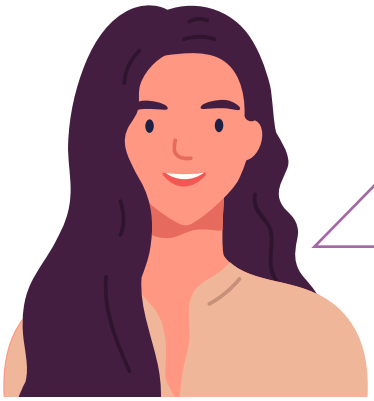

In this activity you will take on the role of a Project Manager planning the construction of a road bridge that will enable trains to cross a busy motorway.

Project Managers have to consider the material costs, construction costs and how long the construction will take. We also have to think about the environmental impact. It's our job to make sure that construction happens on time, on budget and to a high quality.

Danielle, Project Manager

Challenge 1: Choose a Site

There are three potential sites for building the motorway bridge. You must choose to build on the site that has the lowest ecological value, meaning that construction will have the smallest possible impact on the environment.

a) Read the description of the sites in Table 1 and then calculate a score for its ecological value using the scoring system below.

Table 1: Site Descriptions of Proposed Sites

Site	Description	Ecological Value
1	Consists of an old industrial estate with a car park covering an area of 2100m^2, the area to the West of this is 2400m^2 of woodland with a pond at the centre with an area of 500m^2.	
2	Consists of a wildflower meadow covering an area of 3400m^2 with an area of farmland to the South measuring 1600m^2.	
3	Has a grassland area of approximately 3590m^2 with a pond in the northeast corner. The pond has an area is 1409m^2. The site is home to a 1m^2 area that contains a rare protected flower that cannot be found anywhere else in the UK.	

- Ecological value per square meter of land type:
  - Car parks/buildings = 0
  - Farmland = 3
  - Tree = 2
  - Ponds = 7
  - Grasslands = 12
  - Wildflower meadow = 15
  - Woodland = 20
  - Protected flower species = 1500

b) Which site do you think is most suitable for construction? Explain why.

Challenge 2: Choose a bridge.

There are two potential designs for the bridge; a pre-cast concrete bridge or a steel truss bridge. You must decide which bridge will be most suitable based on:

- Total cost including materials and construction;
- CO_2 produced by the production of the materials;
- The time it will take to build.

a) Using the materials data in Table 2, calculate the materials costs, time and CO_2 emissions for the steel truss bridge in Table 3. This bridge uses six different types of steel beam (A-I), in different quantities.

Table 2: Steel truss bridge materials data

Steel Beam Type	Length (m)	Volume (m^3)	Mass (kg)	Cost/m (£)	Time (Days)	$C0_2$ (tCO_2eq)
A	15	0.95	7457.5	250	1.5	3
B	20	1.25	9812.5	250	1.5	3
C	10	0.17	1334.5	250	0.75	3
D	20	0.35	2747.5	250	1	3
E	10	0.05	392.5	250	1	3
F	20	0.09	706.5	250	1	3
G	16	0.08	628	250	1	3
H	22	0.11	863.5	250	1	3
I	16	0.08	628	250	1	3

Table 3: Materials costs, time and CO_2 calculations for proposed steel truss bridge.

Steel Beam type	Length (m)	Quantity	Cost (£)	Time (Days)	CO_2 (tCO_2eq)
A	15	12			
B	20	4			
C	10	2			
D	20	2			
E	10	7			
F	20	7			
G	16	8			
H	22	4			
I	16	6			
		Total:			

b) Using the materials data in Table 4, calculate the materials costs, time and CO_2 emissions for the pre-cast concrete bridge in Table 5. This bridge uses an L-shaped concrete side slab in two sizes (2m and 3m) and concrete slabs in one size (7m).

Table 4: Concrete slab bridge materials data.

Type of Concrete Slab Type	Length (m)	Volume (m^3)	Mass (kg)	Cost per slab (£)	Time (Days)	CO_2 (tCO_2eq)
L-Shaped Wall A	3	4.5	10827	£5,000	0.375	0.2
L-Shaped Wall B Type	2	3	7218	£3,000	0.375	0.2
Deck Slab	7	9.45	22736.7	£12,000	0.0625	0.2

Table 5: Materials costs, time and CO_2 calculations for proposed concrete slab bridge.

Type of Concrete Slab	Length	Quantity	Cost (£)	Time (Days)	CO_2 (tCO_2eq)
L-Shaped Wall A	3	30			
L-Shaped Wall B	2	20			
Deck Slab	7	54			
		Total:			

c) Complete Table 6 to calculate the total cost for each bridge including construction costs.

Table 6: Total Cost.

Bridge Type	Materials Cost (£)	Crane Hire (Days of hire x Cost per day)			Operative Cost (Days of hire x Cost per day)			Cost of Running Site (Days of hire x Cost per day)			Total
		Days of hire	Cost per day (£)	Total (£)	Days of hire	Cost per day	Total (£)	Days of hire	Cost per day (£)	Total (£)	
Steel truss			£10,000			£3,500			£5,000		
Concrete slab			£10,000			£,3500			£5,000		

d) Which bridge do you think is the most suitable? Justify your answer by considering the cost, time to build and environmental impact of your chosen bridge.