Title: Exploring 100 years of Olympic Sports to learn about engineering innovation. Looking into the future of engineering innovation by imagining Olympic Sport in 2050.

Overview: A half-a-day or a full-day option of activities for students to learn about engineering concepts and innovation, and their social impact. The activities are based on the Olympic (and Paralympic) Sport heritage, and, in particular, the London Olympic Games of 1908, 1948, 2012.

For each activity, students are guided and supported in their exploration of the learning materials by a team of volunteer engineers from the STEM Ambassadors scheme. Portia's team ensures the participation of suitable quality and number of engineers, and provides all the needed learning materials and tools for all activities. The level of enquiry and learning outcomes can be adapted to the students' and curriculum needs of KS3 and KS4. Depending on requirements, some activities could be made shorter.

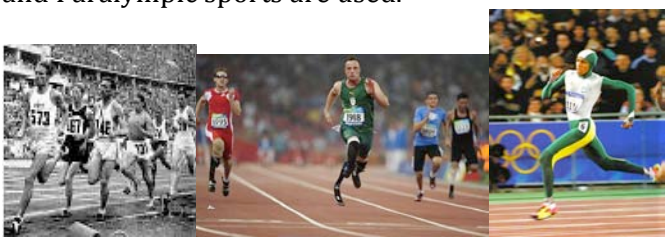
Learning Outcomes:
All students: Will be able to identify and make a judgement about the nature and purpose of engineering innovation in sporting equipment and in Sport.
Most students: Will be able to identify and make a substantiated judgement about specific features of engineering design in sport equipment based on evidence presented
Some students: Will be able to discuss and debate the benefits and issues of continued engineering innovation in Sport in terms of the question: Should there be a limit to engineering innovation in sport in the future?

Links to SEAL: Participation in these learning activities will enhance understanding of how to be part of and communicate as a team; negotiate ideas and agree on a consensus view; build positive relationships with others; give and receive feedback; identify and change strategies to solve problems; empathise with the situation of people different to oneself.
Links to PLTS: Promoting experiential, participative, and group enquiry through a set of structured and concrete activities. Each activity provides opportunities for observation, reflection, experiment, questioning and concept formulation.
At end-of-day, students will conduct self-evaluation to help them identify, reflect, consolidate and generalise the experience and any changes in attitude towards engineering and innovation.

Activities

Volunteer engineers from the STEM Ambassadors Scheme and Portia's team	Pupils	Assessment Opportunities for Teachers
Portia to ensure all materials and media are available and are students instructed in what is expected of them, and how they will work through the day, including the role of volunteer engineers. Volunteer engineers assist students by helping them focus their attention on specific tasks, and encourage general questions about the role of engineering in solving societal problems. Engineers ask questions to help students express their views and concerns about the	**Starter – 'Warm-up' exercise No1 – Collage of the Future – 20min** Children create a collage showing their vision of the world of sport in 2050. Working in groups with volunteer young engineers (from STEM Ambassadors Scheme) the use cut outs from magazines and other materials provided on the table to assemble on the A2 cardboard provided.  Students are asked SEAL questions = how they feel	Teacher has opportunity to assess level of engagement and quality of contribution, as well as, student's ability to see the world though other people's point of view.

world around them, and their perceptions and attitudes towards engineering.	about the future and what they think is important to them and for others.	
Volunteer engineers and Teachers participate as subjects in this activity, to encourage questions and comparisons between the Achilles tendon of a young and older person. Engineers ensure that students stay focused on the purpose of the exercise and encourage questions about usefulness of data. Engineers encourage reasoning about how the tendon works by using the analogy of a spring of different thickness. Samples for children to experiment with will be provided	**Starter – 'Warm-up' exercise No2 – Comparing size of Achilles tendon - 15 min** Students will measure the size of each other's Achilles tendon, as the distance between the middle of the anklebone to the outer edge of the leg, on the inside and outside of the leg (see picture). The purpose of the activity is to introduce the role of science in understanding sporting performance; as well as the importance of measurement; how to collect and present data; and hoe to make valid inferences from measurements. This activity is based on a recent research, which showed that there is a relationship between the size of the Achilles tendon and the capacity to store energy in the tendon during running. The activity encourages individual and group enquiry and discussion how the thickness of the tendon could affects energy use. How does this helps define an athlete's running ability.  Link to SEAL and PLTS: Provides concrete experience to observe, reflect and experiment and then formulate own concepts and ideas. This activity leads to reflection on the distinction between biological 'machines' and man-made machines.	Teacher has opportunity to observe level of engagement and students' understanding of the 'science' purpose of the activity. Teacher is also able to observe how students communicate with one another and with engineers. Teacher can encourage students to ask questions relating to the curriculum.
Portia team provides all the materials and explains the activity. Volunteer engineers help students formulate engineering design problem by focusing their attention on questions about what is needed, and why. Engineers use this activity to introduce basic engineering design concepts such as increasing/decreasing friction, strengthening support, making something stronger, making something more flexible. Volunteers encourage students to reflect on their own experience and	**Starter - 'Warm-up' exercise No3 – Exploring and applying innovation in the context of sport shoe design – 15 min** Students are given a set of pictures of modern Nike sport shoes and images of different Olympic Sports. They have to match the shows to the sports. This exercise is used to encourage reflection, questioning and recognition of that engineering design aims to fulfil specific requirements of the given sport and does this by changing the characteristics of the weight, size of the sole, sole surface, materials.  Student are then given a picture of the Tag-of-War sport,	Teacher is able to supervise level of engagement in terms of sharing of the task between students and how they reach consensus. Teacher is able to observe interactions between members of the group and the engineers, and evolving level of understanding of what innovation is about as a way of solving specific problems.

preferences for sport shoes.	which was included in the London Olympics of 1908, but left out of the Games since then. Students are asked or propose what design characteristics a show for Tag-of-War sport will require (e.g. grip, foot support, ankle support, weight, etc) and how this could be engineered (e.g. studs, carbon fibres, composite surface, etc). This exercise provides an opportunity for transfer of learning from earlier activities.   SEAL & PLTS link – Reflecting why it was easy/hard to perform the first part of exercise. Reflecting why Tag-of-War was dropped as an Olympic sport and should it be re-introduced.	
Portia team ensures that the necessary materials and media are available. Volunteer engineers facilitate discussion by focusing attention on engineering concepts that the group talked about in earlier exercises. For example, of the selected sport is Swimming, engineers will lead all members of the group to comment on each others suggestions and reflections.	**Innovation Workshop – Learning from the Past 15 min** Working in groups, students examine historical and contemporary images of particular Sport, and or equipment, to identify what has been changed/improved over the years. Students suggest explanations what improvements were made possible. The choice of the Sports includes: Swimming, Athletics, Cycling, Pole Vaulting, Tennis, Archery, Basketball, Slalom Canoeing/Kayaking, Taboganning. Both Olympic and Paralympic sports are used.  SEAL and PLTS link - Students reflect and arrive at a consensus about the 'benefits' of engineering innovation to 'improving' sporting performance; societal impact of sport, and how they feel about the role of engineering in Sport.	Teachers supervise level of interest and engagement, and students' ability to analyse and draw comparisons between the different types of information worked with in earlier activities.
Portia team organizes the use of resources needed for this activity and instruct students on what their task is. Volunteer engineers help students prepare their presentations by rehearsing the content with them. If the activity involves competition, the rules of the	**Innovation Workshop 2 – Designing the Future – 45 min (15 min preparing presentation)** Students use the collage method to design a new Sport or re-design existing Sport by introducing new innovative idea to the equipment, how the Sport is done, and possible changes to the venue. This group activity encourages formulation of the design problem, selecting suitable engineering parameters to develop a solution, and learn about 'innovation rules'. Students are encouraged to be creative and follow the 'anything is possible' rule. Solutions can be wacky so long as they	Teachers encourage self assessment by students of what they have learnt in previous activities, by encouraging rationalisation and reflection on the arguments and outputs they have

competition are made clear to students by Portia team and engineers.	can be justified in terms of learnt engineering concepts. Students prepare a brief presentation for other students (this may be as part of a competition). The activity encourages development of communication skills and using appropriate evidence to develop persuasive arguments. 	produced in earlier activities
Volunteer engineers and Portia team instruct students on what the objective of this activity is and answer any questions from the students about the format of the debate and its theme. Portia team collects feedback from students on their opinions about the activities.	**Debate: How much engineering innovation is good for Sport? Should there be a limit to what can be engineered? 45 min**  This is an opportunity for the whole class to reflect on what they learn about the role of engineering in innovation but also on how it can help sports people to achieve their aspirations and successes. Does engineering innovation make individuals better?	Teachers encourage peer assessment of the impact, and the success of the day as a whole on the students.
Differentiation: Differentiation by task – Volunteer engineers and Teacher to devise roles for Students to share. In the Warm-up exercises these will be taking lead on choosing materials for the collage, cutting and preparing materials, assembling the collage, etc. In Innovation Workshops, volunteer engineers and Teacher to devise roles within groups such as organiser and presenter so students can pick the role they are most comfortable with.		
Resources: Materials for collages (magazines, scissors, glue, pens, etc). Graph paper to record measurements. Flip charts and cardboard sheets to assemble paper designs. Sets of images for the shoe-sport matching exercise. Collection of real sport shoes and samples of sporting surfaces.		