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| **Designing a Hoverboard** |
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| Designing a levitating hoverboard that works using magnetism |
| **Subjects:** Design & Technology, Engineering**Approx. time:** 40 - 50 minutes |  | **Key words / Topics*** design brief
* design criteria
* hoverboard
* magnetism
* magnetic fields
* sketching
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| **Suggested Learning Outcomes**  |  |  |
| * To be able to design a levitating hoverboard that would work.
* To be able to apply scientific theory in the design of a product.
* To be able to communicate design ideas using sketches, notes and annotations.
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| **Introduction** |  |  |
| This is one of a series of resources designed to support the delivery of the new 9-1 GCSEs in Design & Technology and Engineering, first taught from September 2017. Each resource covers a key topic from one or more of the specifications for these subjects. This resource focusses on designing a hoverboard that works using magnetism and magnetic fields.Magnetism is a key scientific phenomenon. Utilising this has allowed designers to create new and innovative products, such as fully working MAGLEV trains and hoverboards. |
| **Purpose of this activity**In this activity, learners will design a levitating hoverboard that is aimed at teenagers. The product will make use of magnetism or another appropriate method so that can move without touching the ground.This could be used as the second part of a two-lesson mini unit of learning, with the activity ‘Investigating How Hoverboards Work’ as the initial activity. Alternatively, it could be used as a one off main lesson activity to build knowledge and understanding of the topic. It can also be used in conjunction with or as an extension to the existing ‘The Moving World’ suite of activities and the activity ‘Magnet Madness’. |
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| **Activity**  |  | **Teacher notes** |
| **1. Recap of the Lexus Hoverboard (5-10 mins)**Show and discuss videos recapping the story of and science behind the Lexus Hoverboard design.***Story behind the design:***[*https://www.youtube.com/watch?v=oyGlNLpQ7CQ*](https://www.youtube.com/watch?v=oyGlNLpQ7CQ)***Science behind the design:*** [*https://www.youtube.com/watch?v=qGiGMX0t3\_U*](https://www.youtube.com/watch?v=qGiGMX0t3_U)**2. Introduce the design brief and design criteria (10 mins)**Introduce and discuss the design brief and criteria for the product with the class. ***Situation****1980s films predicted that by 2015 people using hoverboards would be a very common sight! Only now is the technology finally reaching the point where they can become a reality.****Brief****Design a hoverboard for use by teenagers, that can move forwards without making contact with the ground. Your product should use a suitable method of keeping the board in the air, such as magnetism.****Criteria:****The product must:** *Be suitable for use by teenagers.*
* *Be able to move forwards whilst a person is standing on it, without touching the ground.*
* *Use magnetism or another suitable method to achieve levitation.*
* *Be aesthetically appealing to the target audience.*

**3. Designing the product (30 mins)**Learners to sketch their idea for a product that meets the needs of both the brief and the design criteria given. They should ensure that they show and fully explain how the hoverboard achieves levitation using magnetic fields or another appropriate method. Designs can be produced on the handout provided or on blank A4/A3 paper.**4. Target market review (5-10 mins)**Learners to ask three people from the target audience to suggest one improvement each to their design.They should then select one of these suggested improvements and use it to update the design. |  | The recap of the Lexus Hoverboard can be kept short if learners have just completed the activity ‘Investigating How Hoverboards Work’.This activity also provides opportunities to link with the ‘The Moving World’ suite of activities. This includes the resource ‘Overcoming Friction’, which uses MAGLEV trains as an example of the application of magnetism. It could also be used in conjunction with the activity ‘Magnet Madness’, which presents a series of simple experiments to demonstrate how magnets and magnetism works.**Using magnetism and magnetic fields**Learners should draw on their scientific knowledge of magnetism and magnetic fields and focus on applying this in an engineering/design context. Some learners may need additional support with this theory if they have not completed the activity ‘Investigating How Hoverboards Work’ or have not yet studied it in their Science lessons.**Notes and annotations**Learners should use notes and detailed annotations to explain and describe how their design meets the needs of the brief and design criteria. They should especially focus on how the product would function and the underlying science that would enable this to happen. |
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| **Differentiation** |  |  |
| **Basic** |  | **Extension** |
| Additional one to one support for learners who have weaker scientific knowledge surrounding the topic of magnetism and magnetic fields. Provide additional teaching materials surrounding this topic such as relevant science/physics textbooks.Provide links to additional examples of working hoverboards and the science/technologies used to enable them to function.Conduct the activity ‘Magnet Madness’ with learners. This demonstrates some of the basic theories behind magnetism and how it works. |  | Learners could consider the potential uses of the product that they have designed. They could think about how this technology could be used or modified to meet social and/or environmental needs, such as moving injured people around a hospital or transporting heavy goods, thus reducing carbon emissions.  |
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| **Resources** |  | **Required files** icon-docicon-pdficon-ppt |
| * Projector/Whiteboard
* Sketching equipment
* Lexus Hoverboard YouTube videos

<https://www.youtube.com/watch?v=oyGlNLpQ7CQ><https://www.youtube.com/watch?v=qGiGMX0t3_U>  |  | icon-ppt Design a hoverboard presentationicon-pdf Design a hoverboard Handout |
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| **Additional websites** |  |  |
| The following websites can be used for additional background information or to aid with the activity: * **YouTube – Lexus Hoverboard story:** the story behind the design of the Lexus hoverboard. <https://www.youtube.com/watch?v=oyGlNLpQ7CQ>
* **YouTube – Lexus Hoverboard science:** the science behind the design of the Lexus hoverboard. <https://www.youtube.com/watch?v=qGiGMX0t3_U>
* **Wired – How hoverboards work:** Explanation of how the most promising hoverboard designs function. <https://www.wired.com/2015/10/how-the-most-promising-hoverboards-actually-work/>
* **GCSE Bitesize – Electromagnetism and magnetism:** Revision notes explaining the theory behind electromagnetism and magnetism. <https://www.bbc.co.uk/education/guides/z3g8d2p/revision/1>
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| **Related activities (to build a full lesson)** |  |  |
| **Starters*** ACTIVITY: Investigating How Hoverboards Work
* ACTIVTY: Magnet Madness

**Main*** ACTIVITY: Designing a Hoverboard
* ACTIVTY: Overcoming Friction
 | **Plenary*** Target audience review of designs produced.
* Reflection on Objectives and PLT skills used
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| This activity could also link with the resources in ‘The Moving World’ series available from IET Faraday, to provide a broader context and understanding. |