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| **Design a football robot referee** |
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| Designing a robot that can perform the duties of an assistant referee during a football game on the moon |
| **Subject(s):** Design and Technology, Engineering, Physical Education**Approx time:** 50-80 minutes |  | **Key words / Topics:** * assistant referee
* design brief/criteria
* football
* gravity
* lunar league
* moon
* robotics
* sketching
* sustainable design
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| **Stay safe** Whether you are a scientist researching a new medicine or an engineer solving climate change, safety always comes first. An adult must always be around and supervising when doing this activity. You are responsible for: • ensuring that any equipment used for this activity is in good working condition• behaving sensibly and following any safety instructions so as not to hurt or injure yourself or others  Please note that in the absence of any negligence or other breach of duty by us, this activity is carried out at your own risk. It is important to take extra care at the stages marked with this symbol: ⚠ |
| **Suggested Learning Outcomes**  |  |  |
| * To understand the challenges associated with playing football on the moon
* To understand the roles and responsibilities of an assistant referee in a game of football
* To be able to design a robot that can perform the duties of an assistant referee for a game of football on the moon
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| **Introduction** |  |  |
| This is one of a series of resources that are designed to allow learners to use the theme of football on the moon to develop their knowledge and skills in Design & Technology and Engineering. This resource focusses on learners designing a robot to act as an assistant referee during a game of football on the moon. |
| **Purpose of this activity**In this activity learners will make use of the theme of football on the moon to design a robot that can perform the duties of an assistant referee during a game in the ‘Lunar League’. They will consider the challenges associated with playing football on the moon and the duties of an assistant referee. They will then produce a labelled sketch of their idea to meet a set of design criteria.This activity could be used as a main lesson activity to teach about producing initial design ideas for electronic products and systems. It could also be used as part of wider scheme of learning focussed on robotics and automation. |
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| **Activity** |  | **Teacher notes** |
| **Introduction (5-10 minutes)**Teacher to introduce the theme of playing football on the moon and the challenges that would be faced when doing this.**Starter (10 minutes)**Teacher to use presentation slide 4 to prompt learners to think about and discuss the specific problems that would be faced by the players, referee and spectators when playing football on the moon.**Design brief and criteria (10-20 minutes)**Teacher to explain the task to learners, and introduce the design brief on slide 5 of the presentation.Teacher to outline the design criteria given on slide 6 and discuss with learners how these could be met in their design.Teacher to explain the duties of an assistant referee with learners. For example, indicating when the ball is out of play. This could also include collecting the ball and returning it to the field of play.Explain the importance of sustainability and discuss ways in which the robot could be sustainably powered, e.g. using solar panels attached to its outer casing.**Sketching design idea (20-30 minutes)**Learners to sketch and label a design idea for a robot assistant referee that could be used for a game of football on the moon. The example shown on slide 8 of the presentation can be used to help if needed.**Plenary (5-10 minutes)**Identify the good and bad points about their design. How well does it meet the design criteria? |  | **Starter**Slide 3 of the presentation could be used to introduce the theme of football on the moon.Learners could present responses to the starter as a list or a spider chart. Learners could consider problems such as the reduced gravity, how to breathe, how to avoid injury on the rough terrain etc.**Design brief and criteria**Discuss the roles, responsibilities and duties of an assistant referee.This website gives the duties of an assistant referee as defined by the Football Association: <https://www.thefa.com/football-rules-governance/lawsandrules/laws/football-11-11/law-6---the-other-match-officials#:~:text=1.-,Assistant%20referees,a%20substitution%20is%20requested> Explain the design criteria and discuss with learners. How will they meet each of these?The design brief and criteria are set but extra points could be added by the more able. Go through the points and discuss why learners think each should be included.**Designing**Robots do not have to be humanoid.Starter shapes might be used to get learners going, such as cylinders, cuboids etc. They do not have to be human shaped. Encourage 3D drawing where the group are capable of this..**Handout**Learners could use this sheet to present their design idea and annotations or use blank paper.**Evaluation**Reflecting on designs is a good way to introduce to evaluation skills. Learners could be asked to identify one good thing and one bad thing about their design. |
| **Differentiation** |  |  |
| **Basic** |  | **Extension** |
| * Provide sentence starters for annotations/labelling of sketches.
* Provide a template for completing an evaluation of the good and bad points of their design. For example, a table with the design criteria in one column and space for their reflections on how well their design meets each in another.
 |  | * Design a logo for the Lunar League that could be shown on the side of the robot assistant referee.
* Produce a model and prototype of the design idea, using electronics to make it functional.
* Design a robot referee for the games of football to be played on the moon.
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| **Resources** |  | **Required files** icon-docicon-pdficon-ppt |
| * Pens or pencils
* Coloured pencils
* Rulers
 |  |  Teacher presentation – Robot assistant refereeicon-pdf Handout – Robot assistant referee worksheet |
| **Additional websites** |  |  |
| * **The FA - Duties of an assistant referee:** <https://www.thefa.com/football-rules-governance/lawsandrules/laws/football-11-11/law-6---the-other-match-officials#:~:text=1.-,Assistant%20referees,a%20substitution%20is%20requested>
* **Natural History Museum – Facts about the Moon:** <https://www.nhm.ac.uk/discover/factfile-the-moon.html>
* **YouTube – If the football World Cup was on the moon:** <https://www.youtube.com/watch?v=o5tD7eP8izE>
* **YouTube - Two astronauts play football on the moon:** <https://www.youtube.com/watch?v=z3Lt0PRt0Dk>
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| **Related activities (to build a full lesson)** |  |  |
| **Starters** (Options) * Watch the video – if the football World Cup was on the Moon <https://www.youtube.com/watch?v=o5tD7eP8izE>
* Discuss the specific problems that would be faced by the players, referee and spectators when playing football on the moon.
 | **Plenary*** Evaluate each design against the design criteria, listing improvements that could be made.
* Discuss the benefits and possible limitations of using renewable energy to power the robots.
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| **The Engineering Context**  |
| * Travelling and potentially living on the moon presents all sorts of challenges for engineers to overcome. For example, how will we breathe, how will we cope with much lower gravity, how will we play sports and keep fit?
* Engineers have a moral and ethical responsibility to ensure that their work is sustainable and that they do not negatively impact the environment. This includes the use of sustainable energy sources to power products.
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| **Curriculum links** |
| **England: National Curriculum**Design & Technology * KS3 1a, 1d, 1e, 3d

**GCSE D&T**AQA D&T* 3.1.2, 3.2.3, 3.3.4, 3.3.5

Edexcel D&T* 1.1.3c, 1.3, 1.17

Eduqas D&T* Core: 1, 2, 3
* Designing and making principles: 1, 2, 4, 8, 9

OCR D&T* 1.1a, 1.2a, 2.2a, 3.1a, 3.2b, 4.1a

**England: GCSE Engineering*** 3.1.3, 3.3.2
 | **Northern Ireland Curriculum**Technology & Design* Identifying problems; investigating, generating, developing, modelling and evaluating design proposals; giving consideration to form, function and safety
* Developing pupils as contributors to the economy and the environment
* Identify product needs and pursue sustainable harmonious design solutions in a local outdoor/indoor context
* Education for sustainable development.
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| **Scotland: Curriculum for Excellence**Technologies* TCH 3-11a, TCH 3-12a
 | **Wales: National Curriculum** Design and Technology* KS3 Designing: 1, 2, 3, 4, 6, 9
* KS3 Systems and controls: 16
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| **Assessment opportunities** |
| * Formal teacher assessment of completed design sketches.
* Self/peer assessment of completed design sketches.
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