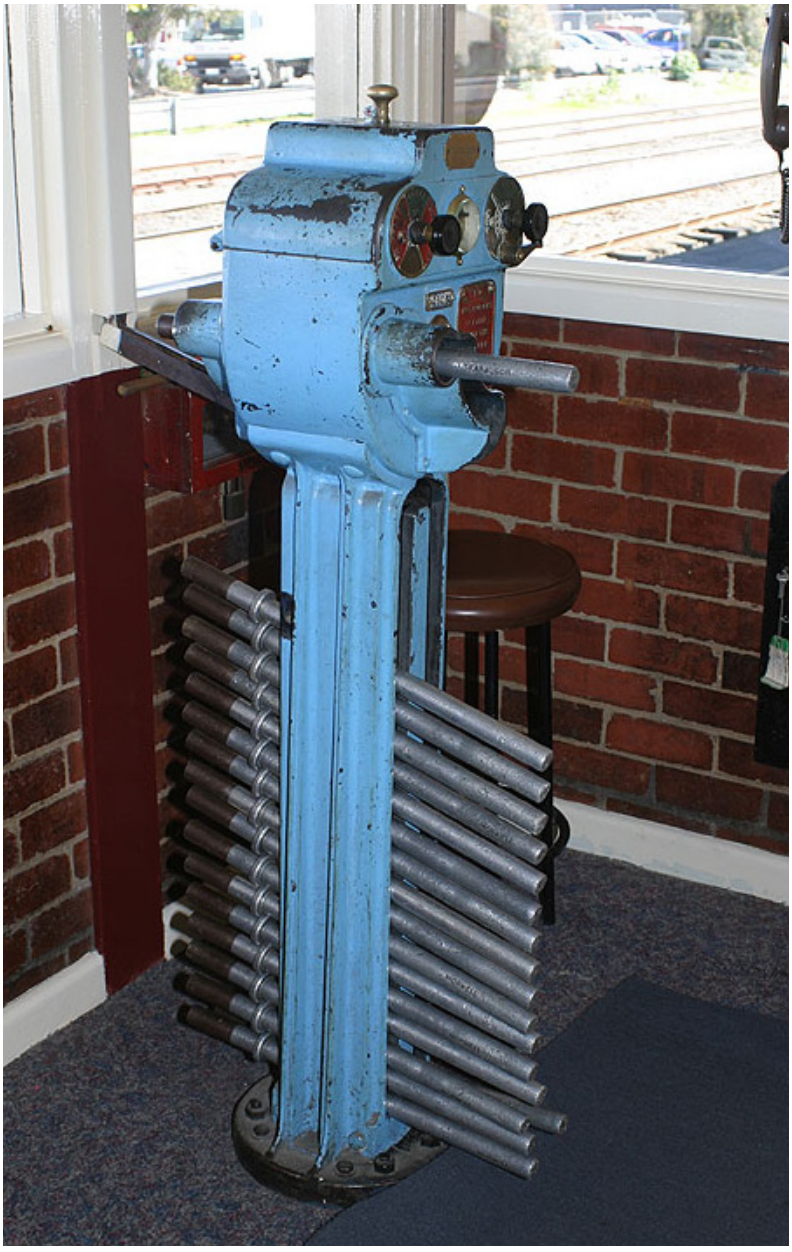
Discuss with students the machinery and tools that they saw, what they were used for, when were they built, have they been replaced?

Show the students the following pictures and information. Hand out a "Tools and Machinery" worksheet to each student. As a whole class activity, read the "Electric Staff Instrument" information and discuss with students. Students are required to listen, comprehend and add information about the Electric Staff Instrument to the worksheet provided. Print out copies of the Victorian Railways C2N Type Trolley, Day 's Petrol Rail Tractor, NKS Motor Trolleys for each table. In pairs or table group, students read and comprehend the information and complete the worksheet.

ELECTRIC STAFF INSTRUMENT

Railway safety is dependent on keeping moving trains apart. On single line railways this was done by the use of a staff – a metal rod engraved with the names of the stations at either end of the single line. Each train needed to carry the staff or a written ticket (if another train was to follow with the staff) to ensure that no other train was on that section of track.

As traffic levels increased it became increasingly difficult to ensure that the staff was always at the required end of the section. Electric Staff Instruments, as presented here, were used to overcome this difficulty by providing a number of identical staffs that were secured in the instruments. Interconnection between the adjoining signal boxes by telegraph wires enabled the signalmen to cooperate with each other in the electrical release of one of the staffs. Once a staff had been released, the electrical circuitry ensured that only when that staff had been placed back into either instrument, could another be obtained. This enabled many trains to travel in the same direction one at a time and, by removing the written tickets used with the single staff system, also removed another possible human point of failure.



VICTORIAN RAILWAYS C2N TYPE TROLLEY

GAUGE*: 2 FEET 6 INCHES (762MM)

Trolleys of this type are known to have existed prior 1910, being used in the years before petrol engines powered the transport of workmen along railway lines.

This exhibit was located at Colac in 1961, after being used on the Colac to Beech Forest and Crowes narrow gauge railway.

Two versions of this trolley were built by the Victorian Railways – one for its broad gauge lines, the other for its narrow gauge lines.

Using the hand pump stick to rotate the wheel would have been hard work on the steep grades of the narrow gauge railways. Braking was also difficult, requiring the pump stick to be removed from the wheel whilst in motion then wedged between deck and wheel tread.

**Gauge refers to the distance between a pair of rails measured between the inside edge of the rails.*

DAY 'S PETROL RAIL TRACTOR

GAUGE: 2 FEET (610MM)

With the introduction of the kerosene-fuelled farm tractor, rail tractors became popular with Industrial railways and sawmilling.

Their popularity was due to their relative low cost when compared with steam locomotives or horses. This Rail Tractor was made by Day's Engineering of South Melbourne. It utilised a 10HP McCormick & Deering 1020 tractor engine and gearbox coupled to their own designed rail body. From 1926 to the 1940s, Day's offered a four-wheel version (as shown on display) and a six-wheel version.

This Rail Tractor was used at the Cheetham salt works for the hauling of salt bins.

Today, only three of this type are known to survive.

NKS MOTOR TROLLEYS

GAUGE: 2 FEET 6 IN CHES (762MM)

These Victorian Railways trolleys were designed and built at the Spotswood Workshops for use in the inspecting and maintaining of the narrow gauge railways in the state.

They are powered by a simple KS-type single cylinder, water-cooled, hand-cranked, two-stroke engine driving one axle via a flat belt. The direction of travel could be reversed simply by stopping the engine, adjusting the magneto setting and re-starting the engine to run in the opposite direction. This feature of a reversible engine meant that complicated gearboxes or the need to turn the trolley around were not required.

Trolley numbers 5 and 8 worked on the various VR narrow gauge lines before coming to Puffing Billy in the early 1960s for use on track restoration work.

The next task is for students to undertake a research project about two different tools or machinery from the past. The tools can be from home, the Puffing Billy Museum or tools/machinery they are interested in. They must include the following information in their research. Students present their information on poster paper or as a power point presentation and provide a short presentation to the class.

- What is your tool/machinery?
- What is it made of?
- Who made it?
- Where was it made?
- What was it used for?
- Who may have used it?
- Draw or include a labelled diagram of your two chosen tools/machinery
- What does this object reveal about the lives and activities of the people who may have used this object?
- Explore and present three interesting facts about the tools/machinery

SUGGESTIONS FOR ASSESSMENT

Ability to contribute to whole group discussion on tools/machinery. Completed Tools and Machinery worksheet. Successful completion of research project and short individual class presentation.

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)

ENGLISH

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

BACKGROUND INFORMATION

PUFFING BILLY RAILWAY ENGINEERING

Puffing Billy, operated by the Emerald Tourist Railway Board, was only the second preserved steam railway in the world. Through a period spanning more than five decades, the restoration, maintenance and repair of our heritage fleet of locomotives and rolling stock has been undertaken on-site by the railway's Rolling Stock Branch. Located at Belgrave, the locomotive workshop is set up to maintain steam and diesel locomotives, with capacity to complete scheduled maintenance and repairs, major overhauls and complete restorations.

It is here that most of our heavy engineering tasks are carried out; machining, welding, fabrication, and assembly.

Our dedicated team of tradesmen, with a wide range of skills and a variety of backgrounds in industry, offer the perfect blend of traditional practices and ongoing innovation required to care for historic assets in a contemporary environment.

Tasks that are undertaken by the Puffing Billy Railway engineers include:

- Project management from the smallest parts to multi-million-dollar capital projects.
- Concept generation and mechanical design including virtual models, concept drawings and calculations.
- Engineering analysis, Finite Element Analysis, and component simulation supported by our robust quality assurance process.
- Simulation of mechanical systems (e.g. valve gear, linkage systems, etc.) to optimise system performance.
- 3D modelling and detailed drafting; from simple parts to complex assemblies and welded fabrications, including Bill of Materials and profile cutting layouts.
- Tourist and heritage railway rolling stock design, construction, and compliance management.
- Heritage rolling stock restoration planning and management.

- Compliance, asset management and maintenance system implementation.

The Puffing Billy Railway, Engineering workshop at Belgrave have a broad machining and fabrication capability, including:

- Turning up to a 1400mm diameter swing and 1950mm between centres.
- Milling, including CNC programmable.
- Fabrication and welding (pressure vessel, pressure pipe and structural).
- Surface and cylindrical grinding.
- Slotting. Experience in maintaining and operating our own heritage fleet allows us to offer specific services such as:
- Axle journal grinding, wheel profile and tyre machining.
- Shrink fitting of tyres to wheel hubs.
- Overhaul and repair of locomotives motion, valve gear and associated components.
- Accurate valve gear setting based on dynamic computer simulation to ensure optimum locomotive performance.
- White metalling of side rod bearings, axle box brasses and crossheads to a high standard.
- Overhauled and repair of boiler fitting (e.g., injectors, safety valves, check valves).

TOOLS AND MACHINERY WORKSHEET

WHAT IS IT?	WHAT IS IT MADE OF?	WHO MADE IT?
1. Electric Staff Instrument	1.	1.
2.	2.	2.
3.	3.	3.
4.	4.	4.
WHERE WAS IT MADE?	**WHAT WAS IT USED FOR?**	**WHO MAY HAVE USED IT?**
1.	1.	1.
2.	2.	2.
3.	3.	3.
4.	4.	4.