



Teachers in Residence

The Heart

Secondary Level Lesson Plan



Centre for Research in Medical Devices

“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 device 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.

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

Medical Devices & the Heart Introduction

Lesson ♥

Secondary School Curriculum Links

Strand One: The Nature of Science

Element:

Understanding about science

Students should be able to:

1. Appreciate how scientists work and how scientific ideas are modified over time.

Element:

Investigating in science

Students should be able to:

3. Design, plan and conduct investigations; explain how reliability, accuracy, precision, fairness, safety, ethics and selection of suitable equipment have been considered.

Element:

Science in society

Students should be able to:

10. Appreciate the role of science in society; and its personal, social and global importance; and how society influences scientific research.

Strand Five: Biological world

Element:

Systems and interactions

Students should be able to:

4. Describe the structure, function, and interactions of the organs of the human digestive, circulatory, and respiratory systems.
6. Evaluate how human health is affected by: inherited factors and environmental factors including nutrition; lifestyle choices.

Element:

Sustainability

Students should be able to:

9. Discuss medical, ethical, and societal issues.

Learning Outcomes

Children should be enabled to:

1. Describe basic heart anatomy and function.
2. Develop an awareness of the conditions that can affect the heart and the treatments available to treat these.
3. Appreciate what a medical device is.
4. Understand the need for medical devices and their advantages.
5. Recognise how medical devices are manufactured.
6. Develop an awareness of the range of careers involved in manufacturing medical devices.
7. Manufacture a medical device.

Keywords and Definitions

	Keyword	Definition
1.	Medical Device	A medical device is a material used to diagnose, prevent, monitor and treat the effects of illness.
2.	Coronary	Relating to the heart and especially to the vessels that supply blood to the heart.
3.	Stent	A stent is a tiny tube that keeps blood vessels open.
4.	Catheter	A long, thin tube that can be inserted into the body.
5.	Diagnose	Identify the nature of an illness or other problem by examination of the symptoms.
6.	Myocardial Infarction	The coronary arteries become blocked stopping the blood from reaching the heart. Heart attack
7.	Atherosclerosis	Narrowing of arteries due to build-up of cholesterol.
8.	Angioplasty	Opens a blocked vessel and restore normal blood flow.
9.	Design Engineer	Develops the device to make sure it functions.
10.	Manufacturing Engineer	Makes sure the manufacturing line is working in the best way to make device.

11.	Quality Engineer	Makes sure the device meets acceptable standards.
12.	Line Supervisor	Manages staff on the production line to make the device.

Learning Activities

Children will:

- Watch a video to introduce the topic:
https://www.youtube.com/watch?v=lt7Tj_KGTNE
- Learn about basic heart anatomy and function through a PowerPoint presentation.
- Engage in talk and discussion on medical devices.
- Appreciate the workings of a manufacturing line and the various careers associated with manufacturing.
- Participate in group activities to construct their own medical device.
- Evaluate their work.

Extra Info / Files

	Web Address	Brief Description
1.	www.youtube.com/watch?v=e13TGGccvT4	Angioplasty animation
2.	www.youtube.com/watch?v=p3z9FLYijrQ	Angioplasty animation

3.	www.youtube.com/watch?v=4owpAvYFX8c	How to Mend a Broken Heart animation
4.	www.getbodysmart.com/ap/circulatorysystem/heart/menu/menu.html	Heart tutorial

Resources

- Teacher Lesson Plan
- PowerPoint to guide lesson
- Evaluation sheet
- Medical Device design hand outs (four)
- One set of materials for each group constructing a medical device:
 - Medical Device design hand out
 - Straws
 - Balloons
 - Toilet rolls
 - Scissors
 - Taper
 - Timer (optional)
 - Pump for balloons (optional)

Methodologies

- Talk and discussion
- Active learning
- Guided and discovery learning

- Collaborative learning
- Free exploration of materials
- Investigative approach

Assessment

- Self-assessment – evaluation sheet
- Teacher observation – construction of medical 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

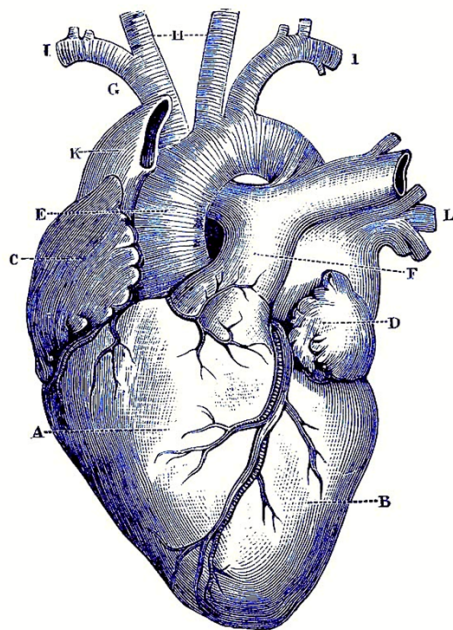
Differentiation By:

- Teaching style
- Support
- Task

Power Point Presentation - The Heart ♥

Introducing the *HEART*

Slide 1



cúrom
Centre for Research in Medical Devices

Teachers in Residence Programme
Deirdre Halleran and Sinéad Ní Mhullaoidh

Slide 2

Today **WE** will build a
medical device to fix a
broken heart!

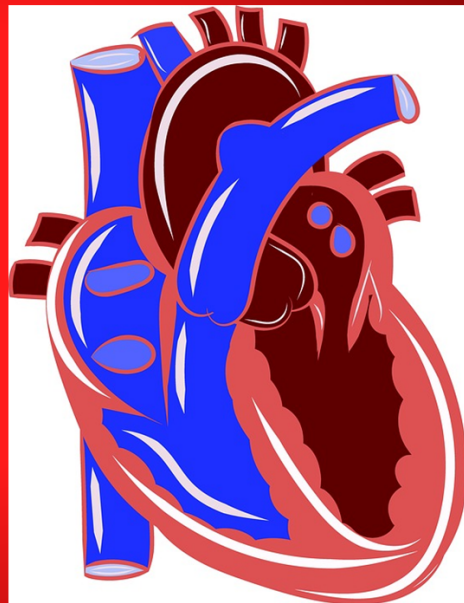


Slide 3



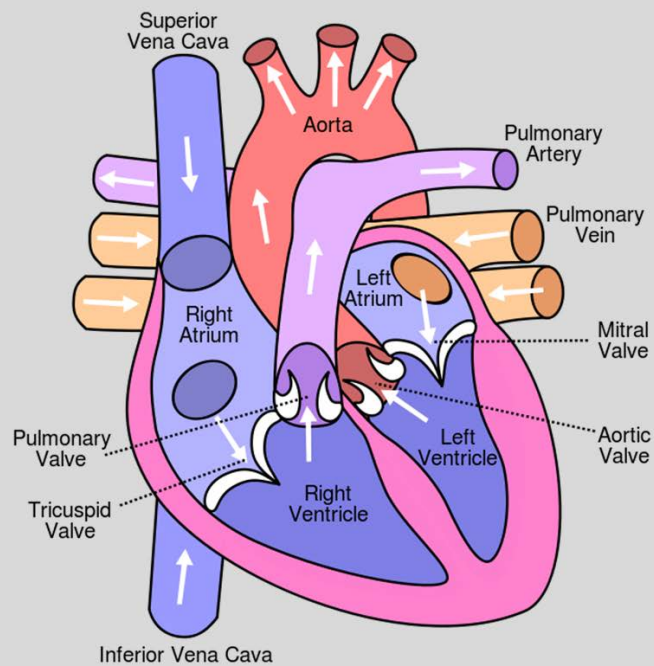
Heart Facts

- Size of your fist in the centre of chest between lungs
- Beats about:
 - 100,000 times in one day
 - 35 million times in a year
 - 2.5 billion times during an average lifetime
- You would have to leave the kitchen tap running for **45 years** to equal that amount of blood your heart pumps during an average lifetime



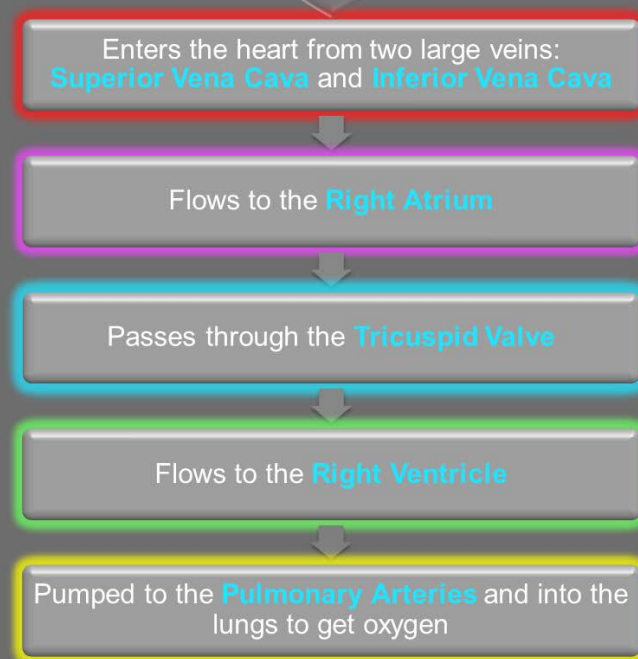
Slide 4

Heart Anatomy



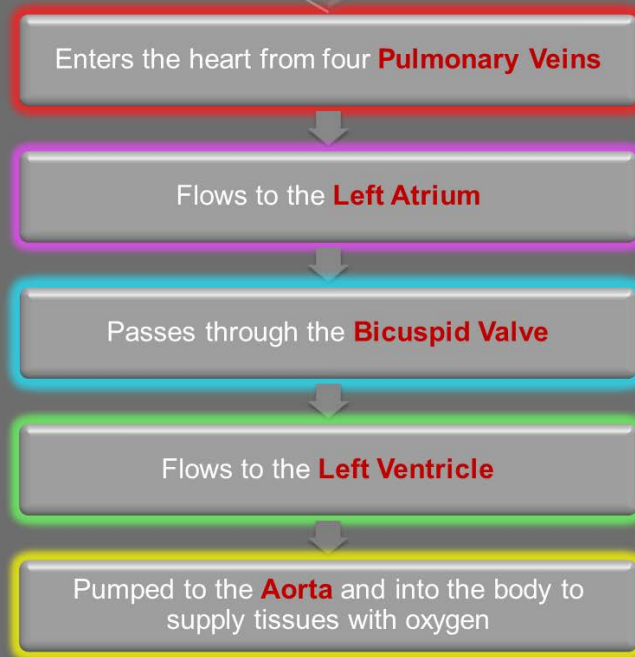
Slide 5

Deoxygenated Blood from the Body



Slide 6

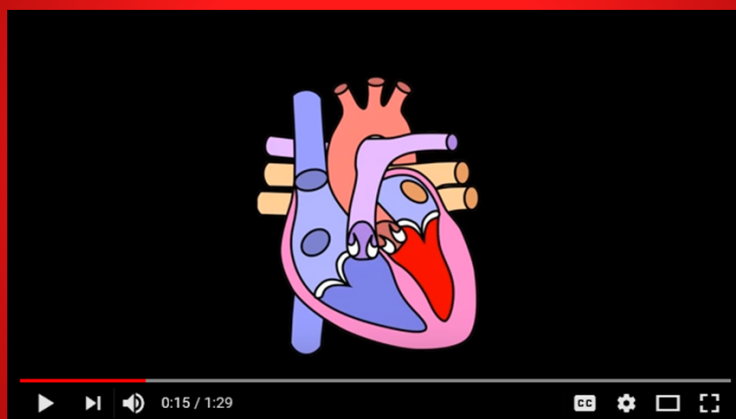
Oxygenated Blood from the Lungs



Slide 7

Look at this video which shows how the blood flow through the heart.

https://www.youtube.com/watch?v=It7Tj_KGTNE



Slide 8

Heart Vascularization

Coronary Arteries

Provide the heart with oxygen and nutrients

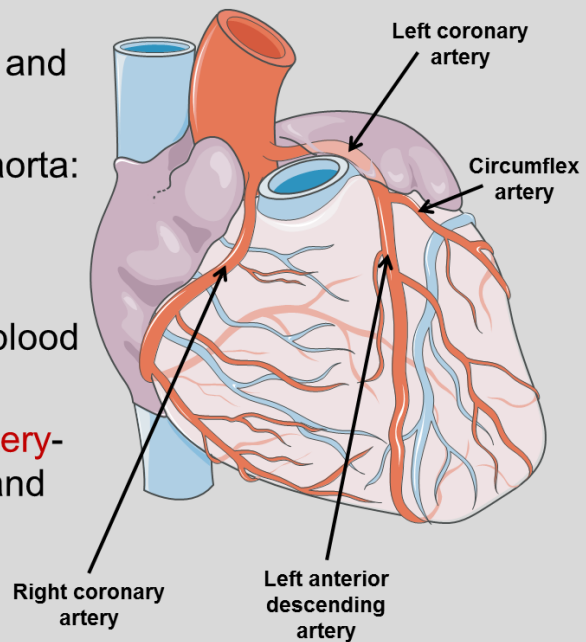
Two main branches from the aorta:

1) **Right coronary artery**

2) **Left coronary artery**

Circumflex artery-supplies blood to the side wall of the heart

Left anterior descending artery-supplies blood to the front and main wall of the heart



Slide 9

Blocked Coronary Arteries

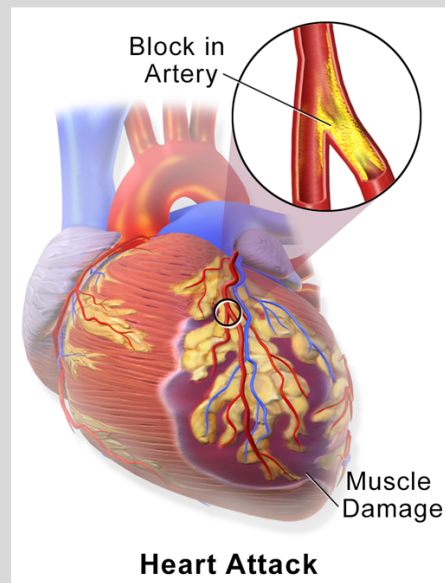
Atherosclerosis

Build up of cholesterol and fat that narrows the coronary arteries causing less blood to reach the heart tissue

Myocardial Infarction

When the arteries become blocked stopping the blood from reaching the heart causing the tissue to die, ie. **heart attack**

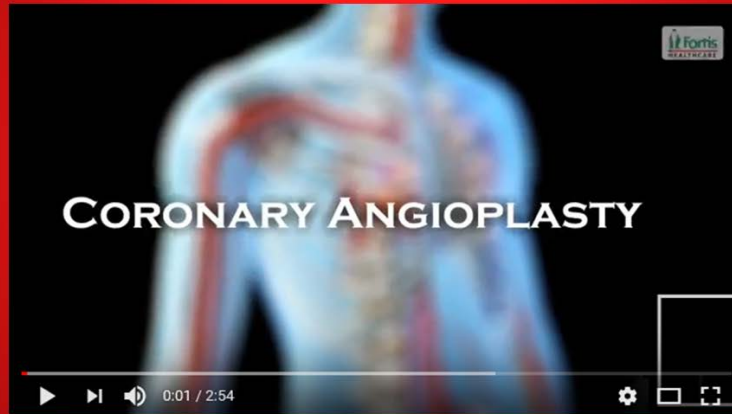
A blockage in the **left coronary artery** can cause a massive heart attack, ie. Widow Maker



Slide 10

Look at this video which shows how an angioplasty is performed.

<https://www.youtube.com/watch?v=e13TGGccvT4>



Slide 11

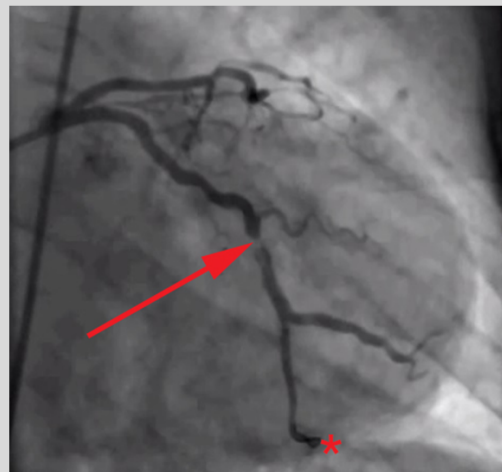
Treatment for Blocked Coronary Arteries

Angioplasty

Procedure that opens a blocked artery using a balloon like device

Steps:

- 1) A long, thin tube called a **catheter** is inserted into an artery in your leg, wrist or arm to reach your coronary artery
- 2) Dye is injected into the catheter which shows on an x-ray any blockages in the arteries



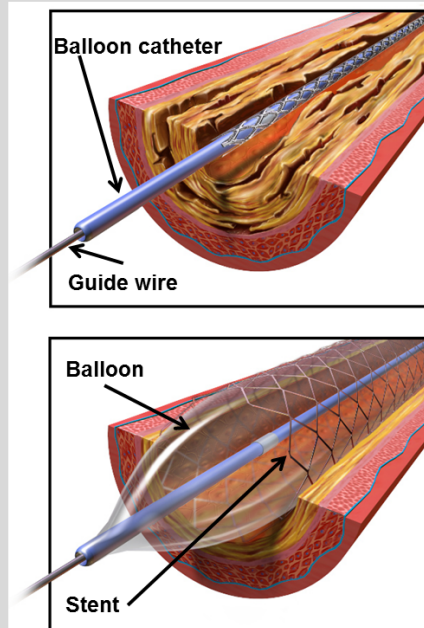
Arrow points at a blockage in the circumflex coronary artery. Star indicates tip of the guide wire that has been inserted into the artery which has passed through the blockage.

Slide 12

Treatment for Blocked Coronary Arteries

Steps:

- 3) A **guide wire** is inserted into the blocked artery to serve as a guide for a balloon catheter
- 4) The **balloon catheter** is inserted over the guide wire
- 5) The balloon is inflated which opens the blockage by squeezing the cholesterol and fat against the wall
- 6) A tiny tube made of wire mesh called a **stent** can be placed inside the artery to keep it open



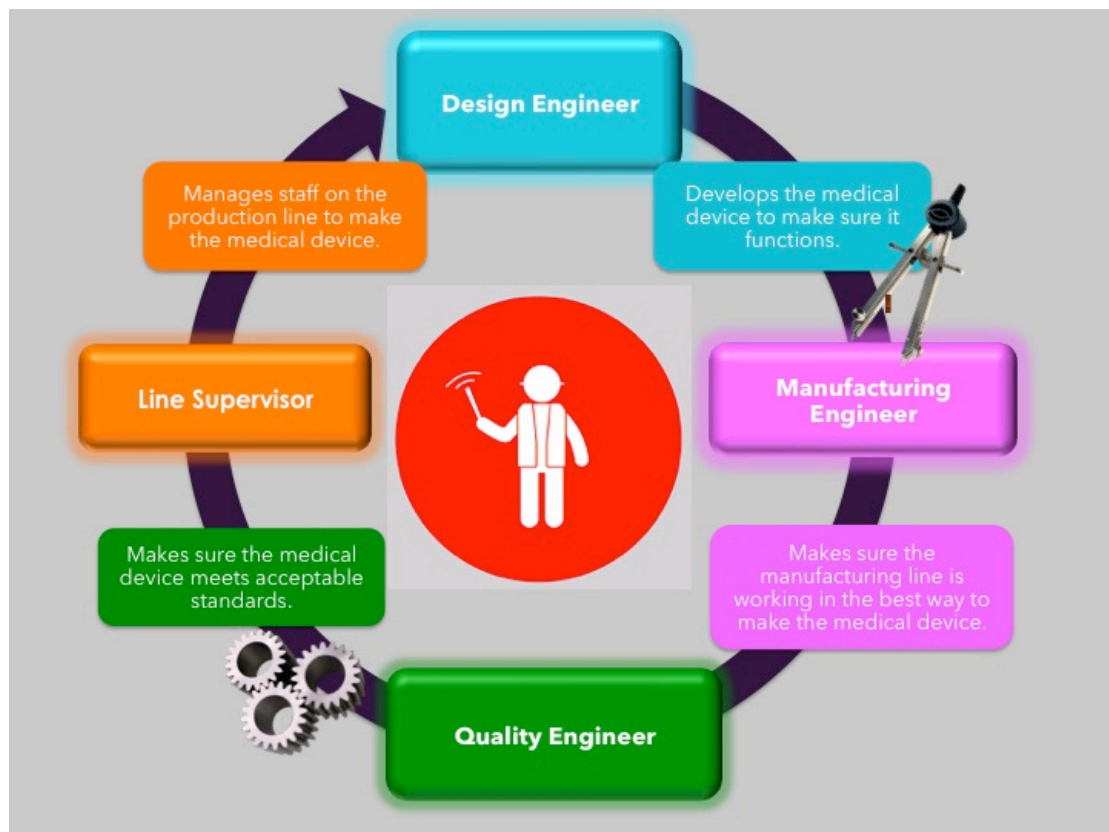
Slide 13

Production of Medical Devices

- Medtronic and Boston Scientific are major producers of balloon catheters
- Medical devices, such as balloon catheters, are made on a manufacturing line
- Manufacturing line=Multiple processes that work together to assemble the components and materials to build a product
- Multiple career opportunities available within a manufacturing line



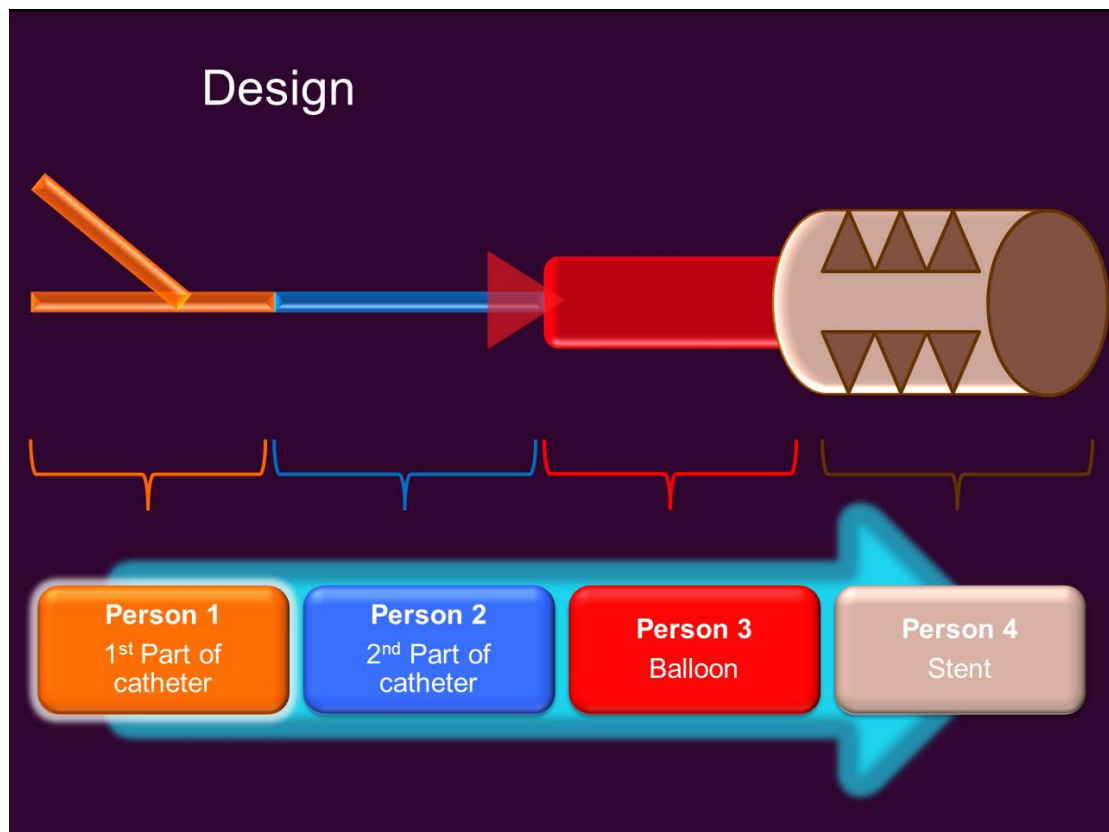
Slide 14



Slide 15



Slide 16



Slide 17



Slide 18

References:

1. Gray's Anatomy
2. www.istockphoto.com
3. www.flickr.com
4. www.pixabay.com
5. commons.wikimedia.org
6. smart.servier.com

Acknowledgements:

Sincere thanks to all of the researchers who gave lectures and generously gave their time throughout the course.

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

Slide 19

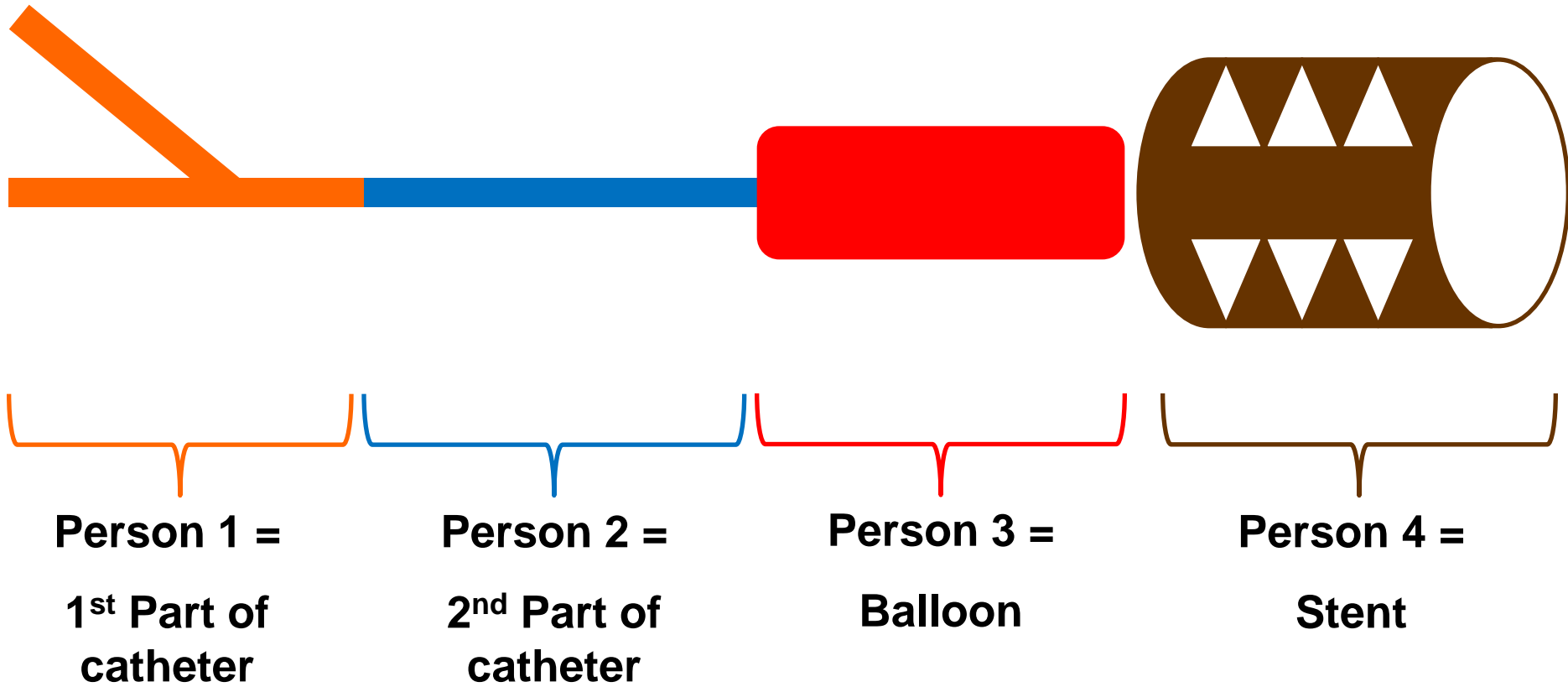
This publication has emanated from research conducted with the financial support of Science Foundation Ireland (SFI) and is co-funded under the European Regional Development Fund under Grant Number 13/RC/2073.

This project has been funded by the European Union Seventh Framework Programme under Marie Curie Initial Training Networks (FP7-PEOPLE-2012-ITN) and Grant Agreement Number 317304 (AngioMatTrain). This project has also been funded by the European Union Horizon 2020 Programme (H2020-MSCA-ITN-2015) under the Marie Skłodowska-Curie Innovative Training Networks and Grant Agreement Numbers 676408 (BrainMatTrain) and 676338 (Tendon Therapy Train).

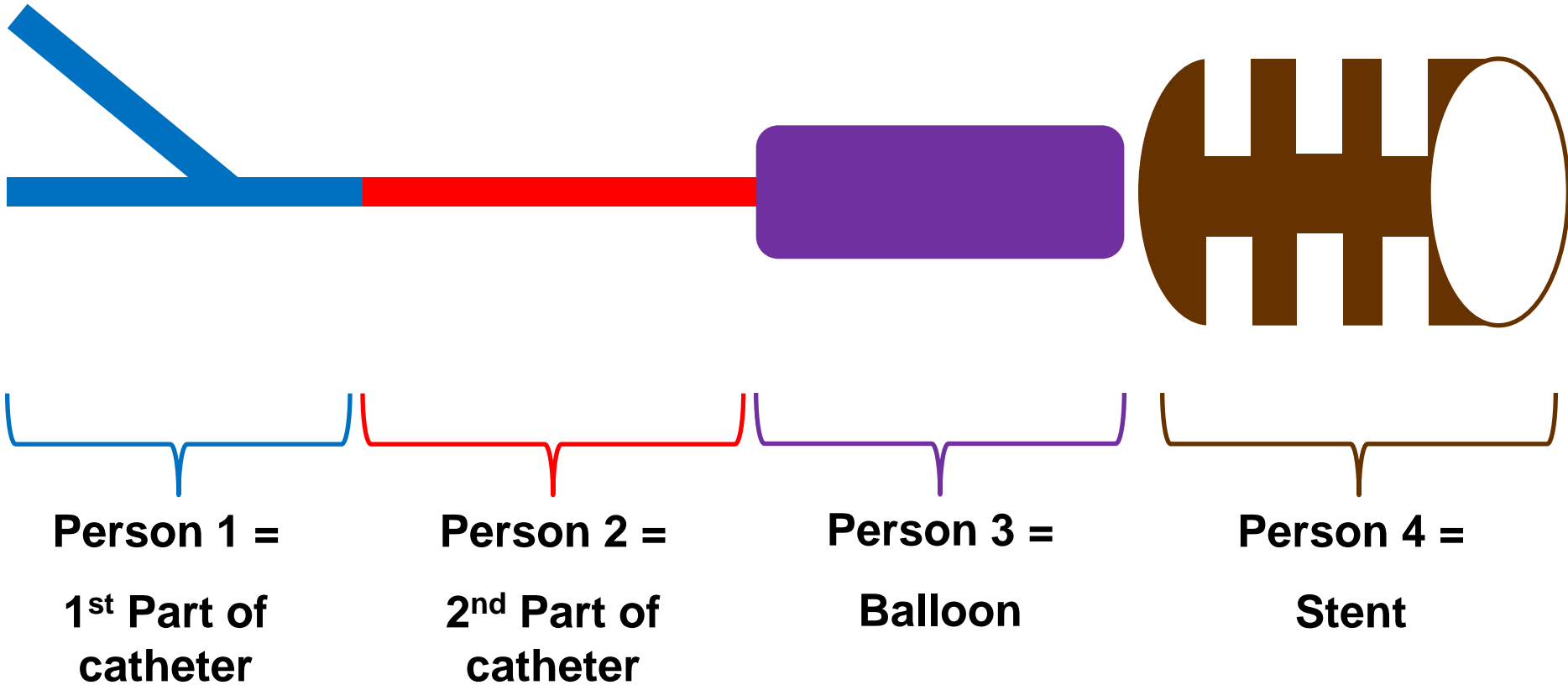


Slide 20

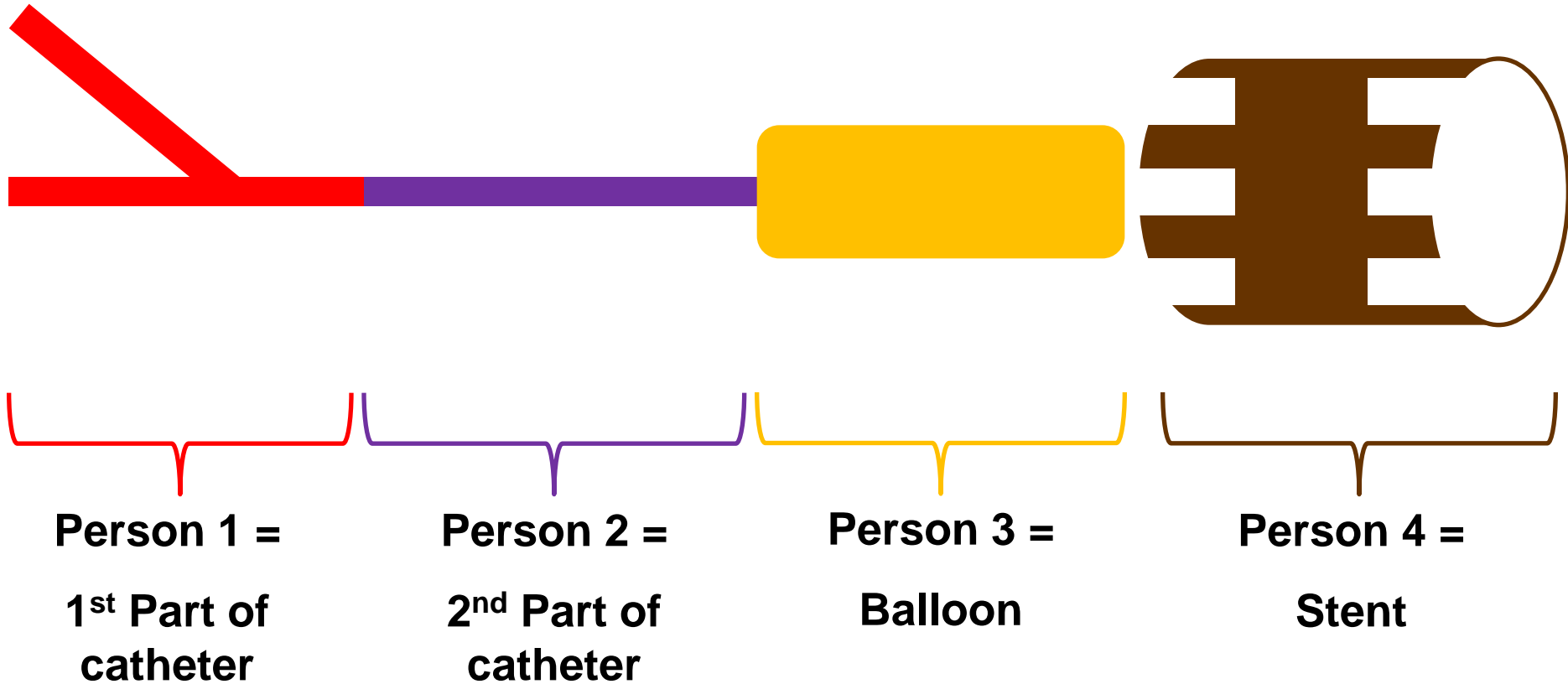
Design 1



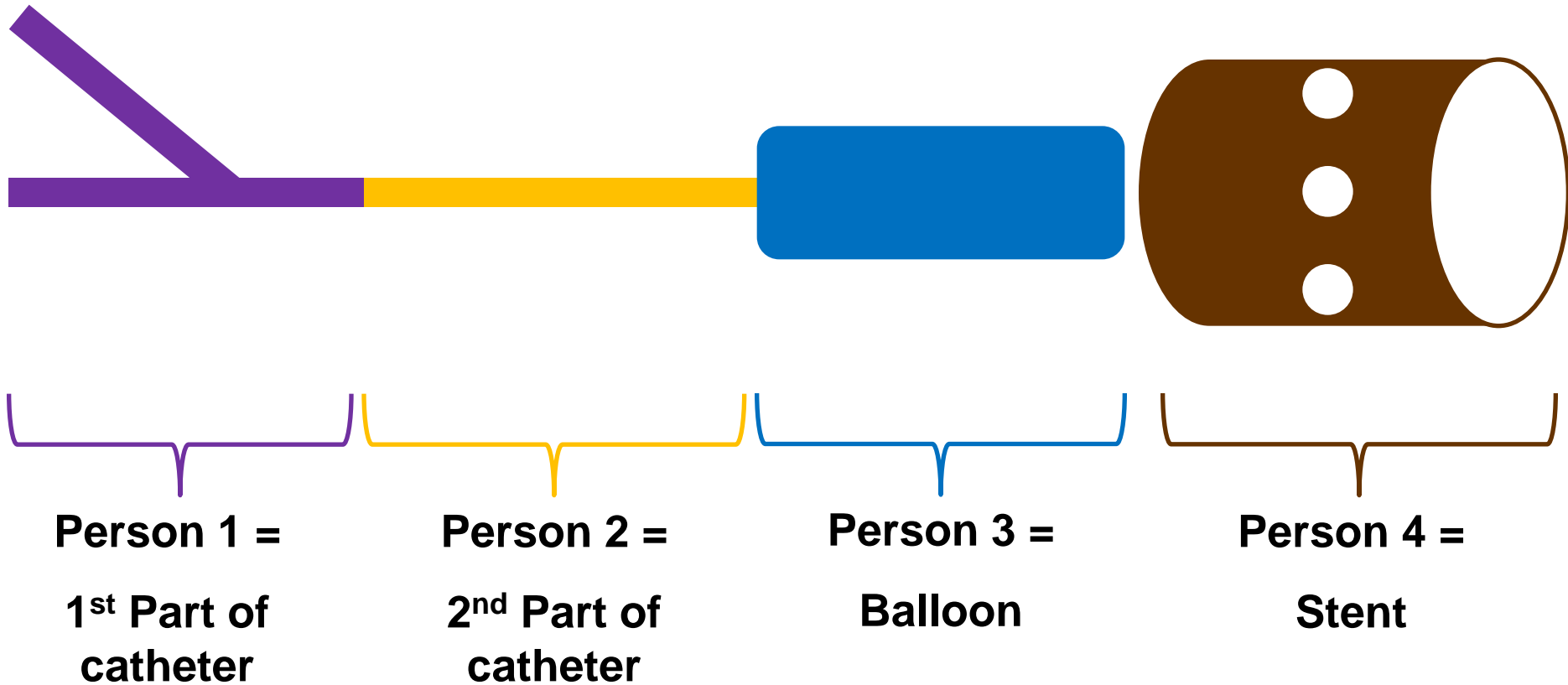
Design 2



Design 3



Design 4



THE HEART-EVALUATION SHEET ♥

Draw a picture of the medical device that you created.



Do you think your medical device is successful? Why or why not?

If you were building the medical device again, what would you do differently?

State three things that you learned today:

1. _____

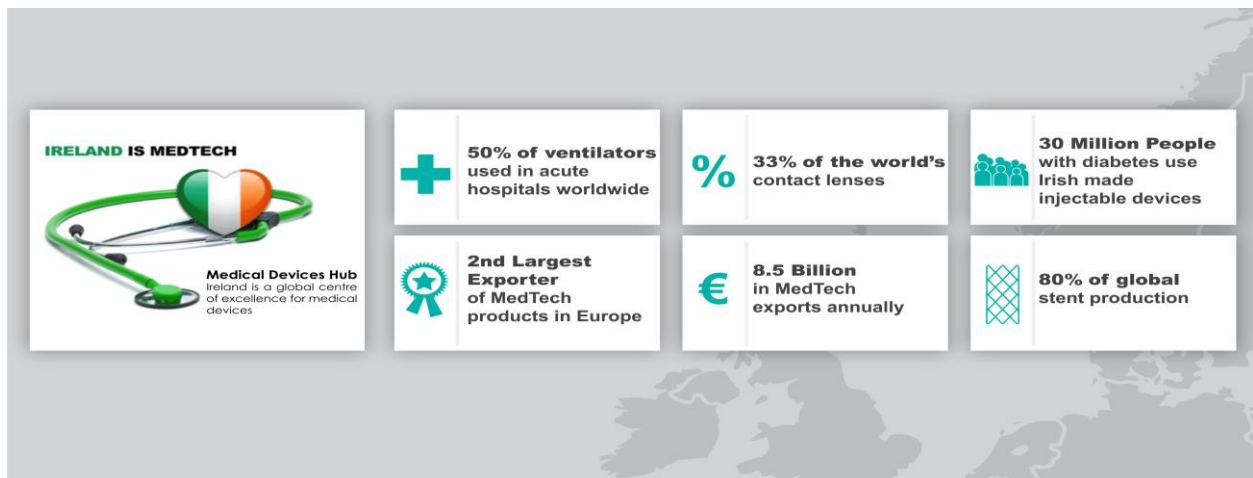
2. _____

3. _____

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.

80% of global stent production is carried out in Ireland. The two largest employers within the Galway region are Medtronic and Boston Scientific, employing over 4000 individuals. Due to the influential presence of these two companies, many companies in Galway are involved in cardiology-related devices, particularly drug-eluting stents and their components, such as guide wires and balloon catheters. This has resulted in Galway becoming recognised for its specialisation in coronary devices, producing the highest levels of R&D and High Tech Innovation worldwide.



Source: IDA Ireland, 2017

ACKNOWLEDGEMENTS

The participants of the 2016-2017 Teachers in Residence Programme: Colm Caomhánach, Thomas Flanagan, Andrew Fogarty, Deirdre Halleran, Ann McGreevy, Iseult Mangan, Sinead Molloy, Clive Monahan, Roisin Ni Bhriain and Carmel Rourke.

Niamh Burke and Rachel Duggan, the participants of the 2015-2016 Teachers in Residence Programme.

Sadie Cramer, the Visual Artist who designed the graphics and layouts of the lesson plans.

The researchers who lectured to and helped develop the lesson plans with the educators: Emmanuela Bovo, James Britton, Hector Capella, Joshua Chao, Ankit Chaturvedi, Paolo Contessotto, Mikey Creane, Marc Fernández, Cathal Ó Flatharta, Hakima Flici, Ana Fradinho, Silvia Cabre Gimenez, Jill McMahon, Luis Martins, Renza Spelat, Maura Tilbury, Alexander Trottier and Dimitrios Zeugolis.

Veronica McCauley and Kevin Davison, from the School of Education, and Matt Wallen, Principal of Knocknacarra Educate Together National School, who contributed to the development of the programme.

The individuals who presented to the educators about on-going outreach programmes: Claire Concannon, Muriel Grenon, Enda O'Connell, Jackie O'Dowd and Brendan Smith.

Nóirín Burke and all the staff at the National Aquarium for the workshops given to the primary students.

This publication has emanated from research conducted with the financial support of Science Foundation Ireland (SFI) and is co-funded under the European Regional Development Fund under Grant Number 13/RC/2073.

This project has been funded by the European Union Seventh Framework Programme under Marie Curie Initial Training Networks (FP7-PEOPLE-2012-ITN) and Grant Agreement Number 317304 (AngioMatTrain). This project has also been funded by the European Union Horizon 2020 Programme (H2020-MSCA-ITN-2015) under the Marie Skłodowska-Curie Innovative Training Networks and Grant Agreement Numbers 676408 (BrainMatTrain) and 676338 (Tendon Therapy Train).





Centre for Research in Medical Devices

Centre for Research in Medical Devices
Biomedical Sciences
National University of Ireland Galway
Galway, Ireland

T: +353 91 495833
E: info@curamdevices.ie

www.curamdevices.ie

  @CURAMdevices

