

Ambassador Guide

Activity Title: Train Design

This Ambassador Guide is designed specifically for the **Train Design** activity. It includes information for the activity and tips on how it could be best implemented. Please use this guide with the Ambassador Presentation to effectively conduct the activity.

Resources needed:

Screen for Ambassador Presentation
Classroom with tables/desks for students to work in groups

Suggested Student Group Size: 2-3

Materials needed for Ambassador:

Railway kit (x10 wooden rods, tape, example car)

Materials needed Per Group:

Masking Tape	Scissors
Lollipop Sticks (x15)	Paper Clips (x6)
Dowel (x2)	Wire (x6 – approx 20 cm each)
Spool (x4)	Ruler

Optional materials

A box of chocolates/ sweets suggested as prizes

Related subjects:

Railroad Engineering, Mechanical Engineering

Documents included:

Ambassador activity guide
PowerPoint Presentation
Student Worksheet
Evaluation Form

Total Estimated Time: 1 hour 30 minutes

Activity	Time (mins.)	Slides
1. Introduce Crossrail and Engineering	5	1-6
2. STEM Background	10	7-11
3. Project Explanation	5	12-14
4. Project Brainstorming/ Planning	10	14
5. Building	30	14
6. Testing	10	14
7. Group Run and Discussion	20	15-16
Total:	90	19

Before the Session Checklist

- Get in contact with Young Crossrail (youngcrossrail@crossrail.co.uk) to ensure that you have the kits/ materials needed to present the lesson
- Review and customize the PowerPoint to your liking
- Practice setting up the railway you will have to assemble in the classroom - in the Railway Kit there will be x10 wooden rods and tape. These will make a rail around 3 meters long when they are set up on a slope. By taping the ends of the rods together you can make a rail for students train cars to run on, as shown in Fig. A. When taping the rods together it's important that you wrap tape about 10 cm on each rod, as shown in Fig B. Three main considerations with the rail are width, stability, and incline:
 - Be sure that the two pieces of the rail are equally spaced in a way that fits the model train car included in the railway kit. Students will have to build around this width.
 - Be sure that the rail is supported (taped down) firmly on both ends and that the middle does not sag too much. Example pictures have been provided below to show you one good way to tape the end to the desk on a slope (Figures C,D, and E).
 - When taping down the rail, tape one end to a chair and the other to the ground. You should test the model train car to ensure that the slope of the rail is adequate so that gravity will carry the car down the slope without stopping in the middle. This practice rail shown below is 0.5m tall. When cars reach the end they are moving pretty quickly and will continue to roll across the floor.



Fig A: Rail sloping from table to floor. Sloping to floor will ensure that rail cars do not derail at the end and break. Notice that the top of the rail is at a slope, not parallel with the table.



Figure B: The temptation will be to just tape where the joint is, but this won't work well. Apply tape liberally. The arrow shows where the joint is. The taped section here is about 10cm long



Figures C, D and E: This is one way to tape the rail to the desk at an angle. It uses 4 pieces of tape. Two are applied directly to the rod; they are then taped to the desk

In the Classroom:

– It is advised to arrive 15- 20 minutes early

- Before the session begins, set up the railway as you practiced before

Activity Instructions:

1. After delivering the activity PowerPoint slides 12-14, divide students into groups of 2-3
2. Give each group their designated materials
3. Initiate Planning Phase
4. Initiate Building Phase
5. Initiate Testing Phase
6. Facilitate Group Rail Run
7. Facilitate Discussion

Requirements and Restrictions:

These are also noted on the student hand-out. They are meant to encourage students to apply the STEM principles they've learned.

1. **Students must build a train car that meets all specifications.**
 - Width between wheels must match rail width (remind them they have rulers)

- Hooks should be positioned in middle (front and back) of dowel
 - Train car wheels roll, not slide, down the track.
- 2. Train cars must connect (via hooks) to other train cars in front and back.**

Organisation:

Keep track of time during the activity and closely monitor students' progress to ensure they are moving at an adequate pace

Phase	Time (mins.)
Planning	10
Building	30
Testing	10
Group Run and Discussion	15

Planning Phase:

Students begin their engineering design process with paper and pencil, evaluating the materials at hand and delegating work to different people in the group.

Building Phase:

Students put their plans into action. It is important to encourage them to test throughout the entire building phase to see how their design is coming along and how it needs to be adjusted.

Testing Phase:

Students test run the train car on the rail and make finishing touches to optimize their design.

Group Rail Run:

This is going to be one of the most hectic parts of the activity. Ask students to form into larger groups and connect their train cars together; there should be three cars per "train" (more will be unstable). Each group will then be able to test their train on the rail and see how well it navigates. This must be closely facilitated by you in order to ensure that all groups have their hooks applied correctly and that trains will not derail and fall apart.

After the Lesson:

Ensure that all pieces of the kits have been returned by completing the check list in each kit.

Activity Tips:

Q: What if students are having trouble with designing?

A: Slide 17 has been included at the end of the PowerPoint with examples if the students seem to be struggling to come up with an idea on how to build the carriage.

Q: What if the student's axles won't spin?

A: There is either too much friction or an obstruction at the junction between the frame and the axles. Walk around and evaluate their designs, suggesting that they use a *circular* shape to wrap *loosely* around the axle.

Q: What if the students' designs don't work?

A: Sometimes things go wrong. It's important to show the students what worked in other cases and what didn't work in their case. Try asking during the discussion what they could have done better and what they learned.

Q: What if a student's carriage won't stay on the track?

A: This can be because of a number of reasons. Their carriage may be the incorrect width and not fit on the rail. It could also be because their carriage won't run straight, which happens when the weight isn't evenly distributed or when the frame isn't sturdy enough. In this case, suggest that they make it more rigid so that pieces are firmly held in place (see PowerPoint slide 19).

Presentation and Discussion Tips:

Q: How do I deal with disruptive behaviour in the classroom?

A: One effective way of preventing this is to set ground rules for students when the presentation begins, such as no talking when the ambassador is talking, no talking over others, showing respect to everyone etc. Making sure that the class as a whole agrees to follow such rules allows you to enforce the rules when they are broken.

Remember that you are not the only responsible adult in the classroom. Teachers are responsible for managing behaviour.

Q: There are students who dominate the discussion or activity work, while others are too shy to speak out and hardly participate. How do I promote equal participation?

A: Repeatedly emphasise that the most important element of engineering is planning and teamwork. Encourage students to work as a team and make decisions after discussion amongst themselves. Allow students to produce responses to questions as a small group, so that students who are too shy to speak out in class are still able to contribute within the team. If a single student is repeatedly answering questions, you can always engage others by saying something like, "I don't think we have heard from this side of the class yet?"

Q: There are students who show disinterest in the presentation and the subject material. How should I handle these kinds of students?

A: The first step is to get them involved. You could use praise or award prizes for correct answers. This will initially make students focus more on what is being presented, but eventually allow them to find an element that interests them.

Secondly, address how the subject matter and the engineering challenge is relevant to daily life. Connect real-world examples and applications to the engineering principles instead of presenting them as just another subject.

Finally, when providing your professional background, remember to include exciting experiences relating to your work, and how Maths and Science are tools you use in your job, rather than just a subject you learnt.

Q: How do I make sure that students will have a positive, educative experience with the activity?

A: When the activity progresses, ask students to justify their actions and decisions. Utilise the reflection prompting questions that are provided with the Ambassador Presentation and Activity Sheets.

After you explain information, ask simple questions that allow students to review what they have learnt. This way, the key concepts are fresh in their minds as they begin the activity. Encourage students to try different activities at home using materials they have seen being used.

Additionally, if a student makes a good point in a classroom discussion, be sure you give them ownership of that contribution, with prize or recognition. Students will gain confidence and actively participate.

Q: What are some different ways I can structure the discussion?

A: There are two main ways you could structure the discussion:

One way, called "Snowball". Begin by engaging the students with discussion questions in their respective groups. Then, after a certain amount of time, join two or three groups to share their discussions. Finally, bring the discussion to the entire class, allowing individual students to speak out about their group's approach to the activity and see how each group had different ideas.

Another way to make sure individual students are participating is called the "Marketplace Format". Allow students to discuss their approach to the challenge provided in the activity in groups. Then, ask the students to form groups consisting of one member from each activity group, and ask them to share what they did to members from different activity groups. This allows individual students to explain the groups design, and promotes each student's participation in discussing and sharing ideas.