

“Breaking Barriers”

THE PHILOSOPHY BEHIND OUR LESSON PLANS

Teachers participating in CÚRAM’s Teachers in Residence programme have developed a ‘learning module’ on MedTech in Ireland that links with multiple streams and themes in the primary and junior cycle curricula. The primary and secondary lesson plans were created **by teachers for teachers** and are accessible online to use in classrooms all over the world.

During their residencies, teachers developed the contents of the lesson plans by working directly with CÚRAM researchers, while learning about the medical devices research being carried out at CÚRAM. Primary teachers were paired with secondary teachers to create plans covering five major themes: biomaterials, heart, brain, musculoskeletal system and stem cells. The partnership between the primary and secondary teachers ensured that the materials created follow a natural progression from one age group to the next.

The lesson plans were further designed and formatted by a Visual Artist who used various teaching methodologies to suit the multiple intelligences and range of learning styles and abilities present in classrooms. By using a range of teaching approaches we hope to engage all children at all levels whatever their natural talents or interests may be.

All presentations, lesson plan booklets and optional resources are free to download at: <http://www.curamdevices.ie/curam/public-engagement/teachers-in-residence/>. We hope that you and your students find these resources an enjoyable way to learn about our research centre and the MedTech industry!

Sincerely,



Dr. Sarah Gundy

Programme Manager-Teachers in Residence

Stem Cells Lesson Plan

Primary School Curriculum Links

Strand:

Living Things

Strand Unit:

Plant and Animal Life

Content Objectives:

- Become aware of some of the basic life processes in animals and plants.
- Become familiar with the characteristics of major groups of living things.
- Develop an increasing awareness of plants and animals from wider environments.
- Group and compare living things into sets according to their similarities and differences.

Strand:

Living Things

Strand Unit:

Human Life

Content Objective:

Identify and understand ways in which the body protects itself against disease and infection.

Learning Outcomes

Children should be enabled to:

1. Understand and identify what a cell is.
2. Understand how a stem cell is unique compared to other cells.
3. Construct animals using balls of plasticine or playdough as 'cells'.
4. Understand regeneration as it occurs in specific species of animals.
5. Compare and contrast regeneration with prosthetic devices.
6. Group animal species according to their ability to regenerate.

Keywords and Definitions

	Keyword	Definition
1.	Cell	The smallest part of an animal or plant that is able to function by itself. Every animal or plant is made up of trillions of cells.
2.	Stem Cell	A type of cell that can copy itself and make other types of cells.
3.	Regeneration	Regrowth by an animal or plant of an organ, tissue, or part that has been lost or damaged.
4.	Gene	A section of DNA that controls what a cell does.
5.	Limb	Your limbs are your arms and legs.

6.	Prosthetic	An artificial body part to help replace damaged tissue, organs or limbs.
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Learning Activities

Children will:

- Construct a model of an animal using plasticine or playdough balls that are mimicking stem cells.
- Understand that some animals/organisms can regenerate.
- Engage in talk and discussion on stem cells and regeneration.
- Participate in a group.
- Present their work to the class.
- Engage in talk and discussion on regeneration and prosthetic devices.
- Evaluate their work by filling in the Exit Ticket.

Extra Info / Files

	Web Address	Brief Description
1.	www.youtube.com/watch?v=evH0I7Coc54	Video on stem cells (more advanced)
2.	www.youtube.com/watch?v=tPulEAryPO0	Video on stem cells (less advanced)
3.	www.eurostemcell.org	Stem cell resources for teachers and students

4.	www.crm.ed.ac.uk/stem-cells-regenerative-medicine/what-are-stem-cells	"What are Stem Cells?" Article with helpful background information for teachers
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Resources Provided

- Teacher Lesson Plan
- PowerPoint to guide lesson
- Pictures of animals
- Video of moving stem cells regenerating head of Hydractinia. Movie can be downloaded at:
<https://elifesciences.org/articles/05506#media2>.
- Exit Ticket
- Optional: STEMinator card game that is part of the CÚRAM "Stem Cells Secondary Lesson Plan Booklet" that can be downloaded at: <http://www.curamdevices.ie/curam/public-engagement/teachers-in-residence/>. Younger students can use the pictures of the stem cells on the cards to make their own stem cells using plasticine or playdough.

Materials Needed

- Red, green, yellow and blue plasticine or playdough
- Pipe cleaners
- Toothpicks

- Paperclips
- Ice lolly sticks
- Straws

Instructions

- Divide the class into groups of four.
- Each group is given pictures of each animal.
- Give a different colour of plasticine or playdough to each student in the group.
- Each student is assigned an animal that corresponds to the following colours:
 - Red – starfish
 - Green – monkey
 - Yellow – tiger
 - Blue - lizard
- Each student makes 30-40 small balls with their plasticine or playdough. These balls will be the cells.
- Using the balls (cells), each student in the group makes their animal.
- Once the animals are made, the students are told that their animal has been in an accident. Each student removes an arm or leg from their animal.
- The class takes a vote on which animals they think can regenerate a new limb (arm or leg).
 - The starfish (red) and lizard (blue) can regenerate as they can use their stem cells to grow a new limb.

- The monkey (green) and tiger (yellow) cannot regenerate as they do not have the correct “genetic recipe” required for the stem cells to grow a new limb.
- The students with the starfish (red) and lizard (blue) build a new limb using the balls (cells).
- The students with the monkey (green) and tiger (yellow) build a prosthesis to replace the limb using a range of materials to act as biomaterials (pipe cleaners, tooth picks, paper clips, ice lolly sticks, straws, etc.).
- Each student presents their animals and limb designs to their group.
- The class discusses the good and bad points of prosthetics and regeneration. Possible talking points are listed below:

	Good:	Bad:
Prosthetics	Quicker to make than regeneration.	Not natural.
Regeneration	Natural.	Slower; takes 6-12 weeks for new limb.

Teachers' Tips

- Flashcards can be used to introduce new language for younger children at the beginning of the lesson.
- Playdough is easier to work with than the plasticine, but dries out quicker.
- If you are using playdough and doing the activity over a few days, keep the animals in a plastic container to prevent the playdough from drying out.

- The students might prefer to make more exotic animals that can regenerate different areas of their bodies. Some examples include the following:
 - Axolotl – limbs, tail
 - Deer – antlers
 - Sea cucumber – whole body
 - Spiders – legs
 - Shark - teeth

Methodologies

- Talk and discussion
- Active learning
- Guided and discovery learning
- Collaborative learning
- Free exploration of materials
- Investigative approach

Assessment

- Self-assessment – Exit Ticket
- Teacher observation – making of animals and fixing with regeneration or prosthetic devices
- Teacher questioning – talk and discussion

Linkage and Integration

- **Maths** – problem solving
- **STEM** – I.T. / Engineering
- **Art** – construction
- **S.P.H.E** – working together co-operatively
- **English** – oral language through talk and discussion and presenting their work

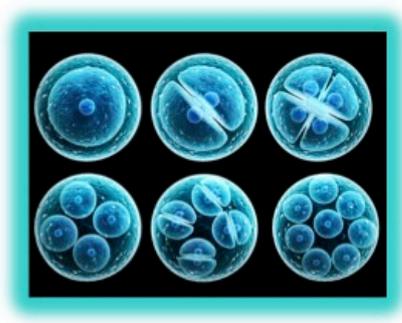
Differentiation By:

- Teaching style
- Support
- Task

PowerPoint Presentation – Stem Cells



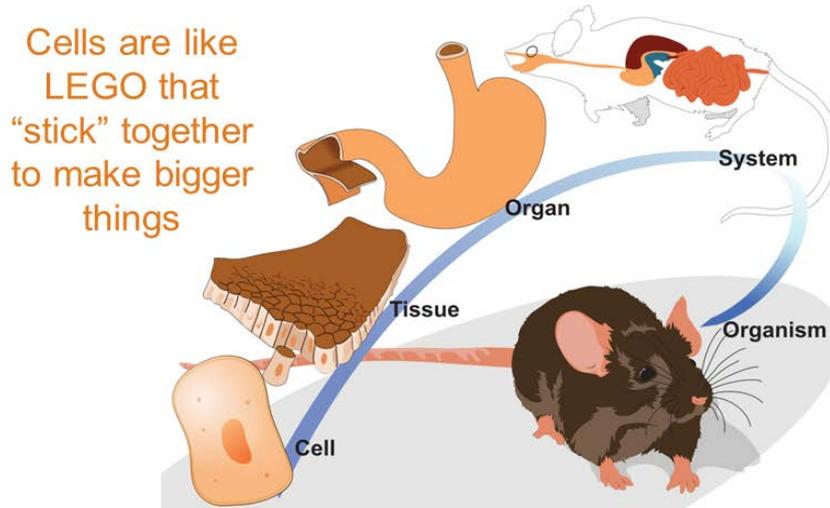
Slide 1



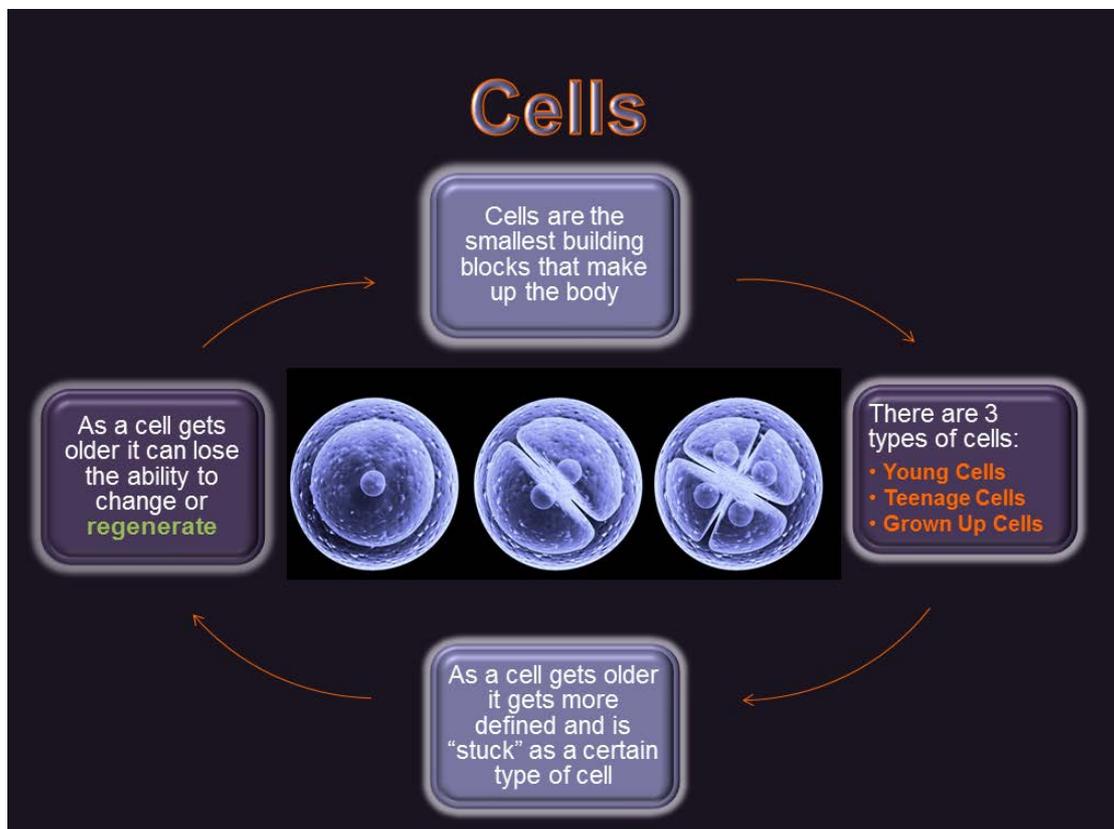
Teachers in Residence Programme
Colm Caomhánach and Róisín Ní Bhraíain

Slide 2

How animals are 'organised'



Slide 3



Slide 4



Stem cells are special because:

- 1) They can copy themselves.
(Not all cells can do this!)
- 2) They can make other types of cells.

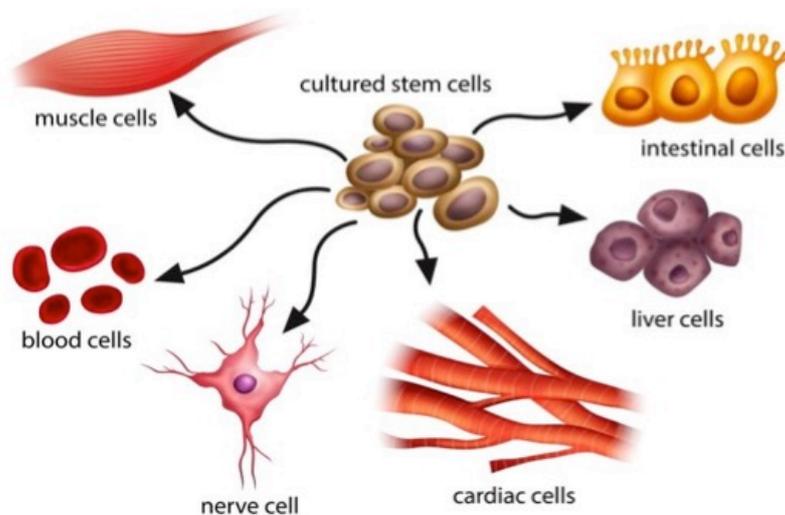
Our body uses stem cells to replace damaged or dead cells.

We hope that we can use them in the future to treat diseases.



Slide 5

Stem Cells Can be Grown into Different Types of Cells



Slide 6

Regeneration

Regeneration is the ability of an animal's cells to make new body parts when they are an adult.

A newt can **regenerate** an entire limb within 7-10 weeks



For example, some animals can do more than just make new skin, they can grow new arms or even heads!

Slide 7

Stem Cells and Regeneration

When an animal is developing, most of the cells turn into a particular type.

Cells become blood cells, heart cells, bone cells, etc.

During development, stem cells sometimes remain that do not turn into a type of cell.

Some animals can use their stem cells to **regenerate** lost or damaged body parts.

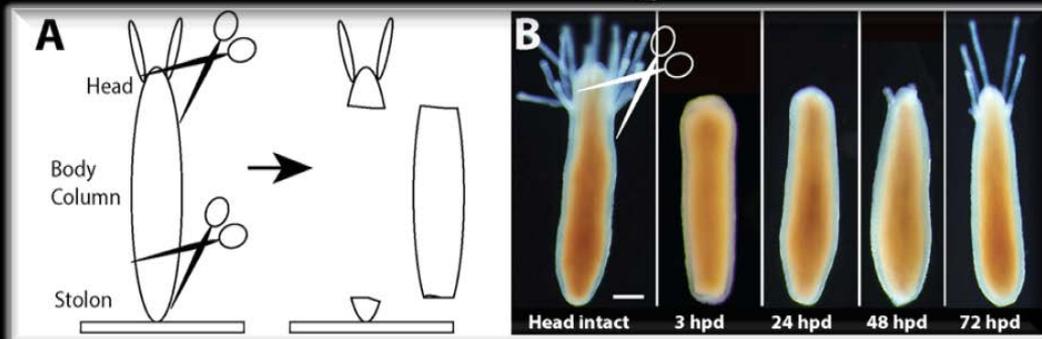
In order for animals to do this, their stem cells need to get the right signals from the rest of the body.

Slide 8

Head Regeneration in Hydractinia

Hydractinia (also known as snail fur) is a small sea creature that lives on the shell of Hermit Crabs.

Hydractinia can **regenerate** its head within 72 hours of being cut off.



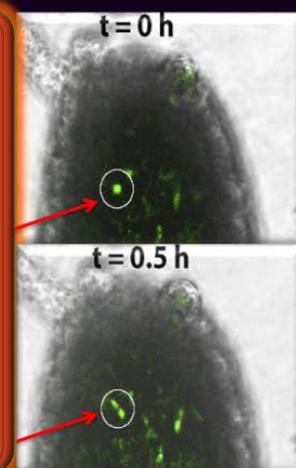
Slide 9

Stem Cells and Regeneration

Hydractinia have the correct **genetic recipe** for regeneration

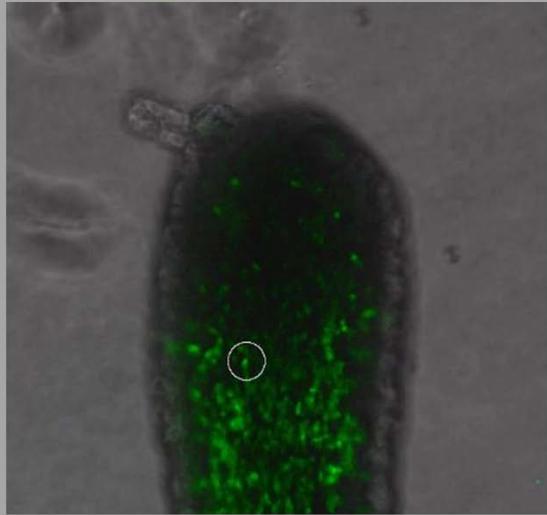
Specific genes get turned on and send signals to stem cells in the body

These signals cause the stem cells to move (red arrows) to the area that needs **regeneration**



Slide 10

Stem Cell Moving into Head for Regeneration

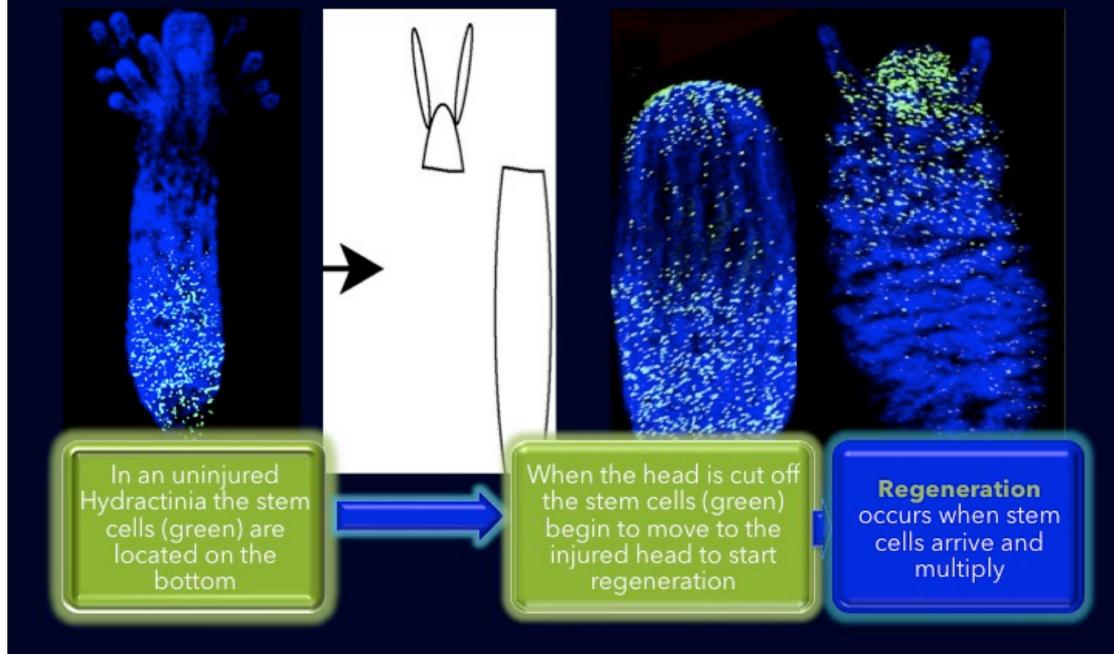


“Video 2”, Bradshaw *et al.*, 2015

Movie can be downloaded at:
<https://elifesciences.org/articles/05506#media2>

Slide 11

Hydractinia Regeneration



Slide 12

Prosthetics



Humans and other animals cannot regenerate heads or limbs like the Hydractinia



Adult humans and other animals do not send the right signals to our stem cells to regenerate a head or a limb because they do not have the correct **genetic recipe** required for **regeneration**



Adult humans do have the correct **genetic recipe** to allow our stem cells to regenerate small injuries (paper cut to our skin), but not to regenerate a full organ



Instead of using stem cells, humans have had to use their brains to create **prosthetics** that can be used to replace arms and legs



Slide 13

Prosthetics

The design of the prosthesis must suit where it goes in the body



A prosthesis for the leg must be suitable for standing and walking, shock absorption, and even running, jumping, and other sports activities



A prosthesis for the arm must be suitable for reaching and grasping, and daily activities like eating, writing, and dressing



Slide 14

Activity: Part 1

Monkey



Starfish

Tiger

Lizard

Assemble into groups

Using plasticine balls (cells), each person in the group makes their 'animal'

Each person shares the animal to the group

Now, imagine your animal has an accident resulting in the loss of a limb (arm or leg)

Each person, picks a limb and removes it

Slide 15

Regenerative Animals

Each person made animals using plasticine 'cells'

Animal	Starfish	Monkey	Tiger	Lizard
Number of Votes				

Take a vote:

Which of the animals do you think can regenerate a new limb?



Slide 16

Activity: Part 2

How will the animals fix their injuries?



Starfish and **Lizards** can regenerate, as they are able to use their stem cells to grow a limb

Monkeys and **Tigers** cannot regenerate...

Use stem cells, or your biomaterials kits to make a **prosthetic** device

Slide 17

Presentation

Present your design to the group

Discuss the good points and bad points of **prosthetics** and **regeneration**



Slide 18

Evaluation

3-2-1 Exit Ticket *Name* _____

3 THINGS I LEARNED FROM THIS LESSON:

1. _____
2. _____
3. _____

2 QUESTIONS I STILL HAVE:

1. _____
2. _____

1 IDEA THAT STUCK WITH YOU:

1. _____

Slide 19

The logo for CURAM (Centre for Research in Medical Devices) features the word "CURAM" in a stylized, rounded blue font. The letter "R" is uniquely designed with a circular dot above it and a vertical line extending downwards from its center, resembling a stylized human figure or a medical symbol.

Centre for Research in Medical Devices

Slide 20

References:

1. Bradshaw *et al.*, eLife 2015;4e05506
2. commons.wikimedia.org
3. goo.gl/images/aFpIMG
4. goo.gl/images/CbYRk5
5. try.stem-kine.com/lf-1/
6. www.youtube.com/watch?v=evH0I7Coc54

Sincere thanks to all of the researchers who gave lectures and generously gave their time throughout the course. A special thanks to Mikey Creane for helping develop the content of the slides.

Thanks also to all the participating teachers who very kindly shared ideas and resources.

Slide 21

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Slide 22

Starfish



https://upload.wikimedia.org/wikipedia/commons/a/a0/Starfish_08_%28paulshaffner%29.jpg

Lizard



http://pngimg.com/uploads/lizard/lizard_PNG28.png

Monkey



https://upload.wikimedia.org/wikipedia/commons/0/09/Langur_monkey%2C_Orchha%2C_Madhya_Pradesh%2C_India.jpg

Tiger



http://pngimg.com/uploads/tiger/tiger_PNG23230.png

3-2-1 Exit Ticket *Name* _____

3 THINGS I LEARNED FROM THIS LESSON:

1. _____
2. _____
3. _____

2 QUESTIONS I STILL HAVE:

1. _____
2. _____

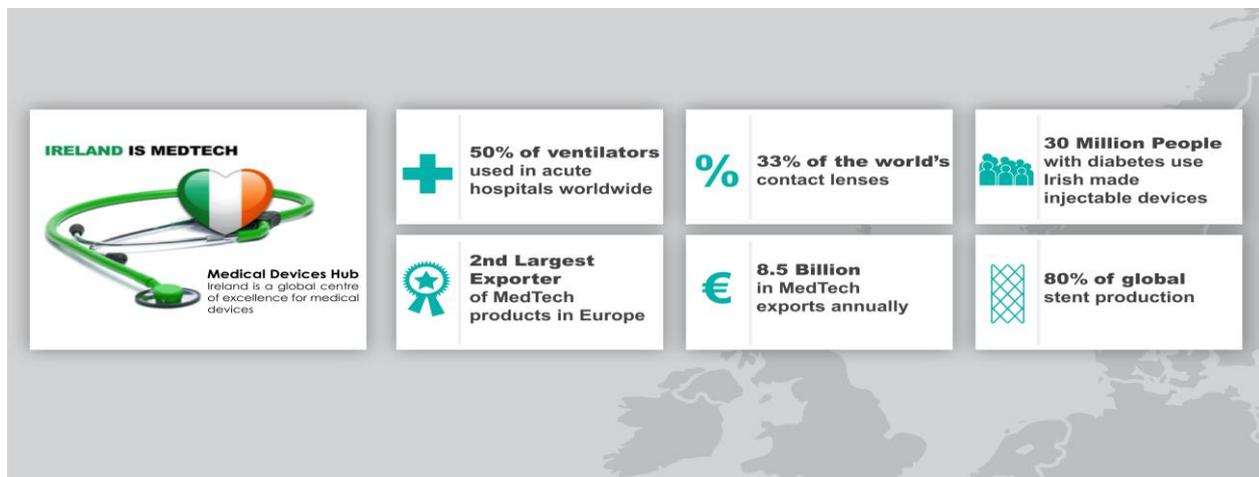
1 IDEA THAT STUCK WITH YOU:

1. _____

FACTS ABOUT MEDTECH IN IRELAND

- Ireland is the second largest exporter of MedTech products in Europe.
- Ireland's MedTech sector employs 29,000 people across 450 companies.
- Ireland has the highest number of people working in the MedTech industry than in any other European country, per head of population.
- 18 of the world's top 25 MedTech companies have a base in Ireland.
- Galway employs one third of the country's MedTech employees.

The Centre for Cell Manufacturing Ireland (CCMI) is the first ever facility in Ireland to be granted a licence from the Irish Medicines Board to manufacture culture-expanded stem cells for human use. The CCMI is a custom built facility based in the Regenerative Medicine Institute (REMEDI) at the National University of Ireland Galway that supplies stem cells for use in clinical trials. Clinical trials are used to test the safety and effectiveness of treatments for diseases. Stem cells that are manufactured at CCMI are being tested to treat conditions such as critical limb ischemia, osteoarthritis in the knee and diabetic kidney disease.



Source: IDA Ireland, 2017

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