



Wearables: The Past Present and Future of Technology, People & Planet

AMBER Centre, Trinity College Dublin

Learning Intensions:

1. What is a Wearable?
2. Wearables: Past, Present & Future
3. Ireland 2050: A more connected world - what are the implications for society?
4. Sustainability & Wearables: Looking for Balance
5. Where in the world will our wearables come from?
6. AMBER scientists, the future of wearable devices & sustainability

The purpose of the workshop is to explore Sustainability through the lens of Wearable Technologies

This document provides instructions on conducting each of the activities undertaken in the workshop and additional information that may be required by teachers wishing to deliver them.

1. What is a wearable? (5 minutes)

The purpose of this activity is to uncover perceptions and understandings of the term. This is an open ended question with no wrong or right answers. It is an opportunity for learners to reflect on personal understandings relating to topic of the workshop.

- Create a word cloud in response to the question – ‘What is a wearable?’
- In the workshop <https://www.polleverywhere.com/> is used. This can be embedded into PowerPoint using the instructions on the website.
- Use the word cloud to form a class discussion on the topic.

2. Wearables: Past, Present & Future (10 minutes)

The purpose of this activity is to identify key trends in the past, present and future of wearables. The activity will enable learners to contextualise their own views, and the wider society, relationship with wearables, and wearable technology. Some additional information is provided for learners overleaf.

- You will be asked to work in groups of 4 or 5.
- Each group will receive packs of 10 wearables (images & information) and will be asked to respond to the question:
 - *Can you identify any trends in the wearables cards?*



- Additional prompts are:
 - *When do you think the wearable was invented?*
 - *Who might use/ have used the wearable?*
 - *Are there any items that have changed their form?*
- You will have 5 minutes to identify 3 trends from the cards.
- After the discussion we revisit the wordcloud to update your understanding of a wearable.

Some additional instructions when using the cards:

- 10 cards is a useful number
- Not all cards have to be given to each group, a mix is fine
- 2 cards are important and should be in each pack:
 - 1505: The first wearable watch – this is useful because the form and utility of the watch has changed so dramatically over time, this is a good example of an elite item becoming mainstream.
 - 1961: The first wearable computer – this is important as it marks the advent of wearable technology.

Some key trends are:

<p>Past to...present! Wearables are not new – they have been around since the 1200’s! Wearable Technology is new. Many of the cards in the pack are wearables that are currently in prototype with just one tech company.</p>	<p>Elite to mainstream Many wearables, and other technologies, start life as a status piece and are not available to mainstream society.</p>
<p>Some wearables change in form over time From the watch to the TV watch to today’s Fitbits and smart watches have evolved from the initial concept of the watch. These are ubiquitous throughout society now!</p>	<p>Wearables... to wearable technology The key year is 1961 which is the first year that electronics were introduced to a wearable. Technology is moving increasingly towards wearables.</p>

Knowledge box:

Wearable technology is a blanket term for **electronics** that can be worn on the body either as an accessory or as part of material used in clothing.

The Internet of Things (IoT) is envisioned to have over 20 billion connected objects by 2020.

The global wearable device market is to grow from \$24.8 billion in 2017 to more than \$84 billion by 2022.

3. Ireland 2050: A more connected world – what are the implications for society? (10 minutes)

The purpose of this activity is to tease out how we think about wearable technology and critically reflect on its potential consequences for society.

Drawing on activity 2 (past, present and future) this activity looks in more detail about the assumptions learners have on the future of wearable technologies. It emphasises the importance of looking at technology from numerous standpoints, and provides the opportunity to reflect on the power of images and video in relation to personal beliefs.

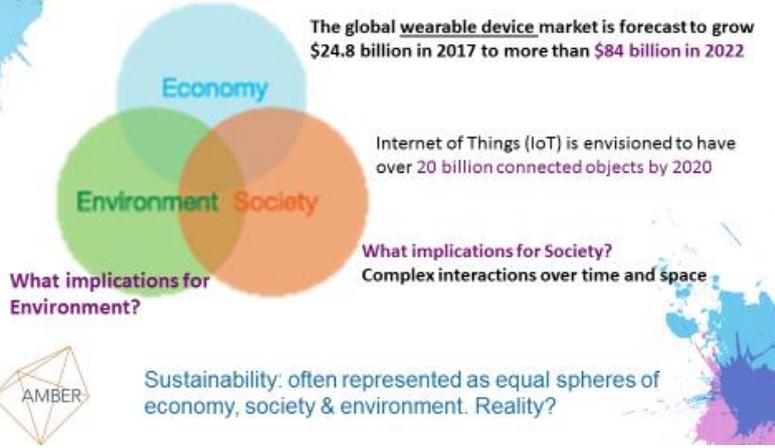
- Review the wearable technology cards.
- In teams consider the positive and negative aspects of living in a more technologically connected world.
 - 2018: what are the +/- of our relationship with technology? Is it different for different age groups or different users?
 - 2050: what might the +/- of our relationship with tech be in 2050?
- Use the two different coloured post-it notes (one colour for + and one for -) to record your ideas
- Place your post-it notes on the sheet provided
- Review the image and video provided:
 - What is this image/video saying about society and technology?
 - Is this the only way of thinking about a Virtual Reality wearable?
 - Do any of your post-it notes reflect the sentiment in this image/video?
- Invite groups to up-date their post-it notes should they like to add anything
- Ask for some individual examples and responses to:
 - 2018: Positive and Negatives? Some examples
 - 2050: Positive and Negatives? Some examples
 - Did the image and video provide a new perspective or provide opportunity for reflection?

4. Sustainability & Wearables: looking for balance (10 minutes)

The purpose of this activity is to:

- Introduce the concept of sustainability into the world of wearables already discussed in the workshop.
- Introduce issues relating to environment are introduced through the idea that resources that are commonly used in the production of smartphones, and which will be important to the production of wearables, are becoming limited.
- Introduce the concept of ‘governance’ – which is the way that we make decisions, collectively, which is central to making decisions around sustainable futures.
- Relate the concept of ‘governance’ to the ‘Global Goals for Sustainable Development’ – in particular Goal 17: Partnerships for the Goals.

Sustainability & Wearables: looking for balance



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ELEMENTS OF A SMARTPHONE

ELEMENTS COLOUR KEY: ALKALI METAL, ALKALINE EARTH METAL, TRANSITION METAL, GROUP 13, GROUP 14, GROUP 15, GROUP 16, HALOGEN, LANTHANIDE

SCREEN

- In** Indium: Indium tin oxide is a mixture of indium oxide and tin oxide, used in a transparent film in the screen that conducts electricity. This allows the screen to function as a touch screen.
- Sn** Tin
- Al** Aluminium, **Si** Silicon: The glass used on the majority of smartphones is an aluminosilicate glass, composed of a mix of alumina (Al₂O₃) and silica (SiO₂). This glass also contains potassium ions, which help to strengthen it.
- O** Oxygen, **K** Potassium
- Y** Yttrium, **La** Lanthanum, **Tb** Terbium: A variety of Rare Earth Element compounds are used in small quantities to produce the colours in the smartphone's screen. Some compounds are also used to reduce UV light penetration into the phone.
- Pr** Praseodymium, **Eu** Europium, **Dy** Dysprosium
- Gd** Gadolinium

ELECTRONICS

- Cu** Copper, **Ag** Silver: Copper is used for wiring in the phone, whilst copper, gold and silver are the major metals from which microelectrical components are fashioned. Tantalum is the major component of micro-capacitors.
- Au** Gold, **Ta** Tantalum
- Ni** Nickel, **Dy** Dysprosium, **Pr** Praseodymium: Nickel is used in the microphone as well as for other electrical connections. Alloys including the elements praseodymium, gadolinium and neodymium are used in the magnets in the speaker and microphone. Neodymium, terbium and dysprosium are used in the vibration unit.
- Tb** Terbium, **Nd** Neodymium, **Gd** Gadolinium
- Si** Silicon, **O** Oxygen, **Sb** Antimony: Pure silicon is used to manufacture the chip in the phone. It is oxidized to produce non-conducting regions, then other elements are added in order to allow the chip to conduct electricity.
- As** Arsenic, **P** Phosphorus, **Ga** Gallium
- Sn** Tin, **Pb** Lead: Tin & lead are used to solder electronics in the phone. Newer lead-free solders use a mix of tin, copper and silver.

BATTERY

- Li** Lithium, **Co** Cobalt, **O** Oxygen: The majority of phones use lithium ion batteries, which are composed of lithium cobalt oxide as a positive electrode and graphite (carbon) as the negative electrode. Some batteries use other metals, such as manganese, in place of cobalt. The battery's casing is made of aluminium.
- C** Carbon, **Al** Aluminium

CASING

- C** Carbon, **Mg** Magnesium: Magnesium compounds are alloyed to make some phone cases, whilst many are made of plastics. Plastics will also include flame retardant compounds, some of which contain bromine, whilst nickel can be included to reduce electromagnetic interference.
- Br** Bromine, **Ni** Nickel

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THE PERIODIC TABLE'S ENDANGERED ELEMENTS



SOURCE: CHEMISTRY INNOVATION KNOWLEDGE TRANSFER NETWORK

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Sustainability & Wearables: looking for balance



Governance is
“the sum of the many
ways individuals and
institutions, public and
private, manage their
common affairs”

The Commission on Global Governance: Our Global Neighbourhood
<https://www.gdrc.org/u-gov/global-neighbourhood/chap1.htm>

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Sustainability & Wearables: looking for balance



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5. Where in the world will our wearables come from? (3 minutes)

The purpose of this activity is to identify the global to local links which underpin our use of resources – which have both positive and negative outcomes. It highlights the interdependent relationship we have on the planet and with people across the globe. The activity focusing on Cobalt, just one element, which goes into making rechargeable batteries. The activity uses a jigsaw approach.

- Form home teams of 6. Give your team a name.
- Give each person in your home team a number between 1-6.
- All the no. 1's go to Expert Station 1, no. 2's go to Expert Station 2... etc.
- At expert stations review materials, discuss, answer questions: become an expert in **15mins**.
- Go back to your home team. Discuss the sustainability of each step in the process. **10mins**
- Create a representation of what you have learnt – it could be a cycle diagram (steps 1 – 6), a real advert, a map, a diagram using the three pillars of sustainability. **15mins**
- Group display

6. Science and Sustainability (10 minutes)

The purpose of this activity is to introduce the work of the AMBER research centre, and in particular, just one of its scientists, Prof. Valeria Nicolosi who is working to create the battery of the future. The question for consideration while watching a short video is can science contribute to sustainability?

What kinds of citizens?



- ◆ **Personally Responsible citizen**- works and pays taxes, volunteer, give to charity.
- ◆ **Participatory** - more actively engages with society- in community organisations , helps organise charity events.
- ◆ **Justice Orientated** - *critically assesses social structures and seeks to change these.*

Westheimer, J. & Kahne J. 2004. "What Kind of Citizen? The Politics of Educating for Democracy", American Educational Research Journal, Vol. 41, No. 2, pp. 237-269

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References:

Additional Information: Congo supply chain

<http://www.mining.com/congo-miners-buying-cobalt-artisanal-operators-balance-market/>

<http://www.mining.com/apple-talks-buy-cobalt-directly-miners-report/>

<https://www.irishtimes.com/business/energy-and-resources/glencore-warns-on-child-labour-in-congo-s-cobalt-mining-1.3463264>

https://www.huffingtonpost.com/entry/cobalt-batteries-child-labor_us_569e5121e4b0cd99679b510c

<http://battery.rcsglobal.com/sourcing-risks/>

<http://corporatejustice.org/news/36-cobalt-blues-environmental-pollution-and-human-rights-violations-in-congoese-cobalt-mines>

https://www.amnestyusa.org/files/this_what_we_die_for_-_report.pdf

<https://www.youtube.com/watch?v=0Mltwauan6M>

<https://www.rte.ie/news/business/2018/0711/977904-glencore-probe/>

<https://www.theguardian.com/global-development/2018/oct/12/phone-misery-children-congo-cobalt-mines-drc>

<http://www.oresomeresources.com/interactive/mining-helps-make-your-house-interactive/>

<https://www.theguardian.com/sustainable-business/ng-interactive/how-ethical-is-your-smartphone>

<https://www.irishaid.ie/stories-of-progress/casestudies/archive/2018/august/trocaire-case-study---drc.html>

<http://dx.cooperhewitt.org/lessonplan/communication-breakdown-part-2-of-2/>

<https://www.911metallurgist.com/mining-iphones/>

Additional information: E-waste

<https://greennews.ie/ewaste-nigerian-eu-toxic-doesnt-work/>

<http://senseable.mit.edu/monitour/>

Workshop learning strategies

Reflecting on images and videos

Uncovering assumptions that can lead to stereotypes and unfair judgments about individuals and groups, or actions that should be taken in response to change

Exploring and reflecting on text

Skimming

Examine the title

Who wrote the article?

Where was it printed/where did it appear?

What do you think the article is about?

Scanning

Who is the article talking about?

What are the people in the article doing?

Where is the article referring to?

How does the article relate to the topic of sustainability?