Teachers in Residence

The Heart

Secondary Level

Lesson Plan

Cúram
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
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**

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

<table>
<thead>
<tr>
<th>Web Address</th>
<th>Brief Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. <a href="http://www.youtube.com/watch?v=e13TGGccvT4">www.youtube.com/watch?v=e13TGGccvT4</a></td>
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<td>2. <a href="http://www.youtube.com/watch?v=p3z9FLYijrQ">www.youtube.com/watch?v=p3z9FLYijrQ</a></td>
<td>Angioplasty animation</td>
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</tbody>
</table>
3. www.youtube.com/watch?v=4owpAvYFX8c
   How to Mend a Broken Heart animation

   Heart tutorial

**Resources**

- Teacher Lesson Plan
- PowerPoint to guide lesson
- Evaluation sheet
- Medical Device design handouts (four)
- One set of materials for each group constructing a medical device:
  - Medical Device design handout
  - 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
Slide 1

Introducing the HEART

Slide 2

Teachers in Residence Programme
Deirdre Halleran and Sinéad Ni Mhullaoidh
Today **WE** will build a medical device to fix a broken heart!

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
Heart Anatomy

Deoxygenated Blood from the Body

Enters the heart from two large veins:

Superior Vena Cava and Inferior Vena Cava

Flows to the Right Atrium

Passes through the Tricuspid Valve

Flows to the Right Ventricle

Pumped to the Pulmonary Arteries and into the lungs to get oxygen
Oxygenated Blood from the Lungs

- Enters the heart from four Pulmonary Veins
- Flows to the Left Atrium
- Passes through the Bicuspid Valve
- Flows to the Left Ventricle
- Pumped to the Aorta and into the body to supply tissues with oxygen

Look at this video which shows how the blood flow through the heart.
https://www.youtube.com/watch?v=lt7Tj_KGTNE
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

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
Look at this video which shows how an angioplasty is performed.
https://www.youtube.com/watch?v=e13TGGccvT4

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.
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

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
Now you will create your own production line
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.

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Design 1

Person 1 = 1\textsuperscript{st} Part of catheter

Person 2 = 2\textsuperscript{nd} Part of catheter

Person 3 = Balloon

Person 4 = Stent
Design 2

Person 1 = 1st Part of catheter
Person 2 = 2nd Part of catheter
Person 3 = Balloon
Person 4 = Stent
Design 3

Person 1 = 1\textsuperscript{st} Part of catheter
Person 2 = 2\textsuperscript{nd} Part of catheter
Person 3 = Balloon
Person 4 = Stent
Design 4

Person 1 = 1\textsuperscript{st} Part of catheter

Person 2 = 2\textsuperscript{nd} Part of catheter

Person 3 = Balloon

Person 4 = Stent
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


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