Teachers in Residence

The Circulatory System

Secondary Level Lesson Plan

curam

SFI Research Centre for Medical Devices

Science Foundation Ireland sfi For what's next

SFI Research Centre for Medical Devices

TEACHERS IN RESIDENCE

"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

Circulatory System Lesson Plan

Junior Cycle Science 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 the three main components of the circulatory system.
2. Describe what blood is made of.
3. Describe the three types of blood vessels and what they do.
4. Describe basic heart anatomy and blood flow through the heart.
5. Develop an awareness of the conditions that can affect the heart and blood vessels.
6. Appreciate what a medical device is.
7. Develop an awareness of how medical devices are designed to treat diseases of the circulatory system.

Keywords and Definitions

	Keyword	Definition
1.	**Red Blood Cells**	Cells in your blood that carry oxygen.
2.	**White Blood Cells**	Cells in your blood that make up part of the immune system.
3.	**Platelets**	Components in the blood that are needed for clotting in order to control bleeding.
4.	**Plasma**	Liquid component of the blood that carries blood cells, nutrients and waste products.
5.	**Arteries**	Blood vessels that carry blood with oxygen and nutrients away from the heart.
6.	**Veins**	Blood vessels that carry blood with waste products to the heart.
7.	**Capillaries**	Smaller blood vessels that give oxygen and nutrients to cells and collect waste products from cells.
8.	**Cholesterol**	A waxy substance in the blood used to build cells which can build up and block blood vessels.
9.	**Heart Attack**	The coronary arteries become blocked stopping the blood from reaching the heart muscle.

10.	**Ischemic Stroke**	An artery that supplies blood to the brain becomes blocked stopping blood from reaching the brain.
11.	**Aneursym**	Weak spot in a blood vessel wall that results in an outward bulging, like a bubble or balloon.
12.	**Haemorrhagic Stroke**	A weakened blood vessel ruptures and blood spills into the brain.
13.	**Medical Device**	A medical device is a material used to diagnose, prevent, monitor and treat the effects of illness.
14.	**Diagnose**	Identify the nature of an illness or other problem by examination of the symptoms.
15.	**Treat**	Give medical care or attention to.

Learning Activities

Children will:

- Learn about the components of the circulatory system and its function through a PowerPoint presentation.
- Engage in talk and discussion on how medical devices made by companies in Ireland are used to treat the heart and blood vessels.
- Participate in a group activity to invent a medical device to treat a disease of the heart or blood vessels.

Extra Info / Files

	Web Address	Brief Description
1.	www.youtube.com/watch?v=GMBSU-2GK3E	Video on blood flow through heart
2.	www.youtube.com/watch?v=mYZXoD73GO0	Video on blood vessels
3.	vascularcures.org/types-of-vascular-diseases/	Website with helpful background information for teachers

Resources

- Teacher Lesson Plan
- PowerPoint to guide lesson
- Activity worksheet
- Optional: "How To Fix A Broken Heart"-A 9 minute animation created by CÚRAM Artist in Residence, Siobhan McGibbon, illustrating how the heart works, problems that can occur and treatments being developed by CÚRAM using biomaterials. The animation can be viewed using the following link: https://www.youtube.com/watch?v=4owpAvYFX8c.
- Optional: "A Tiny Spark"-A 26 minute documentary produced by CÚRAM focusing on research which analyses blood clots that have been removed from patients to see what information they may yield to better treat strokes. A trailer to the film can be viewed using the following link: https://vimeo.com/291731458. The film is available on request by contacting Sarah at sarah.gundy@nuigalway.ie.

Materials Needed

- Pencil/pen
- One copy of the "Guess Who???" activity worksheet per group of students
- Slides 14-16 of the accompanying PowerPoint presentation
- Internet connection (in order to access online videos)

Instructions

- For Activity 1 (Guess Who???):
    - Divide the class into groups of two, three or four depending on class size and amount of activity worksheet copies available.
    - Show the picture of the medical device on slide 14. **Note:** Make sure to point out to the students the true size of the device labelled on the images to give them perspective.
    - Ask the students to look at the shape of the device and record their observations in the corresponding box of the activity worksheet. **Note:** If you think the students need a hint, tell them that the three triangular flaps open and close.
    - Ask the students to think about what function this shape could provide and record their answers in the corresponding box of the activity worksheet.

    - Based on the shape, ask the students to think about where the device may go in the body and record their answers in the corresponding box of the activity worksheet. **Note:** Point out that it goes specifically somewhere in the circulatory system.
    - Based on their first three answers, ask the students to think about what they think the device does to help the circulatory system.
    - Ask the groups to share what they think the device does with the class.
    - Proceed with slide 14 to reveal the name of the device, who manufactures it, where it goes in the circulatory system and what it does in the circulatory system.
    - Using the weblink in the slide, share the video of the medical device performing its function in the circulatory system.
    - Repeat from step 2 for slides 15 and 16.
- For Activity 2 (What Would You Do?):
    - Ask the students to work within their groups to invent a medical device to treat a disease of the heart or blood vessels.
    - Ask students to answer the following about their devices on their activity worksheets:
        - What is the name of your device?
        - What is the function of the device?
        - What is the shape of the device?
        - How does your device get into the body?
        - Draw a picture of your device.

Teachers' Tips

- For Activity 1 (Guess Who???) you can include different or more images of medical devices for the circulatory system whose shapes serve a purpose for their function. Some examples are stents, catheters, vascular grafts and WATCHMAN Left Atrial Appendage Closure Device (clot catcher!):
- https://www.bostonscientific.com/en-EU/products/laac-system/watchman.html
- You can also ask students to find the pictures of medical devices and have them quiz their classmates.

Methodologies

- Talk and discussion
- Active learning
- Guided and discovery learning
- Collaborative learning
- Investigative approach

Assessment

- Self-assessment – activity worksheet
- Teacher observation – identification of medical devices to treat the heart and blood vessels
- Teacher questioning – talk and discussion

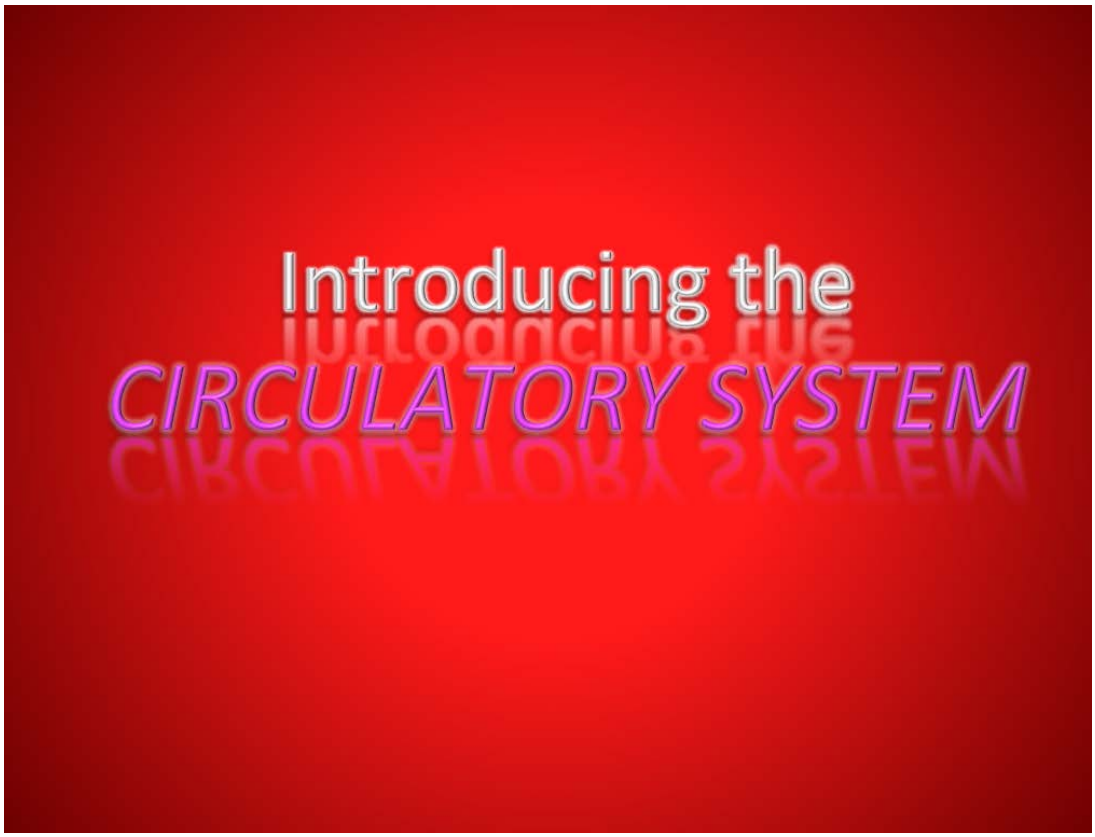
Linkage and Integration

- **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

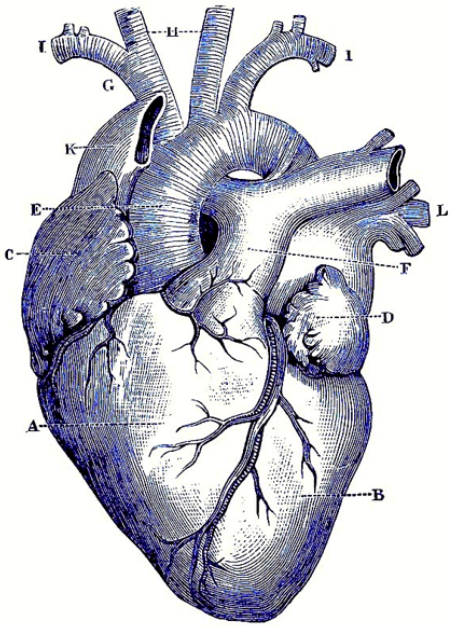
Differentiation By:

- Teaching style
- Support
- Task

PowerPoint Presentation - The Circulatory System



Slide 1



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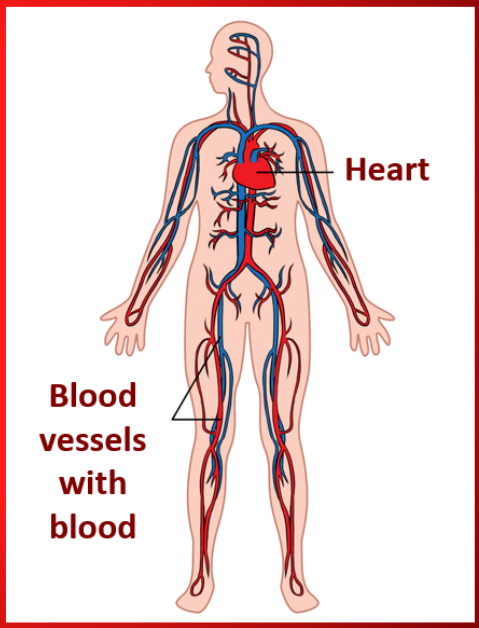
SFI Research Centre for Medical Devices

Teachers in Residence Programme
Deirdre Halleran and Sinéad Ní Mhullaoidh

Slide 2

Circulatory System

- Two main functions:
  - Delivers oxygen and nutrients to cells
  - Takes waste products away from the cells
- Three main components:
  - Blood
  - Blood vessels
  - Heart



Slide 3

Blood

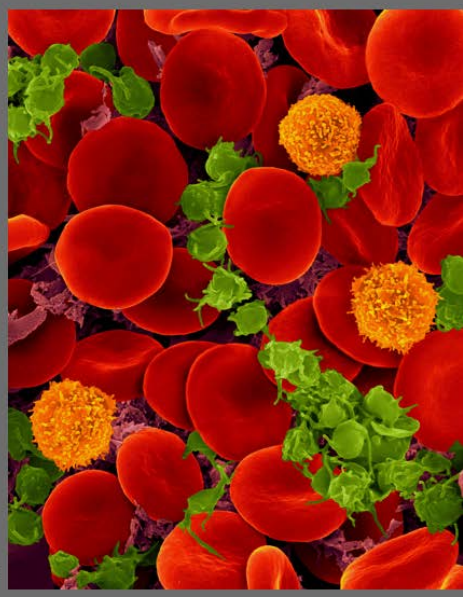
Blood is made of:

- Red blood cells–carry oxygen
- White blood cells–make up part of the immune system
- Platelets–needed for clotting
- Plasma–liquid that carries the blood cells, nutrients and waste products

Red=Red blood cells

Orange=White blood cells

Green=Platelets

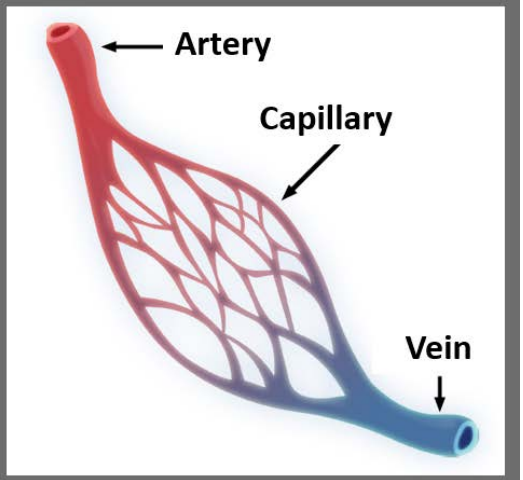


Slide 4

Blood Vessels

- Carry blood around the body
- Different sizes and shapes, depending on what they do

1. Arteries-carry blood with oxygen and nutrients away from the heart
2. Veins-carry blood with waste products to the heart
3. Capillaries
   - Give oxygen and nutrients to cells
   - Collect waste products from cells

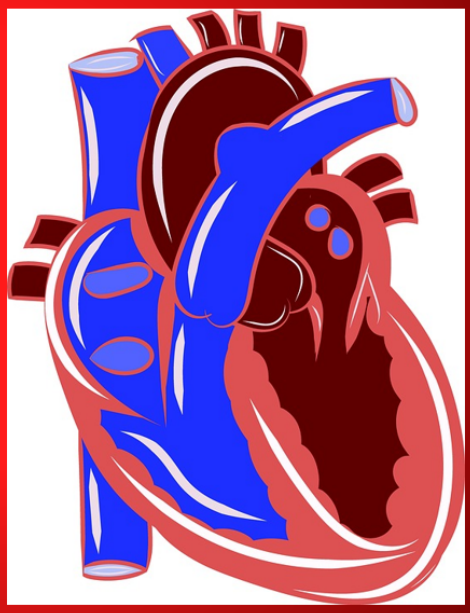


A video about the types of blood vessels can be found here: https://vimeo.com/203674183

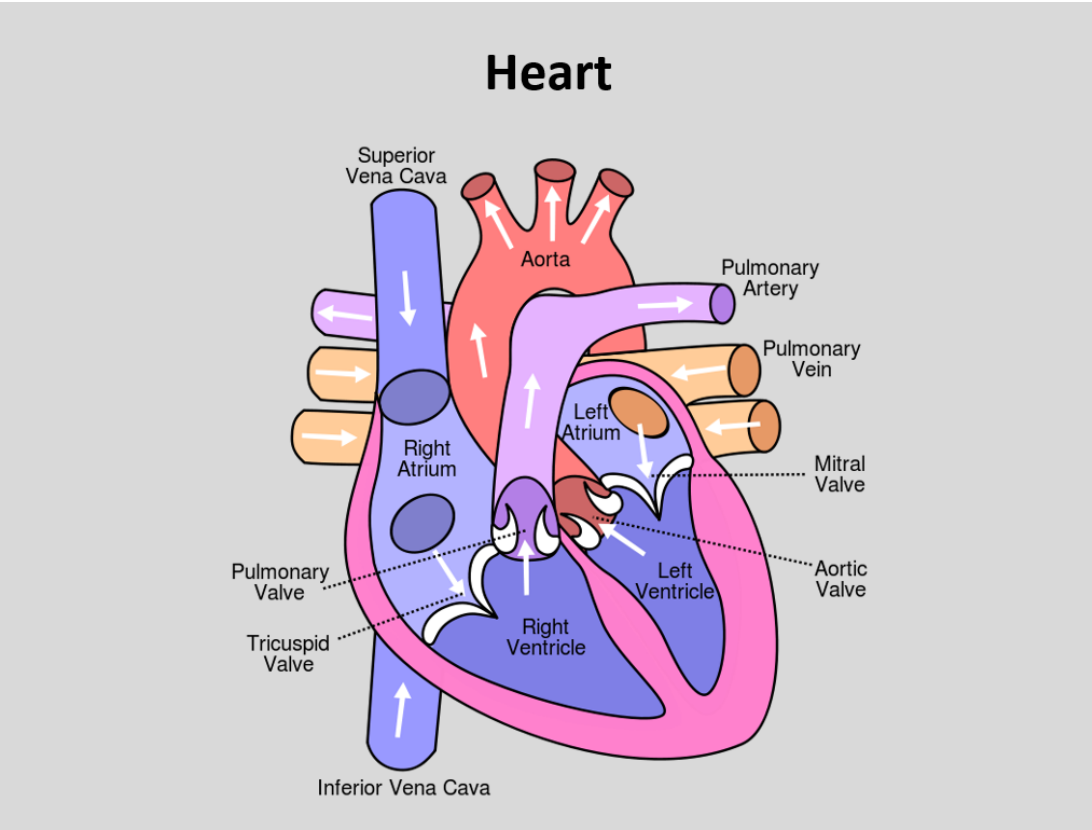
Slide 5

Heart Facts

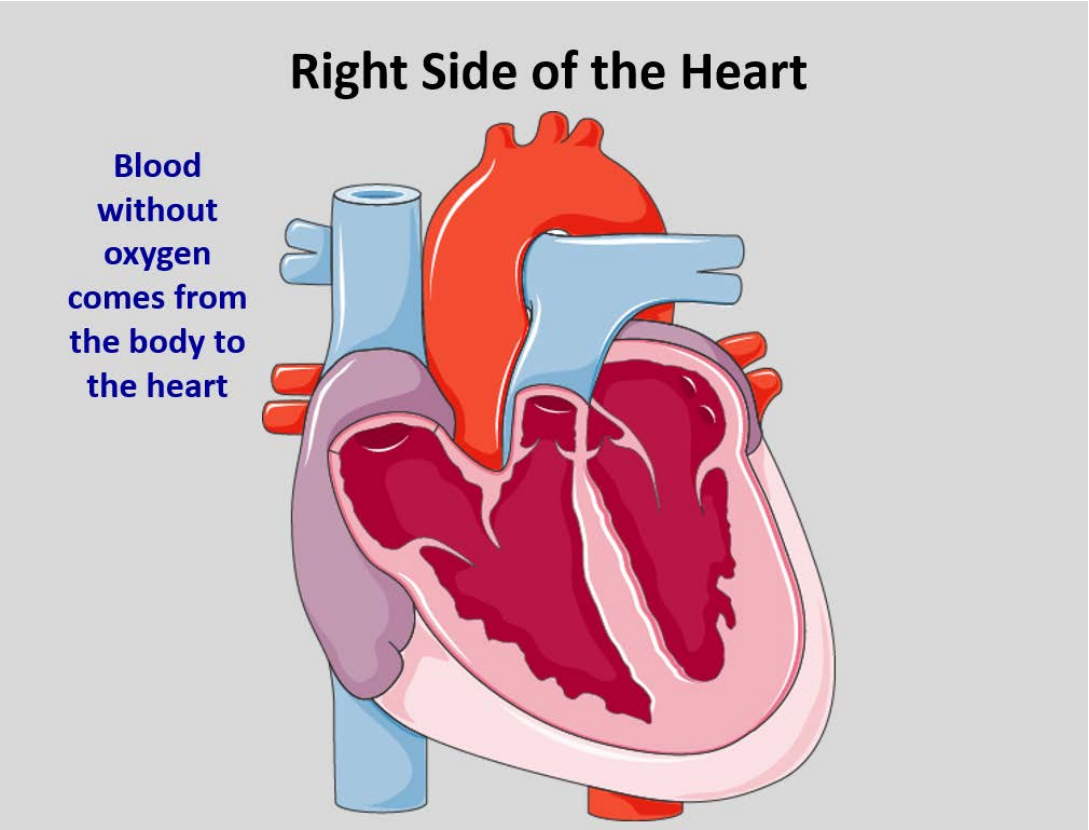
- Size of your fist in the centre of chest between lungs
- Beats about:
  - 100,000 times in one day
  - 35 million times in a year
  - 2.5 billion times during an average lifetime
- You would have to leave the kitchen tap running for **45 years** to equal that amount of blood your heart pumps during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



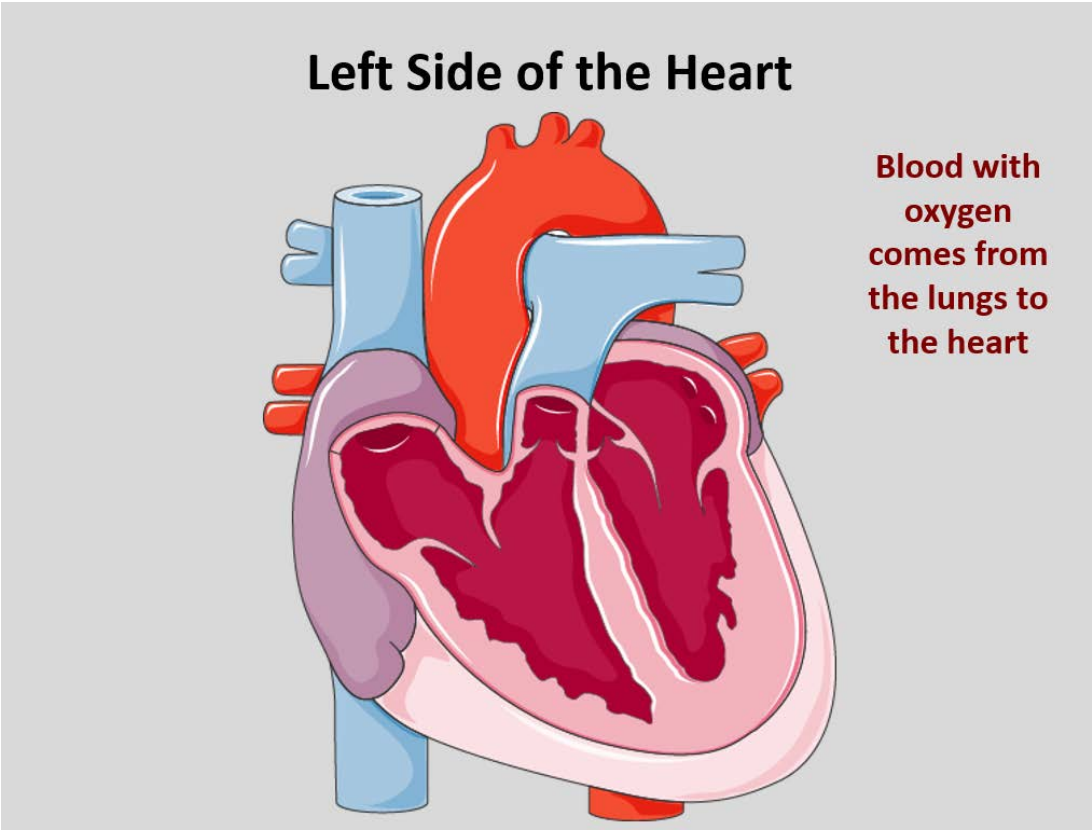
Slide 6



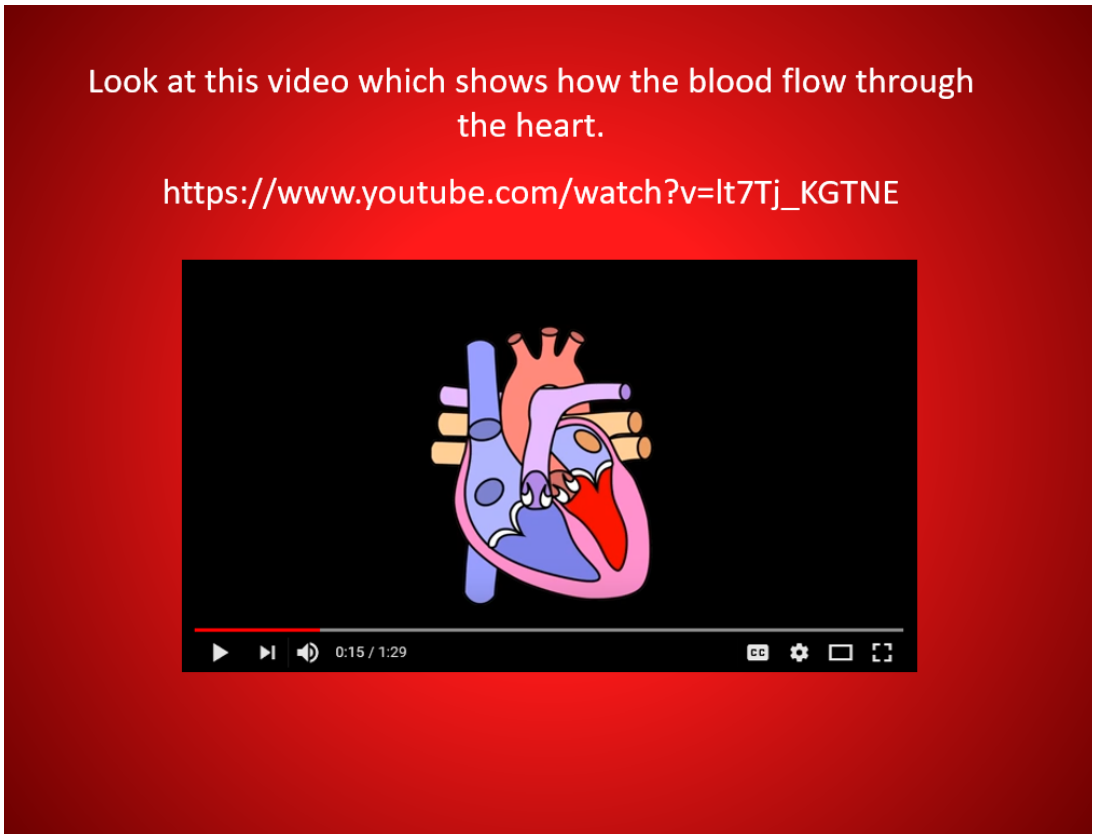
Slide 7



Slide 8



Slide 9



Slide 10

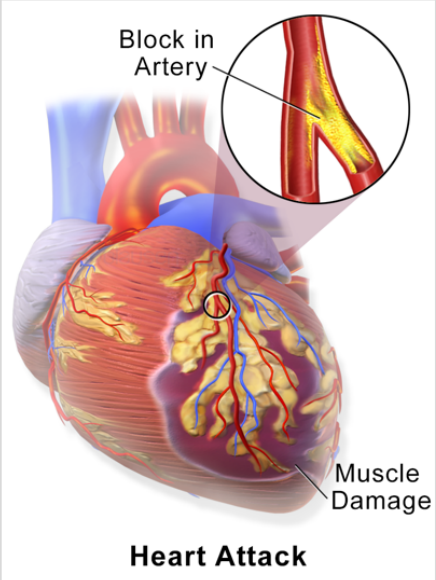
Blockages in Blood Vessels

Heart Attack

- Cholesterol and fat blocks the arteries that supply blood to the heart
- Blockage prevents blood from delivering oxygen and nutrients to the heart
- Heart muscle starts to die

Ischemic Stroke

- Blockage occurs in the arteries that supply blood to the brain
- Brain tissue starts to die



Slide 11

Bleeds in Blood Vessels

Aneurysm

- A weak spot in a blood vessel wall that results in an outward bulging, like a bubble or balloon
- Can happen anywhere in the body, but most common in the brain, aorta and legs

Haemorrhagic Stroke

- A weakened blood vessel ruptures and blood spills into the brain
- Blood creates swelling and pressure that damages the brain

Slide 12

Medical Devices for the Circulatory System

- Medical devices are used to diagnose and treat diseases of the heart and blood vessels
- Examples of what some devices can do:
  - Monitor and correct irregular beating of the heart
  - Replace valves
  - Increase blood flow by opening blood vessels
  - Block vessels to stop bleeding
- Activity 1: Guess Who???
  - Look at the shape of some medical devices **made by companies in Ireland** used to treat the heart and blood vessels
  - Guess where the devices go and what they do

Slide 13

Guess Who??? Device 1

I am a LOTUS Edge™ Aortic Valve System from Boston Scientific!

A video of the device being placed in the heart can be found here: https://youtu.be/5Qy4UMLxk-E

Where do I go?

Between the left ventricle and the aorta

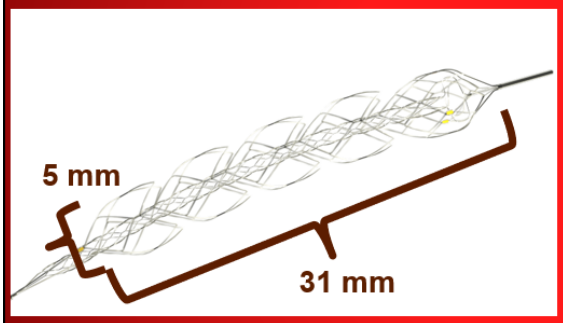
What do I do?

Replace aortic valves without open-heart surgery

Slide 14

Guess Who??? Device 2

I am an EMBOTRAP® II Revascularization Device from Cerenovus!



A video of the device retrieving a clot can be found here: https://www.jnjmedicaldevices.com/en-US/product/embotrap-ii-revascularization-device

Where do I go?

Blood vessels in the brain

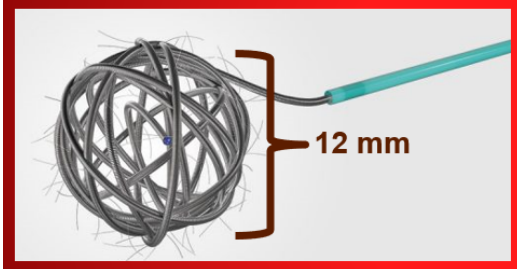
What do I do?

Restore blood flow to the brain by grabbing and removing a clot

Slide 15

Guess Who??? Device 3

I am a Concerto™ detachable coil system from MedTronic!



A video of the device creating a clot can be found here: https://www.medtronic.com/us-en/healthcare-professionals/products/cardiovascular/peripheral-embolization/concerto.html

Where do I go?

Blood vessels around the body

What do I do?

Act as a clot to stop bleeding in blood vessels

Slide 16

Activity 2: What Would You Do?

- What medical device would you invent to treat a disease of the heart or blood vessels?
  - What is the name of your device?
  - What is the function of the device?
  - What is the shape of the device?
  - How does your device get into the body?
  - Draw a picture of your device.

Slide 17

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

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Slide 18

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Slide 19

Activity 1: Guess Who???

Directions: Fill in the boxes below to help you guess where each of the medical devices go and what they do.

Medical Device	What is the shape of this device?	What function could the shape provide?	Where in the circulatory system might this device fit?	What in the circulatory system could this device do?
1				
2				
3				

Activity 2: What Would You Do?

Directions: Within your group, invent a medical device to treat a disease of the heart or blood vessels. Answer the questions below about your device.

1) What is the name of your device?

2) What is the function of the device?

3) What is the shape of the device?

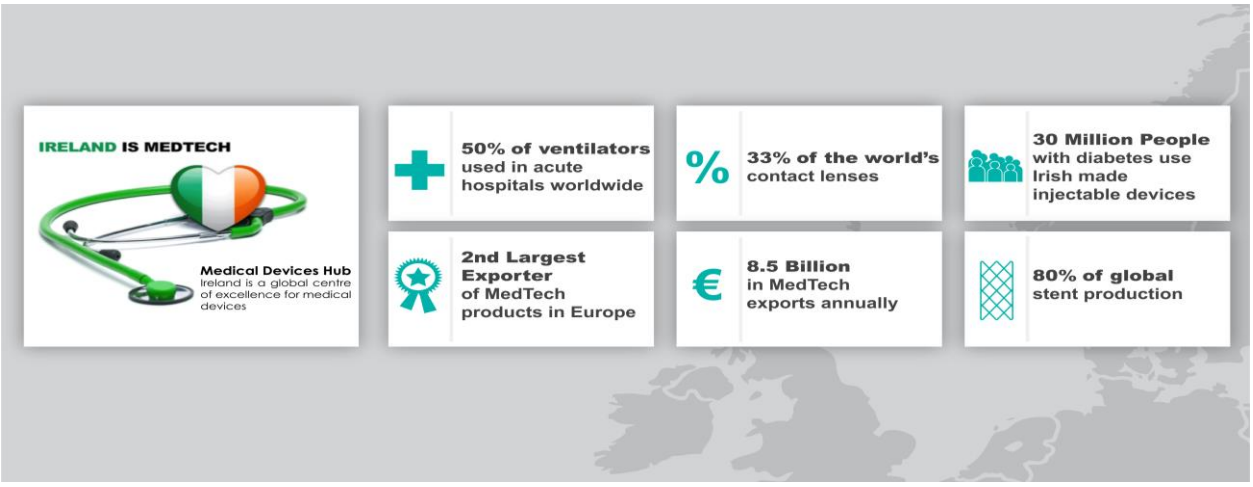
4) How does your device get into the body?

5) Draw a picture of your device:

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

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AngioMatTrain

brain mattrain

Tendon Therapy Train

Engineering *in vitro* microenvironments for translation of cell-based therapies for tendon repair

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