Think Like an Engineer

Ever wondered what it's like to be an engineer?

Well here's your chance to plan your own road and think like one!

Think Like an Engineer

Key Learning:

To investigate the role of an engineer on the A9 Dualling project.

Experiences and Outcomes: Second Level

I am investigating different careers/occupations, ways of working, and learning and training paths. I am gaining experience that helps me recognise the relevance of my learning, skills and interest to my future life. *HWB 2-20a/HWB 3-20a/HWB 4-20a*

Having discussed the variety of ways and range of media used to present data, I can interpret and draw conclusions from the information displayed, recognising that the presentation may be misleading. *MNU 2-20a*

Having determined which calculations are needed, I can solve problems involving whole numbers using a range of methods, sharing my approaches and solutions with others. MNU 2-03a

I have carried out investigations and surveys, devising and using a variety of methods to gather information and have worked with others to collate, organise and communicate the results in an appropriate way. *MNU 2-20b*

I can discuss the environmental impact of human activity and suggest ways in which we can live in a more environmentally responsible way. *SOC 2-08a*

I can consider the advantages and disadvantages of a proposed land use development and discuss the impact this may have on the community. *SOC 2-08b*

Having analysed how lifestyle can impact on the environment and Earth's resources, I can make suggestions about how to live in a more sustainable way. *TCH 2-02a*

During practical activities and design challenges, I can estimate and measure using appropriate instruments and units. *TCH 1-13a / TCH 2-13a*

Learning Intentions:

- I am learning about the type of work an engineer does in a road dualling process
- I am learning the importance of tabulating data in order to make informed choices

Success Criteria;

- *I can explain the type of work an engineer carries out*
- *I can read data from different sources and use this to fill in tables correctly*
- *I can use coordinates to place constraints on a map*

The Activity

To work with an engineer from the A9 dualling project to discuss two aspects.

1. How;
   a) journey time (*in terms of driver satisfaction*)
   b) safety
   a. constraints
   b. cost

   impact on ***one*** possible route selection when dualling a road.

2. How engaging in discussion will help pupils make **informed choices** about other possible route selections that may be presented to them in the future

NB This activity forms part of the 'Roadshow' that will be delivered into schools. It will be led by an **engineer** from one of the three design consultancies engaged in dualling the A9. It will take approximately 40 minutes.

Notes for Teachers

- The purpose of this activity is to highlight the considerations engineers must make when planning, designing and constructing a new road – in this case the A9. It will provide pupils with a 'real world' example of how tabulating data can take arbitrary information and present it in a manner that helps engineers in the decision-making process.
- This decision making process can be complex when planning or making changes to a new or existing road therefore this introductory lesson will be **adult led and guide pupils into interactive activities**. Delivery in this way will support pupils gain a greater understanding of all aspects involved in dualling making them better placed to make informed choices by themselves in future lessons.
- In the activity, **black** text is general information, **blue** text is pupil activities and **green** text is answers/additional information for teachers.

Think Like an Engineer – Engineer Challenge for the Primary Roadshow

Required by school:

- Sticky label for each pupil to write their name on.
- Pot of pencils
- Access to Smartboard

Key Learning: To investigate the role of an engineer on the A9 Dualling project.

Key Vocabulary: tabulating, constraints, data, coordinates, key, bog, frustration, arbitrary

ELO Checklist:

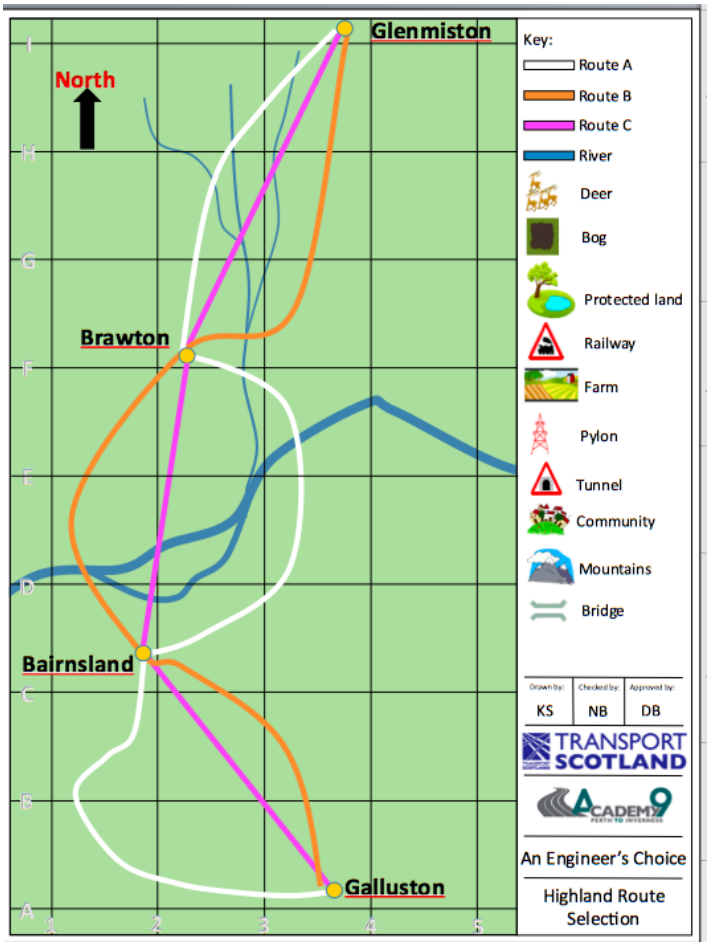
- ✓ Engineer prompt sheet/instructions
- ✓ Answer Sheets (Slide 6 and 14)
- ✓ Teacher Pack linked to CfE
- ✓ Online stopwatch: http://www.online-stopwatch.com/countdown-timer/

ELO gives out and teacher collects and keeps:

- ✓ 1 Pupil Worksheet per pupil

ELO gives out and takes back:

- ✓ 1 x A1 Map (aka "Slide 3") and enlarged cut-out constraints (Slide 17) (If no smartboard available)
- ✓ 2 x A1 Answer Sheets (aka "Slide 6 and 14") (If no smartboard available)
- ✓ Laminated A4 blank map per pupil (Slide 3)
- ✓ Laminated stick on constraints – 1 set per pupil (Slide 17)
- ✓ Blue tack to stick on constraints to A4 laminated map
- ✓ 1 A4 Laminated Data Sheet per 2 pupils (Slide 16)
- ✓ Lanyard per pupil (Name stickers should be put on by teacher)

1	• **Before you start** have **Pupil Worksheet** and **maps** on tables for pupils. • **Introduce yourself** to the pupils (**name, job title etc.**) • Explain to pupils that they are going to become an engineer for the day and look at possible routes for the A9. • Tell them that this will help them understand the decisions that the engineers have to make before actual dualling can take place. • **Hand out lanyards.** (Pupils should be wearing name stickers already) • **Go over LIs and SCs (Slide 2)**
2	Show pupils **slide 3** of the PowerPoint 
3	Draw pupils' attention to the **KEY** and elicit its importance. (A key UNLOCKS information) **Discuss only that part of the key that outlines each of the possible routes (i.e. *coloured bars*).**

4	Tell pupils that the coloured bars represent the routes that engineers are currently assessing to see which one would be the best route for the A9 to be dualled. (*Elicit from pupils that the **BLUE lines are rivers**)*
5	Tell pupils that today we are going to research and discuss the **WHITE** route only. Tell them that they will transfer all that they have learned from discussing this route to **researching other routes on their own in the future.**
6	Interactive: Highlight the **black dots** and explain that they are **towns**. (**If time** - Ask one pupil to come to the smartboard and slowly trace the **WHITE** route with their finger. While they are doing this all other pupils say the name of the starting town and all other towns as they are passed.) **OR** do this **yourself.**
7	Tell pupils that we are going to put the information about the **WHITE** route from this map into a table or **'tabulate'** it. This means next time we will have the information written down so they (as engineers) can refer to it when they want to compare the different routes at the end. Today we are just **'tabulating'** the **WHITE** route.
8	**Interactive:** Draw attention to **Pupil Worksheet** – 'Tabulating Information'. Using the **powerpoint map** show pupils how to fill in table 1 for the journey from Galluston to Bairnsland. THEN set the **online stopwatch** and give them **45 seconds** to complete the rest of the table including the **TOTAL TIME. (See Slide 5 for answers – Slide 4 can be used to explain the process further if required)**
9	Tell pupils that the **journey time is important** and that engineers have to take this into consideration when planning and building a new road. (**Ask 'Why?'**)
10	**Interactive:** Set the **online stopwatch** and give pupils **30 seconds** to discuss with shoulder partner the reason for this. **Take feedback** (Answer driver satisfaction/ safety frustration/cost).
11	Tell pupils that to help engineers make an informed decision when discussing **all** route options they often use a **'penalty point' system. Like football – the team/route that LETS IN the LEAST penalties is the WINNER.**

12 Explain that **ONE penalty** is given for each **FIVE minutes** driven.

- Show pupils how to calculate the penalty points for **Galluston – Bairnsland** and **fill in on the table** (Table 1) (i.e 30 minutes = 6 points)
- Ask what sum I had to do for this? **(ie 30 ÷ 5)**

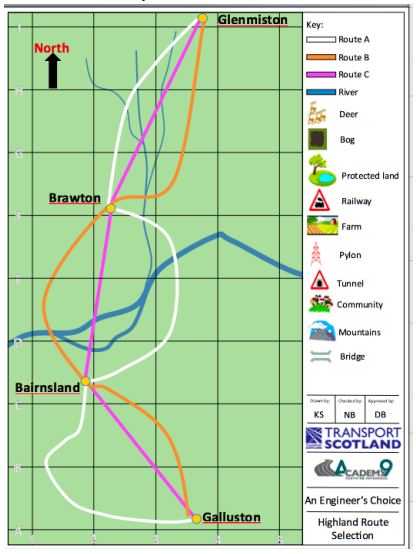
13 **Interactive:**

a. Using **online stopwatch**, allow 2 minutes for pupils to fill in the rest of **Table 1.**
b. Explain that **engineers always check each other's answers** to make sure structures like bridges and tunnels are built safely and won't fall down.
c. **Peer assess** each other's work using **Slide 6** of the PowerPoint.

14 Tell pupils that when engineers are involved in the decision making process, considering the best place to dual, there are **other factors** apart from 'time' they have to take into consideration. We call these **'constraints'**.

15

- Using the Key from slide 7 on the PowerPoint.
- Ask if anyone doesn't know what any of the **'constraints'** are and **explain them.**



16 Tell pupils that some of these **constraints** are situated along the WHITE route. Engineers know this because they have been out on site and surveyed the area ***(BRIEFLY explain how engineers carry out surveys).***

17 Tell them that to compare different routes engineers place these constraints on a map. **(Explain coordinates. NB ALONG then UP** (as a way to remember which coordinate should go first give pupils the saying, **(*'along the corridor and up the stair!*)**

- Seeing **constraints** on a map will help engineers decide the most **cost effective**, **safest** and **environmentally friendly** route with the least amount of upset to people who may live nearby.

18 **Interactive:** Tell pupils they are now going to become engineers and **<u>place the constraints where they are known to be</u>**

Resources required:

- Worksheet 1 "Tabulating Information"
- **Give out Map of WHITE route** (see slide 3 or 7) with **attached packets of cut-out 'constraints'** for each pupil (i.e. 1x herd of deer, 1 x Protected Land, 2 x bogs, 5 x bridges.)
- **Give out Data sheet** showing constraints, coordinates and penalty points
- **(If no whiteboard available you will need large map and constraints to demo this part)**

a. Draw pupils' attention to **Data sheet** and tell them these are the constraints that engineers found on the **WHITE** route. Draw their attention to the **coordinates of these constraints** and tell them they must use these coordinates to place the constraints correctly on the **WHITE** route

b. Because the **bridges** have not been given coordinate points, pupils place these where they think fit. (**<u>If time</u>** some pupils can be chosen to give the coordinates of where they placed the bridges and justify their choice and place larger copies of these on the smartboard)

c. Demonstrate how to place the constraints on the map using the **'Protected Land'** as an example. (See **Slide 8**)

d. Using the **online stopwatch**, give **4 minutes** for this activity ***(including peer assessment time)***. Referring to coordinates on the Data sheet, pupils place constraints on their graph.

e. **Peer assess** by comparing answers to **slide 9** of powerpoint.

19 Tell pupils that these constraints are also given '**penalty points**' Tell them that penalty points are awarded depending on the constraint *(e.g a tunnel is more difficult to build than a bridge, costs more and takes more time = more penalty points etc)*

a. Interactive: Referring to **Data sheet** and using the table on **Pupil Worksheet** pupils write the number of penalty points for each constraint then add them together for an **overall "Penalty Point" total**
b. **Explain** by using the example of **Bridges** (e.g 5 bridges worth 5 points = 5 x 5 = 25 points) (If pupils require additional demonstration/explanation use slides 11 – 13 to show them step-by-step guidance)
c. Using **online stopwatch**, give **4 minutes** for this activity **(Including Peer Assessment using slide)**
d. **Add these 'constraint penalty points'** to the **'time penalty points'** in Table 3 on **Pupil Worksheet.**
e. **Peer assess** – by comparing answers to **correct answers on slide 14.**
f. **Sign sheet** at bottom to show that this has been checked
g. **Engineer also to sign to 'approve'**

20 Finish off by asking the following questions: **Children are asked to use their thumbs to show how well they understand. Explain that:** = I Understand, = I am a little unsure, = I really don't know.

a. Can you tell me the type of job an engineer does? (Pick someone with to answer)
b. Are you able to use data to place constraints properly?
c. Do you understand the importance of tabulating results in order to make informed choices?

Conclusion

That concludes your time as an engineer. I hope you have learned a little about my job on the A9 dualling. As you pass me your lanyard, tell me one thing an engineer does? Would any of you like to be an engineer? Have you any questions?
Ensure the Pupil Worksheets from this and Follow-up Lesson 1 are kept safe to be used in Follow-up lesson 2.
Ask questions to ascertain learning in line with the Success Criteria. (Slide 15)