Ex'straw'dinary Engineering

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Age group

7 – 11
11 – 14

Curriculum focus

Design and Technology, Careers, Enterprise

Learning objectives

Student will:

- discover the variety of roles carried out by engineers
- identify suitable frame shapes for a strong and rigid structure
- draw a simple scale plan
- build and test a simple model.

Older students can also:

- identify client criteria in a bid document and respond with design specifications.

Time needed

85 – 115 mins

About this activity

- This activity uses a realistic bid or challenge to explore the design criteria and design specifications that might apply to a jacket structure for an offshore oil rig.
- Students first use slides to explore the role of engineers in BP and the role of the jacket structure in offshore oil installations. Older students then read and interpret a 'bid document' to identify key design criteria. For younger students, there's a simpler challenge document that explains what they must do.
- Working together, teams must draw up outline plans for a jacket structure. Older students must also identify the main criteria for the structure and then list some design specifications that would make their structure suitable.
- Teams build a scale model using straws and marshmallows, and calculate the cost of their structure, with each straw or marshmallow costing $1 million. They test their designs to see which ones meet the specification for height and strength and which of these is the strongest.
- Finally, students reflect on how well they worked as a team and how this relates to the real world of work.

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What you will need

- Slide presentation
- Wood blocks for testing
- Ruler (preferably with no 'spare' before 0)
- Trash bag for waste straws and marshmallows
- Cloth and cleaning equipment for the tables
- Plastic sheeting to protect the desks (if available)
- Prizes if you wish to run as a competition

Per team of 3 - 5:

- Bid or 'Your challenge' worksheet
- 18 straws
- 12 marshmallows
- 1 pair scissors
- Spare paper for draft designs
- Plastic board for placing on top of structure
- Graph paper
- Pencils and rulers

Timings and structure

Total time: 85 – 115 mins

Activity	Time (mins)
Introduction and Q&A	5
Activity 1: What do engineers do?	10 - 20
Activity 2: What is a jacket structure?	10
Activity 3: Your challenge	5
Activity 4: Teamwork *	10
Activity 5: Design and build	20 - 30
Activity 6: Testing and results	20
Activity 7: Evaluation	10
Round up	5

* optional activities

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Prior knowledge and preparation

- Choose how much you wish to highlight teamwork, and whether you will get students to formally reflect on their team working and link this to the BP competency of 'team work'.
- Make sure you use the right student worksheets for the age of the group, and the corresponding slides in the presentation.
- It can be helpful if they are familiar with concepts of design criteria and design specifications and have previously drawn up design criteria for a product. This is only necessary if the school wishes to link this activity closely to design and technologies – it also works well as a teamwork exercise as well, linked to enterprise and the world of work.

Deliver the activities

Introduction and Q&A (5 mins)

Introduce yourself and the topic of engineering.

1. Introduce yourself and give a simple explanation of what you do at BP. Explain that you're going to help students learn more about what engineers do and some of the skills they use.
2. Use slide 2 to review what will happen during the session.

Activity 1: What do engineers do? (10 mins)

Find out about some different types of engineers and what they do.

1. Ask students to suggest what engineers do and come up with a definition of an engineer. What ideas made them describe engineers this way?
2. Use slides 3 - 5 to explore the roles of engineers in everyday life and in BP, focusing on civil, mechanical, chemical and electrical specialists (see background information in the appendices and amend for age group).
3. Use slides 6 — 9 to briefly review some other engineering applications across BP as an 'energy business' (not simply as an 'oil company').

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Activity 2: What is a jacket structure? (5 mins)

Briefly explore jacket structures and how they support the topside elements of an offshore oil installation.

1. Explain that the topsides of an oil rig include the drilling equipment, oil production plant and accommodation (go into as much or as little detail as you feel comfortable with). You could talk about the size of the topsides - how may people sleep there, the facilities they have (e.g. restaurant, recreation room, gym, helipad) - see background notes.
2. Use slides 10 - 12 to review the function of the jacket structure: to position and support the topsides of the rig.

Activity 3: Your challenge (10 mins)

Students learn what they do as they take on the role of engineers.

1. Explain that, in teams, students will take on the role of engineers. For ages 12-14, show slide 13 and review the BP bid.
   For ages 7-11, show slide 14 and review the 'Your challenge' sheet. Both age groups should review the rules on slide 15.
2. Briefly discuss questions that teams might need to think about as they identify client criteria, draw up their design specification, and draw and cost some plans for their jacket structure design.
3. Explain that students will be creating scale models of their designs using straws and marshmallows (not to be eaten!).The structures need to be made at the cheapest cost and each straw and marshmallow is worth $1million.
4. Explain that teams will have 20 – 30 mins to complete the written parts of their bid and to construct their scale model ready for testing.
5. Use slide 16 to show how you will test the scale models. Allow teams to feel the weight of the wooden blocks that their structure will need to support.

Activity 4: Teamwork (optional - 10 mins)

Students consider the importance of working together, on their challenge and in real life.

1. Show slide 17. Students explain their ideas of teamwork: what skills or qualities does this include? Why is it important? Draw on your own experiences of why teamwork is important in the real world of engineering and in BP.
2. Emphasize that students must work as teams if they are to do their best in the challenge.

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Activity 5: Design and build (20 - 30 mins)

Students work in teams to respond to the bid as they draft their written response and build their scale model. (Younger children will just complete the construction challenge without using the bid.)

1. Divide the group into teams of 3 – 5 students. Hand out team sets of straws and marshmallows and the plastic platform. Remind students not to eat the marshmallows (they are worth $1million each after all!). Explain that their structure will need to support the platform – it can't be bigger than this at the top. They can't have extra straws or marshmallows.
2. Circulate among teams to answer questions and provide assistance. Key elements might include:
   a. For older children help to identify client criteria that are explicit (e.g. that the jacket must be at least 500 feet tall or implicit (that the structure must have a coating that can withstand salt water).
   b. Clarifying the right scale at which to design and build and that teams can cut their straws (suggest 1:1,000 so that 1in = 10 feet).
   c. Helping teams split the tasks and work as a team.
   d. Pointing out that straws must be rounded up to the nearest whole straw for costing (e.g. if a team cuts up and uses 6.5 straws they must cost for 7).
3. Teams create drawings of their designs on grid paper and work out the cost.
4. Teams build their scale models.

Activity 6: Testing and results (20 mins)

Teams watch as their scale models are tested.

1. Gather teams' models together and label them. Remind students not to eat any remaining marshmallows.
2. Ask teams to share how they decided on their design and the frame shapes they used (older students should refer to client criteria and their design specification).
3. Test structures for height (minimum 15 in) and load (8,000 'tonnes' – represented by wooden blocks on a tray).
4. Announce the winning team - the cheapest structure that supports the design load. If more than one meet this requirement and are of equal cost, the winner is the structure that can support the most weight.

Activity 7: Evaluation (10 mins)

Students reflect on their performance.

1. Show slide 18. Ask teams to share ideas for what it was like to work together and complete the challenge. What went well? What didn't go so well? What would they do differently next time? Importantly, get them to reflect on whether what they had designed initially worked in real life. If not, explain that this often happens - engineers are constantly testing things out and amending plans. They need to be determined and not give up. Optionally, use slides 19 and 20.
2. Share and discuss ideas about how communication and team working is important in BP and in any career.

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Round up (5 mins)

1. Thank students for listening and for the effort they have put into taking part.
2. Ask general questions to review what students have learned about how it's important to understand and respond to design criteria, and work together as a team.
3. Hand out prizes if you are running the activity as a competition.
4. Wish students well for the future and remind them to put their learning into practice – BP recruits engineers across all its business areas, not just oil, and like any big company, also looks for important qualities like the ability to work together.