

Wearable tech with O2

A teacher's guide to delivery



Introduction

This project has been developed with the support of O2, to introduce students to wearable technology and the Internet of Things. Students are provided with a brief – to create a wearable device that monitors the proximity of a child to a parent – and are then given all the guidance needed to design and build the device. There is also a downloadable Android app that is used to connect to an iBeacon which acts as the sensor within the device. This has been built for this project by the team at O2's The Lab in Slough for use in schools.

We have produced an e-learning module to start the project which explains how wearable technology works within the Internet of Things, and also covers issues around security, and form and function in the design process.

A set of five Open Badges are available to students who complete tasks along the way, including completion of the e-learning module.

To help you with the technology, there is a guide to downloading the Android app and pairing the iBeacon with the app to model the proximity sensing device. You will find this alongside this document in the Resources section.

Resources provided

On the course page, there is a bank of resources underneath the e-learning modules that scroll using the arrows at each end of the row.

You are provided with the following resources:

- > The e-learning module which students can work through individually in the classroom or at home – this includes seven pieces of video featuring O2 employees talking through the technology that underpins the Internet of Things and wearable devices
- > Information documents on Wearable Technology, the Internet of Things, Sensors, Bluetooth Technology, Security, and Form and Function
- > Video that explains the technology, and how the iBeacon and phone app work together
- > Link to the downloadable Android app
- > A guide to setting up the app and iBeacon
- > E-learning modules on security and technology
- > A completion certificate for the e-learning module

Gaining Open Badges in the Tech Partnership Badge Academy

There are five Open Badges available for completion of tasks within this project. Students who complete the e-learning module, gaining a certificate of completion, can use this to claim the **Wearable Tech - Knowledge** badge from the Tech Partnership Badge Academy.

The **Wearable Tech – Technology** badge is available to students who demonstrate they have understood the technology by working through an assessed e-learning module that is on the course page.

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The **Wearable Tech – Security** badge can be earned by students who demonstrate they have understood the security implications of the Internet of Things and wearable technology by working through an assessed e-learning module that is on the course page.

Students can also gain the **Wearable Tech – Design** badge using evidence of their prototyping and design activities. When you have verified that a student has produced a design for the wearable device that will accommodate the iBeacon, be suitable for a child, and not easily removed by the child, you can provide the student with a code that, when uploaded into the platform, awards the badge. *[To access the code, email helpdesk@techfuture.com – these are changed regularly to avoid sharing of codes].*

Finally, the **Wearable Tech – Project Completion** badge is available to students who produce the wearable device and present it to an audience in the last lesson of the project. *Again, email to access the code to be given to students who successfully present their ideas for the wearable at the end of the project.*

More information about the Badge Academy is available in the Guides section on the Learning Hub.

Steps in the ‘Wearable Tech with O2’ e-learning content

The main e-learning for the project, which explains the Internet of Things and wearable tech is entitled ‘Wearable Tech with O2’ and is in the first row of e-learning on the course page.

The following table shows the steps in the e-learning and how students are presented with the information they need to complete the project.

Steps in the e-learning content	Detail
The challenge	Charlie, an O2 Guru, explains the project and the brief to design a piece of wearable technology
The Internet of Things icon – video presentations	Link to further information on what tech can do and the Internet of Things through two video clips. Courtney, who works in IT at O2, explains the Internet of Things. Charlie explains how wearable devices link to the Internet of Things, and what these devices can do.
The Internet of Things – additional information and examples	Examples include the Internet of Lettuce, the Internet of Toilets, the Internet of Fridges, the Internet of Slippers, the Internet of Nappies and the Internet of Cows.
The Apple Watch	Information about the Apple Watch and what it can do
Wearable Tech Quiz	Set of five true/false questions to assess students’ understanding
Wearable Tech icon – information and examples	Examples include Apple Pay, Google Glass, and remote recording of TV programmes
Improve Lives icon – video presentations	Courtney explains the technology, focusing on sensors. Charlie explains Bluetooth technology.
The Smart Phone	Explaining the technology within a smart phone
Sensors Quiz	Match the sensors to their function.



Steps in the e-learning content	Detail
Tech Quiz	Set of five true/false questions to assess students' understanding
Exploring Tech icon – video presentations	Charlie talks about form and function – the design of the wearable device. Courtney talks about security of the device.
Designing Technology	Recap of form, function and security and how the wearable device must serve to solve a problem or deal with an issue.
The O2 Challenge	Becomes available when all other icons have been explored. Downloadable document is made available to explain the brief.
Examine – create	Steps that explain how to create a new product starting with examining the problem and moving through research, brainstorming, experimenting to creating the solution.
Summary	Brings together the learning outcomes and encourages students to complete a survey.

Building the device

When students have worked through the e-learning, they can move on to build their devices in small groups or teams.

They are asked to create something that a child can wear which incorporates an iBeacon which is then paired to the downloadable Android app. An iBeacon is a simple proximity sensor which pairs through Bluetooth with a compatible device such as a smart phone. The O2 team have built a special app for this project which records the proximity of the iBeacon to the phone once it has been paired. A simple interface represents the parent as a person icon and the child as an owl icon. As the iBeacon moves away from the parent's phone, the owl moves away on the screen. When the child moves too far away, an alarm is triggered on the phone, which vibrates to alert the parent. Students can actually demonstrate this providing they have the app on an Android phone, and have created a device for the child to wear, which could be a badge, bracelet or pendant, or it could be inserted into a garment or pocket.

The steps, as detailed in the e-learning, will include thinking about the best wearable device for a young child – something they cannot instantly remove and discard, and which the child may actually want to wear. They can prototype this on paper or on CAD software, thinking about the design (form) and perhaps collecting some information on their ideas from parents and younger siblings. If available in your school, they could 3D print their prototype design.

Linking the iBeacon with the phone is explained in the **Guide to using the app and iBeacon** downloadable from the website. There are ideas in the guide for experimenting with the iBeacon and phone app even if a wearable device has not been completed.

Exploring the security of the iBeacon is important and is covered briefly in the e-learning unit. Students who wish to gain the **Wearable Tech – Security** badge will look at this in more detail and work through the assessed e-learning module on the course page.



Suggested timings for delivery

This project could be completed in five sessions, assuming that sessions are no less than 50 minutes long. The lesson plans below explore how to deliver this through to project completion.

As a guide, students can complete the main e-learning module, and achieve the Knowledge open badge, within one lesson. The Security module could be completed in a second lesson, which covers the important issues around the security of the information that this wearable, and any wearable device, could be collecting. Students achieving 80 percent or more on this module (found in the Badge Modules section of the course page) will automatically receive the associated Open Badges.

The technology behind the wearable is likely to occupy another lesson, where students can use the downloadable guide to the tech, and complete the e-learning that covers their understanding of the specific technology they are going to use to create their wearable device. Another badge is available for students who complete the e-learning and gain 80 percent or more in the assessment.

Depending on how the design phase is carried out, this can take 1-2 lessons. If you have access to the Design and Technology or Art department of your school, students may be able to model their design and even create something in sculpting clay. If this is not possible, students can paper-prototype their design and, if available, use CAD software to represent their design. Extension activities involving 3D printing are possible with this project, should the technology be available, and you can access this through the Design and Technology department in your school. This will allow students to print their wearable tech holder for the iBeacons.

The final lesson would allow students to demonstrate the working wearable device, try out the different settings (as explained in the **Guide to using the app and iBeacon**). They could try out different environments (e.g. inside and outside, busy or empty rooms) to see how effective the device is within different locations.

Pre-delivery preparation

Students can learn just about wearable technology and the Internet of Things by working through the main e-learning module in a single lesson. To access this content, they will require an individual account on the Tech Partnership Learning Hub. You can upload students through your teacher account, and they will then become aligned with you as their teacher, and you will be able to monitor their progress. There are guides available to show you how to do this in the Guides section on the main landing page of the hub.

To build the wearable devices, you will need to download and install the provided app on an Android phone – the guide to this can be seen in the Resources section on the course page.

You will also need iBeacons for students to use. iBeacons can be bought for around £12-15 each from stores such as Amazon and BeaconZone.

To fully explore the design element of this, collaboration with the Art or Design and Technology departments would work well to allow students to use modelling techniques (e.g. sculpting clay) or 3D printing. Alternatively, students can paper-prototype their designs and present them as a poster in the final session.

We hope you enjoy delivering this project to your students. If you have any further questions about the project, and the technology behind it, email helpdesk@techfuture.com. We will endeavour to respond to your query within 48 hours.

Lesson plans to support delivery of the O2 Wearable Tech Project

Lesson 1 – Introduction		
Description	Content type	Time required
<p>Students will require individual accounts to view the project on the TechFuture Classroom (see associated guide to uploading students under Guides on the site).</p> <p>This project uses e-learning to explain the Internet of Things and wearable technology. Students can earn badges as they complete different e-learning modules that focus upon knowledge, technology and security.</p> <p>Students are introduced to the project, shown the e-learning module and the first video before going to their own computers to access the content individually (note, it is important for students to have individual access with their accounts to make sure they are awarded badges for completion of e-learning modules).</p> <p>Students continue to work with the e-learning to gain knowledge about the Internet of Things and important factors with wearable technology including security, form and function in design and the project brief.</p>	<p>Group introduction to the project</p> <p>Display the learning platform and the module 'Wearable Tech with O2'</p> <p>Individual access to the e-learning content</p> <p>Plenary</p>	<p>15 minutes</p> <p>30 minutes</p> <p>5 minutes</p>
Lesson plan	Extension activities	Downloads for learners
<ul style="list-style-type: none"> ✓ Introduce the topic by explaining that students will firstly learn about the Internet of Things before working together in small teams to create a piece of wearable technology suitable for a child to wear to monitor their proximity to a parent. Brainstorm with students what they understand as 'wearable tech' – examples they identify can include the Apple Watch and other watches, fitness bands and other activity monitoring devices, headgear associated with gaming. ✓ Project to whole class the website to explain where the project can be located (Students>Technology in the Real World>Wearable Tech with Telefonica). Identify the first module (Wearable Tech with O2) and click on it to show students how to open it. You 	<p>Students can continue with the e-learning content at home, and/or be asked to research wearable technology and come back with a list of different devices.</p>	<p>Information documents on key content presented in the e-learning:</p> <p>Wearable tech and the IoT</p> <p>Sensors</p> <p>Bluetooth Technology</p> <p>Security and Wearable Tech</p> <p>Form and Function</p>

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Lesson 1 – Introduction		
<p>can also project the first video, where Charlie (an O2 Guru) explains the project and the brief – to build a piece of wearable tech.</p> <ul style="list-style-type: none">✓ Students can continue to work individually on the e-learning on their own computers, using individual accounts (to ensure they receive their badges for completion of the modules). They can continue to access the modules at home, and could therefore be told to complete the e-learning for homework. <p>Plenary</p> <ul style="list-style-type: none">✓ Bring students together and ask them what they have already learned about the Internet of Things. Ask if anyone can explain the Internet of Cows, or Lettuce. Be prepared to remind students of these ways of monitoring activity – often for health reasons, but also to ensure productivity of crops – is improving people’s and animals’ lives.		<p>Teacher resources</p> <p>Guide to delivery including breakdown of the content of the e-learning module.</p>



Lesson 2 – The security implications of wearable technology		
Description	Content type	Time required
<p>Students complete the Wearable Tech with O2 e-learning module (if not already completed) and then consider two key aspects to the work they are going to do – security and the technology behind wearable tech.</p> <p>Students work through the e-learning module ‘Wearable Tech – Security’ which will give them the associated badge when completed. This is accompanied by the downloadable document ‘Wearables and Security’ which explains further the issues around security when wearing a device that is collecting and transmitting personal data.</p> <p>The session ends with a discussion about the project brief – create a piece of wearable technology that measures a child’s proximity to its parent (the child wears the device and the parent monitors proximity on a smart phone app) – and what particular security concerns should be considered with such a device.</p>	<p>Whole class recap</p> <p>Discussion about security arising from students’ experience of the first e-learning module</p> <p>Individual access to the e-learning content</p> <p>Plenary</p>	<p>20 minutes</p> <p>20 minutes</p> <p>10 minutes</p>
Lesson plan	Extension activities	Downloads for learners
<ul style="list-style-type: none"> ✓ Remind students of their work so far, and check progress on the Wearable Tech with O2 e-learning module. This should be completed before moving on to the security issues around wearable tech. ✓ Before students move to their computers, explain that all technology has security risks, because of those who can hack into the systems that make technology work, and access information. Brainstorm the sort of security issues that students are familiar with, and which of these could be a problem for wearable tech (e.g. cyber criminals accessing personal information collected by the device, interception of data transfer between device and phone, or between phone and the Internet/Cloud). ✓ Refer students to the document on the website ‘Wearables and Security’. This can be accessed online by clicking on the link under the Resources section of the site, or it can be printed out and made available (3 pages). Using this, they can access the ‘Wearable Tech – Security’ e-learning, which, when completed, will give students the associated badge if they score 80 and above on the built-in assessment. 	<p>Students who are particularly interested in cyber security can go to the Cyber Security modules (Key Stage 4) and find out more about security in the set of e-learning modules available there.</p> <p>For more able students, they could consider not just the security aspects of wearable tech that monitors location, but also the ethical issues. Is it ethically appropriate to track someone?</p>	<p>Information documents on key content presented in the e-learning:</p> <p>Security and Wearable Tech</p>
		Teacher resources
		<p>Guide to delivery including breakdown of the content of the e-learning module.</p>



Lesson 2 – The security implications of wearable technology

Plenary

- ✓ Bring students together and discuss some of the key issues with wearable technology and its security. Ask students to list the reasons why data collected by a wearable could be useful for cyber criminals, and how it could be used. Examples will include personal medical information, users' locations, their movements, and their emotional state. Pose the question relating to the wearable device they are going to build – what particular issues around security relate to this device? Examples will be the monitoring of children's activity and location by others than the parent, or the blocking of the signal.



Lesson 3 – The technology behind the wearable device		
Description	Content type	Time required
<p>Students find out about the technology that they are provided with to create their own wearable device – the app that has been kindly built and provided by the O2 team, and the iBeacons that can be paired with the app and then integrated into a wearable device.</p> <p>Students work through the e-learning module 'Wearable Tech – Technology' which will give them the associated badge when completed. This is accompanied by the downloadable document 'Guide to the app and iBeacon tech' which explains in detail how to download the app to an Android device (note, this app will only work with Android) and how to pair the iBeacon.</p> <p>The session ends with a discussion about the iBeacon and its importance to the device and how students will need to build a wearable device that incorporates the iBeacon (thinking about shape and size) that a young child will wear. This will set them thinking about the next task – to design the device.</p>	<p>Whole class recap</p> <p>Discussion about the technology</p> <p>Individual access to the e-learning content</p> <p>Plenary</p>	<p>10 minutes</p> <p>5 minutes</p> <p>25 minutes</p> <p>10 minutes</p>
Lesson plan	Extension activities	Downloads for learners
<ul style="list-style-type: none"> ✓ Recap with students their progress so far – they have learned about the IoT and the place of wearable technology, and the security around it. Check whether any students have thought more about security or the ethical issues around location monitoring. Introduce today's lesson by showing students the iBeacon and, if possible, the app on an Android phone downloaded and installed in advance. Help with this step in the process can be found in the Resources area in the app and iBeacon technology guide. ✓ Before students move to their computers, explain that they can work through an e-learning module, and use the guide document, to find out more about how the technology works, particularly around the app and use of Bluetooth pairing with the iBeacon. If they complete this e-learning, they will automatically gain the Wearable Tech – Technology badge. This will equip them to carry out the pairing activity when making the device work as well as understanding how the trigger values work in different environments. 	<p>If students have never realised that different mobile devices use different operating systems (e.g. iOS on Apple, Android and Windows) they can do some research on these different systems and what they mean for the mobile phone and tablet market. Are there just as many apps for Windows phones as there are for Apple iPhones?</p>	<p>Information documents on key content presented in the e-learning:</p> <p>Guide to using the app and iBeacon tech</p>
		Teacher resources
		<p>Guide to delivery</p> <p>Guide to using the app and iBeacon technology</p>



Lesson 3 – The technology behind the wearable device

Plenary

- ✓ Bring students together to explain the next task – to design the wearable tech device, which will need to integrate the iBeacon and be attractive enough that a child will be happy to wear it. Ask students to think about what sort of device could work for a child (e.g. a bracelet, pendant, badge) and which would not be easily removed. They can do some research before the next lesson on what type of device would work for a young child.



Lesson 4 – Designing your wearable device		
Description	Content type	Time required
<p>Students now have to think about the design of their wearable device, to make something a child will be able to wear and not remove, that will accommodate the iBeacon.</p> <p>Students can revisit the video in the e-learning that discusses form and function, and make use of the associated downloadable document, before working in groups to think about the design of their device. Note, the use of CAD software is possible here, if students are familiar with it, or the designing and prototyping can be paper-based. Access to 3D printing technology could allow students to 3D-print their wearable case. Alternatively, and in conjunction with Art, or Design and Technology departments, sculpting clay (e.g. Sculpey Primo) could be used to create the wearable device.</p> <p>The session ends with a discussion about the challenges and successes of creating the wearable tech case for the iBeacon.</p> <p>Students can gain a Wearable Tech – Design badge for their design.</p>	<p>Whole class recap</p> <p>Discussion about form and function</p> <p>Working in groups to design and prototype the wearable device</p> <p>Plenary</p>	<p>10 minutes</p> <p>5 minutes</p> <p>30 minutes</p> <p>5 minutes</p>
Lesson plan	Extension activities	Downloads for learners
<ul style="list-style-type: none"> ✓ Recap with students that, at the end of the last lesson, they were asked to think about a design for a piece of wearable tech that a child would wear, and which would be difficult to remove. If appropriate, brainstorm their ideas (if you are running a competition for the best design, this probably is not something you would want to do at this stage!). ✓ Divide students into groups with the task to decide on the wearable they want to design, remembering that it must be able to incorporate the iBeacon. Starting with paper and pencils, students can design their device. Depending on whether you have access to the Art, or D&T, departments, they may be able to use modelling or sculpting clay to build their wearable. ✓ If you have access to 3D printing, and the expertise to translate students' designs into the print software, students can print their wearable cases. ✓ Students who are not able to use either CAD software or 3D printing can produce a labelled, coloured document (by hand) that demonstrates the features of their wearable, how it attaches to the child, and any other features that would make it attractive to a 	<p>3D printing of the wearable device would be an extension activity for this task, and using CAD software as the tool for the design.</p> <p>Students could share their design ideas with potential customers – their parents and younger siblings – to research their ideas and whether they are likely to be successful.</p>	<p>Information documents on key content presented in the e-learning:</p> <p>Form and Function</p> <hr/> <p>Teacher resources</p> <p>Guide to delivery</p> <p>Form and Function document</p> <p>Email helpdesk@techfuture.com for a code to give to students who complete</p>



Lesson 4 – Designing your wearable device

child (e.g. colour). They can also clearly show how the wearable is built to incorporate the iBeacon.

Plenary

- ✓ Bring students together to discuss the challenges and successes of their design work so far. Note, this task may take additional lessons depending on whether you are able to make use of sculpting clay and/or 3D printing.
- ✓ Announce the final session – next time – when they will have the opportunity to demonstrate their wearable and their design to the rest of the class. Decide whether this will be in the classroom, or whether there will be opportunity to demonstrate them inside and out (where the trigger values can be changed), and whether this is part of a competition or judged presentation.

the design task so they can be awarded the Wearable Tech – Design badge.



Lesson 5 – Demonstrating your wearable as a working device		
Description	Content type	Time required
<p>In this final session, students can demonstrate their wearable device to others in the class (or even to a larger group at an assembly).</p> <p>They should be prepared to demonstrate both the design – either as a poster or a model – and the wearable working. Ideally this will be with one person acting as the child and another acting as the parent, with a third member of the group explaining how the tech works. They can also demonstrate their device in different locations (inside and outside the school) to show how the environment impacts on the signal and how that can be changed to work optimally inside (e.g. a shopping centre) or outside (e.g. a playground).</p> <p>If you have considered this as a competition, this presentation could be as a form of entry or pitch.</p>	<p>Whole class recap</p> <p>Groups present their ideas and the working device to the class</p> <p>Plenary</p>	<p>10 minutes</p> <p>35 minutes</p> <p>5 minutes</p>
Lesson plan	Extension activities	Downloads for learners
<ul style="list-style-type: none"> ✓ Explain to students that this is their opportunity to present their wearable device, showing both their design (either as the model or a poster) and the device actually working. You will need to provide access to an Android phone for each group. ✓ Students take turns to present their working device and their design to the rest of the class either in the classroom or outside, or both. <p>Plenary</p> <ul style="list-style-type: none"> ✓ End the project with final congratulations for the work completed and a reminder that students can gain the Project Completion badge for their work. A code for upload to the platform is available from helpdesk@techfuture.com and all students who have reached the end of the project can receive the code and the badge, which is automatically awarded when the code is inserted into the platform. 	<p>Explaining the trigger settings and how the signal is dependent on what is around – the environment – could be part of the presentation.</p>	<p>Teacher resources</p> <p>Guide to delivery</p>