

## Teacher Guide

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### Background

Inspired by the Innovation at HS2 accelerator programme, in this project students will design a new product to improve customer experience when travelling by train.

Exploring the views and needs of customers and rail staff, the students will take their initial ideas and develop them into an annotated final design and model, to be presented in a pitch for a £100,000 investment.

Students will have to use their creativity, drawing skills, modelling skills and persuasiveness to be successful.

### Overview

Innovating the Future has been developed to meet the CREST Discovery Award requirements, and by completing the activity and a CREST Discovery Passport the students are eligible to be entered for the Award.

You can deliver this resource as a full one-day STEM event, over five consecutive lessons in a STEM context or as part of extracurricular learning, with a full class or a smaller group of students.

### The Challenge

In this challenge students aged 10-14 will work on their own or in teams of up to four to design a new product to be used when travelling by train. The product should improve the customer experience of rail users.

#### Students will:

- Research the needs of rail customers to locate a design problem;
- Find out about new digital technologies to incorporate into their product;
- Work as a team to develop a final idea;
- Present their product as a drawing and model;
- Write a marketing plan;
- Deliver a five-minute presentation explaining their product.

### Learning Objectives

#### Students will learn to:

- Use research and exploration to identify a design problem and user needs;
- Develop a design specification;
- Communicate design ideas using annotated sketches, models and an oral presentation.

### Essential Skills

This project incorporates the Skills Builder Framework for Essential Skills. Students will have the opportunity to use their essential skills of creativity, teamwork and speaking. See the Skills Builder Framework for Essential Skills for more information at <https://www.skillsbuilder.org/>.

## Materials and Printing List

Activity	Materials/printing for a group of 30	Presentation slides
<b>Introduction</b>	<ul style="list-style-type: none"> <li>1 x Innovating the Future Teacher Guide</li> <li>30 x Innovating the Future Student Packs</li> <li>30 x Discovery Passports (<a href="https://discoverylibrary.crestawards.org/crest-discovery-passport/62595428">https://discoverylibrary.crestawards.org/crest-discovery-passport/62595428</a>)</li> <li>Screen and computer for presentation display</li> </ul>	<b>1-6</b>
<b>Workshop 1: Setting the Scene</b>	No additional materials required	<b>7-8</b>
<b>Workshop 2: Research &amp; Specification</b>	30 x Plain paper, A4	<b>9-10</b>
<b>Ideation &amp; Design Development</b>	<ul style="list-style-type: none"> <li>30 x A3 plain paper</li> <li>10 x A4 lined paper</li> <li>Coloured pencils</li> <li>Coloured pens</li> <li>Modelling materials               <ul style="list-style-type: none"> <li>Mixed coloured paper and card</li> <li>Mixed fasteners such as drawing pins, split pins, paper clips, staplers</li> <li>Pipe cleaners</li> <li>A5 Neoprene in mixed colours</li> <li>Modelling straws, plain or coloured</li> <li>Lolly sticks</li> <li>Coloured modelling matchsticks</li> <li>Glue sticks</li> <li>PVA glue</li> <li>Adhesive tape</li> <li>Masking tape</li> <li>String</li> <li>Fabric scraps</li> <li>Thread</li> <li>Tissue paper</li> </ul> </li> <li>Modelling Tools               <ul style="list-style-type: none"> <li>15 x Scissors</li> <li>15 x Rulers</li> <li>5 x Staplers</li> </ul> </li> </ul> <p>Adjust materials and tools according to your classroom context.</p>	<b>11-13</b>
<b>Preparing to Present</b>	No additional materials required	<b>14</b>
<b>Presentations</b>	No additional materials required	<b>15</b>
<b>Plenary</b>	No additional materials required	<b>16</b>

## Timings (for a one-day project)

Activity	Description	Timings
<b>Introduction to Innovating the Future</b>	Introduction to the project, the CREST Discovery passport and Innovation at HS2.	<b>15m</b>
<b>Workshop 1: Setting the Scene</b>	This includes three structured activities to set the scene for students and to get them thinking about their own and other customers' needs when travelling.	<b>40m</b>
<b>Workshop 2: Research and Specification</b>	Students will investigate inspiring technologies and testimonials from train customers and staff to find a problem to solve with their product.  Students will choose a design problem to solve and write a product specification.	<b>30m</b>
<b>Ideation and Design Development</b>	Students will work towards developing a final idea for their product. They will present this as a detailed drawing, a model of the product and marketing plan.	<b>1hr 30m</b>
<b>Preparing to Present</b>	Students finish their work and plan their presentation.	<b>1hr</b>
<b>Presentations</b>	Students deliver their five-minute presentations as if to potential investors.	<b>40m</b>
<b>Plenary</b>	Students reflect on their learning from the project and complete their CREST Discovery Passport.	<b>10m</b>

### Top tips

Circulate the room to check that the students are completing the activities correctly, and allow the students to discuss their answers as they work in their groups.

Adjust the timings to fit around your school day. If the students are off-timetable, allow extra time for their arrival.

Try to stick to the recommended times for practical activities.

Adjust the timings and your delivery depending on the age and ability of the students.

Reward the students for demonstrating progress in their essential skills. The project focuses specifically on creativity, teamwork and speaking. See the Skills Builder Framework for Essential Skills for more information at <https://www.skillsbuilder.org/>.

## Timings (for a five-lesson project)

Activity	Description	Timings
<b>Introduction to Innovating the Future, Workshop 1: Setting the Scene</b>	Introduction to the project, the CREST Discovery passport and Innovation at HS2.  Setting the Scene includes three structured activities to set the scene for students and to get them thinking about their own and other customers needs when travelling.	<b>1hr</b>
<b>Workshop 2: Research &amp; Specification, Ideation &amp; Design Development Part 1</b>	Students will investigate inspiring technologies and testimonials from train customers and staff to find a problem to solve with their product.  Students will choose a design problem to solve and write a product specification.  Students start to work towards developing a final idea for their product.	<b>1hr</b>
<b>Ideation &amp; Design Development Part 2</b>	Students will finish developing a final idea for their product. They will present this as a detailed drawing, a model of the product and a marketing plan.	<b>1hr</b>
<b>Preparing to Present</b>	Students add any finishing touches to their drawing, model and marketing plan, and plan their presentation.	<b>1hr</b>
<b>Presentations, Plenary</b>	Students will have ten minutes to prepare for their presentations.  Students will deliver their five-minute presentations as if to potential investors.  Students reflect on their learning from the project and complete their CREST Discovery Passport.	<b>1hr</b>

### Top tips

- Students may wish to complete some of their work as homework tasks between lessons.
- Recap the activities of the previous lesson at the beginning of each lesson to keep students focused.

## Step-by-step guide

### Pre-project preparation

- Read through the Innovating the Future Student Pack and familiarise yourself with the project background. Download the Innovating the Future Presentation.
- Prepare the modelling materials for the session. You could create separate boxes of materials for each group or allow students to take materials from a side table.
- Sort the group into teams of four. If the numbers do not divide evenly, divide into groups of three or five.
- Print all hand-outs in advance using the Materials and Printing List.
- Set up the room with tables of four, and put four Discovery Passports, four Student Packs and four sheets of plain paper on each table.

**INNOVATING THE FUTURE**
**Introduction to Innovating The Future (15m)**

The first six slides form the project introduction.

- **Innovating the Future – CREST Discovery Award (Slide 1)**  
Welcome the students and seat them at their tables.
- **What is Innovation? (Slide 2)**  
Use this slide to introduce the concept of innovation at HS2. Explain that innovation is the process of creating ideas for new products, systems and services, and that the aim of this project is to innovate a product that improves 'customer experience'. Explain that you will come back to that term later.
- **Your Challenge (Slide 3)**  
Introduce the challenge. Students will be designing a new product to be used when travelling by train. Students will design, model and present their idea in a pitch for a £100,000 investment.  
Explain that each project will have the chance to win (so every group could win) and that students should know that they will still be eligible for their Discovery Award whether they win the activity or not.
- **CREST Discovery Award (Slide 4)**  
Introduce the CREST Discovery Passport. Explain to the students that it is their responsibility to fill out their passport over the session. Ask students to write their names on their passports. Without this, they will not get their Discovery Award.  
Allow them to look through their passport for a couple of minutes and answer any questions that they may have about the questions.
- **Timetable (Slide 5)**  
Explain the order of the day.
- **The Brief (Slide 6)**  
Explain the project challenge in more detail using the text on the slide. Make sure that students understand that this must be a new product, or a significantly improved existing product with at least one new feature.  
Explain the essential skills that the students will be using over the day. Ask if the students have any questions.

**Workshop 1: Setting the Scene (40m)**

This first teacher-led workshop aims to get students thinking about rail travel and the types of products that they might use or carry with them when travelling.

- **Workshop 1: Setting the Scene (Slide 7)**  
Ask students to complete Challenge 1: Packing for a Long Journey. Students should create a list of items that they would take with them on a long train journey and explain their answers. After ten minutes ask the students for their answers. You could create a list or mind map on a whiteboard if you have access to one.
- **Workshop 1: Setting the Scene (Slide 8)**  
Explain that the customer experience of travelling by rail covers everything from booking a ticket to arriving at the destination. Ask students to complete Challenge 2a: Customer Experience Map. They may discuss their answers with their team. After 15 minutes ask the students to feedback their answers.  
Ask the students how the customer experience would be different for people who have a disability, such as the impairments listed in question b). Ask how the customer experience would be different if they were travelling with young children or a baby in a buggy c).  
Discuss the students' answers. Answers for this challenge can be found in the Workshop Answers section of this Guide.

## Workshop 2: Research & Specification (30m)

In this second teacher-led workshop students will investigate new technologies and read testimonials from train customers and staff. By the end of the workshop students will have chosen a design problem to solve with their product, written a product specification and investigated inspiring technologies to incorporate into their products.

- **Workshop 2: Research & Specification (Slide 9)**

Explain to the students that research is an important part of the design process. In this workshop they will be using research to locate a problem for their product to solve and a user who will benefit from the product. Ask the students to complete Challenge 1: Research. Note that no writing is necessary for this challenge but students may sketch or take notes if they wish.

Explain to the students that they have fifteen minutes to read.

- **Workshop 2: Research & Specification (Slide 10)**

After 15 minutes ask the students to progress to Challenge 2: Problem & Specification. After deciding as a team which problem they will solve they should answer questions a) and b) in their Student Packs. Question b) asks the students to write a list of success statements. This is a 'product specification'. The statements should refer to what the product must do or qualities that it must have. These statements should not restrict the design too much at this stage. Note that students may come up with their own problem beyond those mentioned in the customer statements.

If students cannot pick a problem use the following guidance:

- If they are a lower ability group, suggest that they choose to solve the problem of creating the perfect overnight travel case or a way of preventing drinks from falling over.
- If they are a higher ability group, suggest that they choose to solve the problem of children getting lost in stations, navigating a station when visually impaired or monitoring customer wellbeing.

- **Workshop 2: Research & Specification (Slide 11)**

Students should spend the last five minutes of this workshop reading about the inspiring technologies and deciding which technologies they could incorporate into their product.

Note that students are not making any design decisions at this point, they are just thinking how one or more of these technologies could help to solve problem.

## Ideation & Design Development (1hr 30m)

Students should now begin the process of working towards a final design. How students reach their final design is up to them; however, they must all input into the design process. Once a final design is reached it should be presented as a detailed, annotated presentation drawing and a model. Each group will also have to produce a marketing plan.

- **Ideation & Development (Slide 12)**

Explain the process of ideation to students. For the first 15-20 minutes, students should work on coming up with a variety of design ideas. Students may wish to work separately and then come together to decide which idea to bring forward, or work more collaboratively on developing one or two ideas. Students should concentrate on their essential skill of creativity during this period; sharing and developing ideas. Encourage students to think outside the box and to take risks. It doesn't matter if ideas are 'wacky' at this point.

If you have set up a table for students to collect materials and equipment, explain that it must remain tidy and that only one student from each group should collect at once.

## INNOVATING THE FUTURE

- **Ideation & Development (Slide 13)**

Students should now have decided on a final idea. The rest of this session should be devoted to the key outcomes of the project: a detailed, annotated presentation drawing, a model and a marketing plan. Set high expectations; students should produce presentation-quality work. Annotations should explain how the product works, and the choice of materials for the product. Introduce the students to the modelling materials. Explain to the students that they should feel free to experiment, but that they should not waste materials. Their model does not have to be to scale but should represent how they imagine the finished product would look and function.

The marketing plan should be a written document. It should explain all of the criteria listed in their Student Packs. Lined A4 paper is available should they need it.

### Preparing to Present (1hr)

Students add any finishing touches to their drawing, model and marketing plan, as well as planning their presentation.

- **Preparing to Present (Slide 14)**

Use the slide to explain that they must prepare a presentation to be presented to a group of investors offering £100,000. Explain that these are people who will help to fund the product, and at the end of each talk they will vote with a show of hands whether the investment will be awarded.

Explain to students that they have one hour to prepare their presentations and that everyone in the group should have a speaking part.

Students may use this time to add finishing touches to their drawings, models or marketing plans. They may also use the modelling materials to make any props that they need for their presentations. Stop the students five minutes before the end of the session to tidy up. Recycle any materials that you can.

### Presentations (40m)

Students are to deliver their presentations. The 'Investors' will be the other teams who are watching.

- **Presentations (Slide 15)**

Invite each group to the front of the room to present their product idea. Try to keep the pace up between presentations. Explain that after each presentation there will be a short period of time for questions, and then the investors (the students watching) will vote. If more than 50% of students vote in favour of investment it is awarded. Each team will then receive a polite round of applause. Note that more than one team can be granted an investment.

During the presentations make sure that the students watching are quiet, and think of your own question whilst you are watching. Use your questioning to help students to answer the brief if they haven't already. Further questions could include:

- What materials will the product be made from?
- What safety considerations are there for the product?
- Are there applications for your product outside of rail travel?

Ask students to vote based on whether they think the product fulfills the initial brief, and whether they think it is a good product that they would invest in.

### Plenary (10m)

Students reflect on their learning from the project and complete their CREST Discovery Passport.

- **Plenary (Slide 16)**

Ask students to complete their CREST Discovery Passports neatly and in full sentences. Ask the students to fold their Passports and to make sure that their names are on them, as well as the rest of their work from the session.

## Workshop Answers

### Workshop 1: Setting the Scene

#### Challenge 1

Example student answers might include:

- Umbrella
- Snack
- Keys
- Phone
- Wallet
- Tickets
- Railcard
- Phone charger
- Waterproof coat
- Book
- Headphones
- Portable battery
- Bag
- Water bottle
- Smart device or laptop
- Sanitary Products
- Makeup
- Hairbrush

Each answer should be justified.

#### Challenge 2

The correct order is:

1	Jan uses an app on her Smart Device to book an advance train ticket.
2	Jan packs for the trip.
3	Jan travels by bus to the station.
4	Jan arrives at the station and collects her ticket from a ticket machine.
5	Jan buys a snack and a magazine from the station shop.
6	Jan finds a seat in the station waiting area and waits for the train platform to be announced and displayed on the passenger information screen.
7	The platform is announced and Jan passes through the ticket gates.
8	Jan uses the platform bathroom.
9	Jan waits in the platform waiting room and listens for her train to arrive.
10	The train arrives and Jan boards. Jan finds her seat and charges her phone.
11	Jan buys a hot drink from the train refreshments trolley.
12	Whilst sitting drinking the hot drink, Jan answers some emails using the train Wi-Fi.
13	Jan changes trains. Jan's next train is on a different platform which is located across a footbridge. Jan walks up the stairs and down to the other platform.
14	Jan's second train arrives. There are no seats available so Jan stands in the hallway.
15	Jan uses the bathroom on the second train.
16	The train attendant announces Jan's destination station. Jan departs the train and follows the signs to the exit.
17	Jan follows the signs to the taxi rank.
18	Jan finds the taxi rank and waits for a taxi.
19	Jan travels by taxi and pays for the journey using cash.
20	Jan arrives at the destination.

b) Accept the following answers:

Each impairment would make Jan's customer experience more challenging.

- **Additional challenges with a hearing impairment might include:**
  - Hearing the station or train announcements;
  - Hearing her train arrive.
- **Additional challenges with visual impairment might include:**
  - Using the ticket machine to collect her ticket;
  - Using the ticket gates;
  - Finding her way around the station;
  - Boarding the train and finding her seat, including reading the seat reservation displays and tickets;
  - Using the passenger information screen;
  - Finding a taxi.
- **Additional challenges with a mobility impairment and being a wheelchair user might include:**
  - Boarding the train;
  - Finding a safe place to be when the train is busy;
  - Finding an accessible toilet on the same platform;
  - Changing trains using the footbridge;
  - Finding a wheelchair accessible taxi.

c) Accept the following answers:

- **Travelling with a young child would make Jan's customer experience more challenging. Additional challenges might include:**
  - Finding a place to change or breastfeed her child;
  - Finding space for a pushchair or buggy;
  - Finding two seats together to sit with her child;
  - Having to keep her child entertained during the journey;
  - Keeping track of her child during the journey;
  - Finding a suitable snack and drink for her child;
  - Carrying her child or the buggy upstairs across the passenger bridge;
  - Keeping her child safe when waiting on the platform.

## Workshop 2: Research & Specification

**Challenge 1: No written answer needed.**

**Challenge 2:**

- a) Students' answers should highlight the problem their product will fix.
- b) Student's answers should describe the user of their product. Students' answers should include five justified specification points. Answers should refer to features or qualities of the product, and should not overly limit the design of the product.

**Challenge 3:**

- a) Students should explain how one or more of the technologies could be used to solve their design problem. There could be more than one use for any of the technologies.

## Facilitation Questions

Use these questions to facilitate discussion and to help stimulate and refine the students' design thinking.

- How could Internet of Things technology improve your product?
- How could AI technology improve your product?
- How could you make the product more appealing to the user?
- How could you make the product work universally for all users?
- What materials will your product be made from?
- What types of people will use your product?
- How will your product be made?
- How will your product be packaged?
- What is the lifespan of your product?
- How will your product be priced?
- How will you make sure that your product is safe?
- Does your product meet all of your specification points?
- Why should someone invest in your product?
- How will users find out about your product?
- How could you make your product more sustainable?

## Further Reading

- Innovate at HS2: <https://www.hs2.org.uk/building-hs2/innovation/>
- HS2 Design Vision: <https://www.hs2.org.uk/design-vision/>
- HS2 Education: <https://www.hs2.org.uk/in-your-area/education/>
- Skills Builder: <https://www.skillsbuilder.org/>