INTEGRATED LEARNING

SCIENCE & MATHS

SSEP EXAMPLE // ELECTRICITY INDUSTRY
DEVELOPED BY // HUNTLY COLLEGE AND MERCURY

ACTIVITY EXAMPLE

KEY WORDS

Electricity | hydro power | kinetic energy | potential energy | mechanical energy | electrical energy | energy supply | watts | gravity | flow | density | efficiency | cost | number | volume | percentage | cubic meters | units | height | weight

ALSO USEFUL FOR

Technology | Business Studies | Economics

PROGRAMME OUTLINE

3 POINTS OF CONTACT

- Staff come into classroom (x2)
- Workplace visit (x1)

EXAMPLE

1. Staff come into classroom, introduce themselves, background to the industry, their careers and how maths and science is used in the industry. Discussion about attitudes, behaviours and values important for the workplace. **Student Activity:** hands-on energy transformation models of a wind turbine and a hydro turbine.
2. Workplace visit includes tour of power station and offices. Demonstrations of maths and science concepts and models.
3. Staff come into classroom. **Student Activity:** electricity generation discussion, energy calculation worksheets.

Videos featuring Mercury to support this learning module can be found in the SSEP Resource Centre video library




For more on SSEP see:
www.smartnz.nz

Huntly College Year 9 Science & Maths

1 Run Sheet

1.1 Introduction (5mins)

Taking what you have learnt in the classroom and out on site to do some further learning today.

1.2 Interactive Activities (15mins)

1.3 Exercise One (15mins)

1a. Show animation of Hydro station – Relate to potential energy, kinetic energy, mechanical energy and electrical energy. https://www.youtube.com/watch?v=q8HmRLCqDAI 0 – 59 secs.

1b. Potential energy calculation – Flow x height x gravity x density and translate into houses

1c. Actual energy calculation – 32MW x 3 and translate into houses

1d. Efficiency calculation – Potential / actual

- Give an example of where there is electrical energy at a Karapiro power station.

1b.

- How much potential energy (MW) is behind the Karapiro dam? (Flow x height x weight of water x gravity ÷ 1,000,000)

_____

- How many houses can this energy supply? (1MW can power 1000 houses)

_____

1c.

- How much actual energy is generated by the Karapiro power station?

_____

- How many houses does this energy supply? (1MW can power 1000 houses)

_____

1d. How efficient is this? (*actual* ÷ by *potential* x 100)

Exercise Two

2a. What are the four different stages of the Karapiro maintenance in the video?

1. _____
2. _____
3. _____
4. _____

2b. Calculate the costs of each stage of maintenance and the total cost of the maintenance (*each person costs $500 per day*)

1. Labour:_____ + Materials:_____ = _____
2. Labour:_____ + Materials:_____ = _____
3. Labour:_____ + Materials:_____ = _____
4. Labour:_____ + Materials:_____ = _____

Total cost of maintenance: $_____

2c. Calculate the cost of lost generation ($20,000 per day)

- How many days did it take to do the maintenance? _____
- What is the lost cost of generation? $_____

Mercury

Answers (Not to hand out)

Exercise One

1a.

- Give an example of where there is potential energy at a Karapiro power station. Water behind the dam
- Give an example of where there is kinetic energy at a Karapiro power station. Water moving down the penstock
- Give an example of where there is mechanical energy at a Karapiro power station. Spinning turbine
- Give an example of where there is electrical energy at a Karapiro power station. Generator, transformer, transmission

1b.

- How much potential energy (MW) is behind the Karapiro dam? (Flow x height x weight of water x gravity ÷ 1000000)

Flow (360m^3/s) x Height (32m) x weight of water per m^3 (1000kg) x gravity (9.81m/s) = 113,011,200W ÷ 1,000 = 113,011kW ÷1,000 = 113MW

- How many houses can this energy supply? (1MW can power 1000 houses)

133MW x 1000 = 133,000 houses

1c.

- How much actual energy is generated by the Karapiro power station?

3 units x 32MW = 96MW

- How many houses does this energy supply? (1MW can power 1000 houses)

96MW x 1000 = 96,000 houses

1d. How efficient is this? (actual ÷ by potential x 100)

96MW ÷ 113MW x 100 = 85% efficient

Exercise Two

2a. What are the four different stages of the Karapiro maintenance in the video?

1. Planning
2. Pulling all the parts out
3. Parts repair
4. Putting all the parts back in

2b. Calculate the costs of each section of maintenance and the total cost of the maintenance (each person costs $500 per day)

1. Labour: 3 people for 100 days ($150,000) + Materials: 0 = $150,000
2. Labour: 10 people for 20 days ($100,000) + Materials: 0 = $100,000
3. Labour: 15 people for 200 days ($1,500,000) + Materials: $2,000,000 = $3,500,000
4. Labour: 10 people for 20 days ($100,000) + Materials: 0 = $100,000

Total cost of maintenance: $3,850,000

2c. Calculate the cost of lost generation ($20,000 per day)

- How many days did it take to do the maintenance? 240 days
- What is the lost cost of generation? 240 x $20,000 = $4,800,000

Mercury

Whiteboard Information (Not to hand out)

- 1000 Watts (W) = 1 kilowatt (kW)
- 1000 kW = 1 Mega Watt (MW)
- 1 MW = Electricity for 1000 houses
- $1m^3/s$ = 1 cubic meter of water per second

- Karapiro flow is $360m^3/s$. This is the same as the Huntly Aquatic Centre swimming pool
- Karapiro height is 32 meters
- Weight of a cubic meter of water is 1000kg
- Gravity is 9.81 meters per second
- A single unit at Karapiro is 32MW