Teachers in Residence

Biomaterials

Primary Level Lesson Plan

CÚRAM Research Ireland Centre for Medical Devices

Taighde Éireann Research Ireland

"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: https://curamdevices.ie/public-engagement/teachers/. 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

Biomaterials Lesson Plan

Primary School Curriculum Links

Strand:

Environmental Awareness and Care

Strand Unit:

Science and the Environment

Content Objectives:

- Appreciate the application of science and technology in familiar contexts.
- Examine some ways that science and technology have contributed positively to the use of the Earth's resources.
- Recognise the contribution of scientists to society.

Strand:

Materials

Strand Unit:

Properties and Characteristics of Materials

Content Objectives:

- Identify how materials are used, made or caused by humankind.
- Recognise that some materials decay naturally while others survive a long time in the environment.

Learning Outcomes

Children should be enabled to:

1. Appreciate what a medical device is.
2. Give examples of medical devices.
3. Appreciate what a biomaterial is.
4. Give examples of biomaterials.
5. Recognise that the design of a biomaterial is important for its function.
6. Understand the uses of biomaterials in biomedical procedures.
7. Make a biomaterial.

Keywords and Definitions

	Keyword	Definition
1.	**Medical Device**	Any material, apparatus, software or other article that is used to: Diagnose, prevent, monitor or treat a disease or injury; Investigate, replace or modify a part or process of the body.
2.	**Biomaterial**	A material that can be engineered to help the body heal itself.
3.	**Diagnose**	Identify the nature of an illness or other problem by examining the symptoms.
4.	**Monitor**	Observation of an area in the body over time.
5.	**Treat**	Give medical care or attention to.

6.	**Investigate**	Discover the cause of an illness or disease.
7.	**Replace**	When an area of the body is removed and a new one is put in its place.
8.	**Modify**	To change an area of the body.
9.	**Implant**	A medical device that is made to replace an area of the body, or support a damaged area of the body.
10.	**Prosthesis**	An artificial body part to help replace damaged areas of the body (tissues, organs, or limbs)
11.	**Stent**	A tiny tube made with a biomaterial that keeps blood vessels open.
12.	**Natural**	Existing in or coming from a biological source; not made or caused by humankind. Ex. Alginate, collagen, or agarose.
13.	**Synthetic**	A material made by chemical synthesis, especially to imitate a natural product. Ex. Polymer, ceramic or metal.
14.	**Biocompatible**	Not harmful or toxic to living tissues.

Learning Activities

Children will:

- Complete the K and W parts of the KWL chart.
- Learn about synthetic and natural sources of biomaterials.
- Learn about how biomaterials can be made into different shapes to support new tissue growth.
- Participate in a group activity to make a biomaterial.
- Evaluate their work using a worksheet.
- Fill in the L part of the KWL chart.

Extra Info / Files

	Web Address	Brief Description
1.	www.youtube.com/watch?v=ptE8dEdSbeY	Video on biomaterials
2.	www.youtube.com/watch?v=T_uMkdKS6wQ&t=213s	Video on biomaterials
3.	edge.rit.edu/edge/P10022/public/team_docs/technical_literature/Overview%20of%20Biomaterials%20and%20Their%20Use%20in%20Medical%20Devices.pdf	"Overview of Biomaterials and Their Use in Medical Devices" Article with helpful background information for teachers

Resources Provided

- Teacher Lesson Plan
- PowerPoint to guide lesson
- Interactive KWL worksheet
- Evaluation worksheet
- Optional: Biomaterials PowerPoint quiz
- Optional: "Bittersweet"-A 26 minute documentary produced by CÚRAM capturing the health system's fight to treat the rising number of diabetic patients, and personal stories of young people who are living with diabetes and their daily struggle to manage it using medical devices. A trailer to the film can be viewed using the following link: https://vimeo.com/242714712. The film is available on request by contacting Sarah at sarah.gundy@nuigalway.ie.

Materials Needed

- Mixing bowls
- Measuring cups (½ Cup)
- Measuring spoons (Tablespoon, Teaspoon, and ½ Teaspoon)
- PVA glue
- Various colours of paint (for colour)
- Bread soda
- Optrex eyewash
- Paper towels for clean up

Instructions

- Divide the class into groups of two, three or four depending on class size and amount of materials.
- Provide a set of materials as listed above for each group.
- Each group mixes the following into a mixing bowl:
    - ½ Cup PVA glue
    - 2 Tablespoons of paint (for colour)
    - 1 Teaspoon bread soda
    - ½ Teaspoon Optrex eyewash
- Option: Materials can be premeasured for the groups to make it a bit easier or save time.

Teachers' Tips

- Flashcards can be used to introduce new language for younger children at the beginning of the lesson.
- The students are actually making slime which is similar to a type of biomaterial that is made in the laboratory!
- The biomaterial must be soft and jelly-like so that it is easily injectable, and is the same consistency as the tissue it is going into (such as the heart or brain).
- A harder biomaterial would need to be made if a harder tissue was being treated (such as bone).

Methodologies

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

Assessment

- Self-assessment – evaluation worksheet
- Teacher observation – making of biomaterials
- Teacher questioning – KWL, talk and discussion

Linkage and Integration

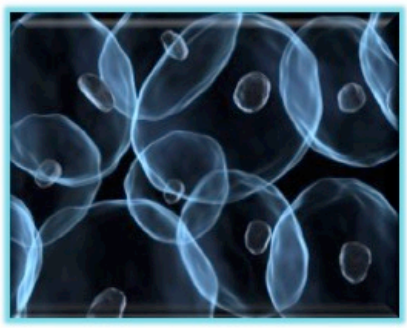
- **Maths** – problem solving
- **STEM** – I.T. / Engineering
- **Art** – construction
- **S.P.H.E** – working together co-operatively
- **English** – oral language through talk and discussion and presenting their work

Differentiation By:

- Teaching style
- Support
- Task

PowerPoint Presentation – Biomaterials

Slide 1



cúram
Centre for Research in Medical Devices

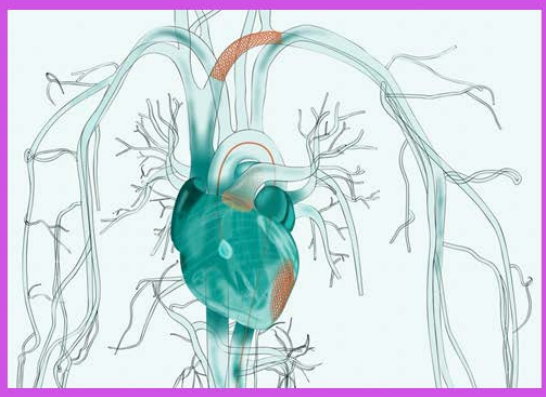
Teachers in Residence Programme
Iseult Mangan and Tom Flanagan

Slide 2

MEDICAL DEVICES

Any material, apparatus, software or other article that is used to:

- *Diagnose*, *prevent*, *monitor* or *treat* a disease or injury
- *Investigate*, *replace* or *modify* a part or process of the body



Slide 3

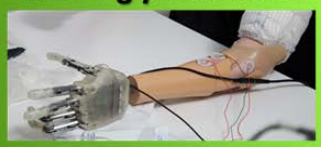
CAN YOU NAME SOME MEDICAL DEVICES?

tongue depressor

hip implant

tooth implant

arm/leg prosthesis



stethoscope

thermometer

stent

disposable gloves

heart valve replacement

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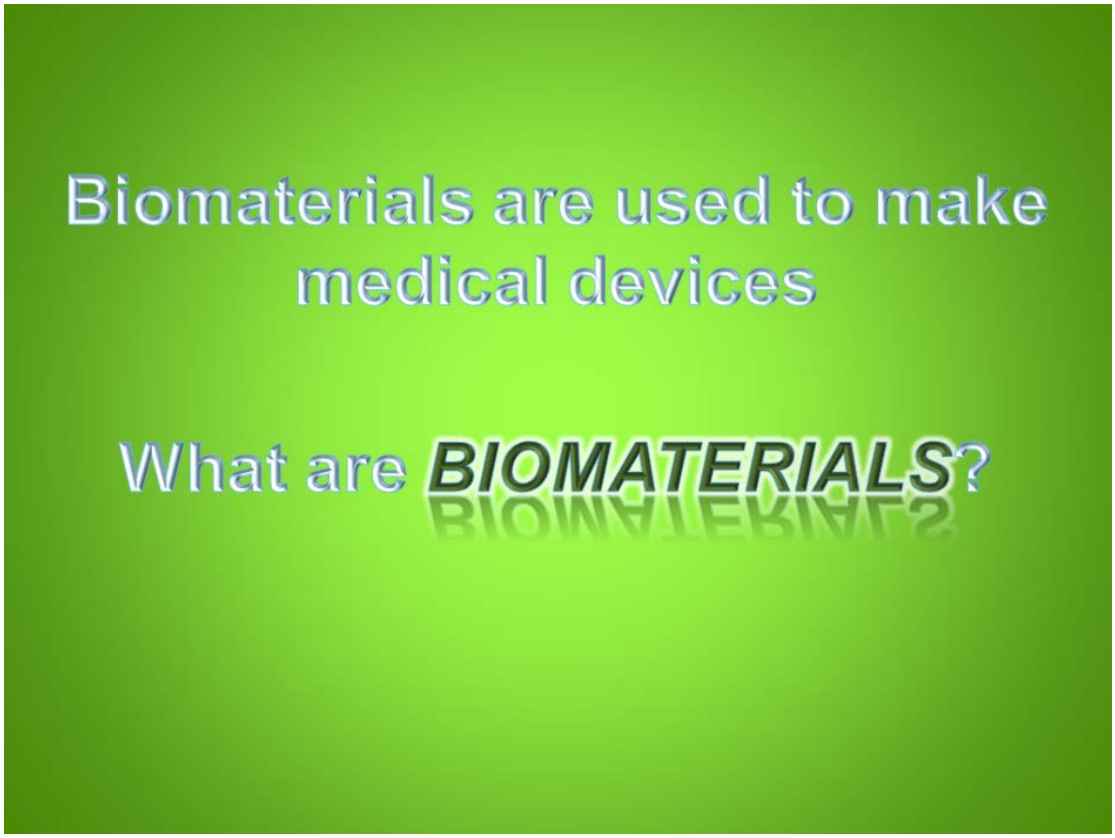

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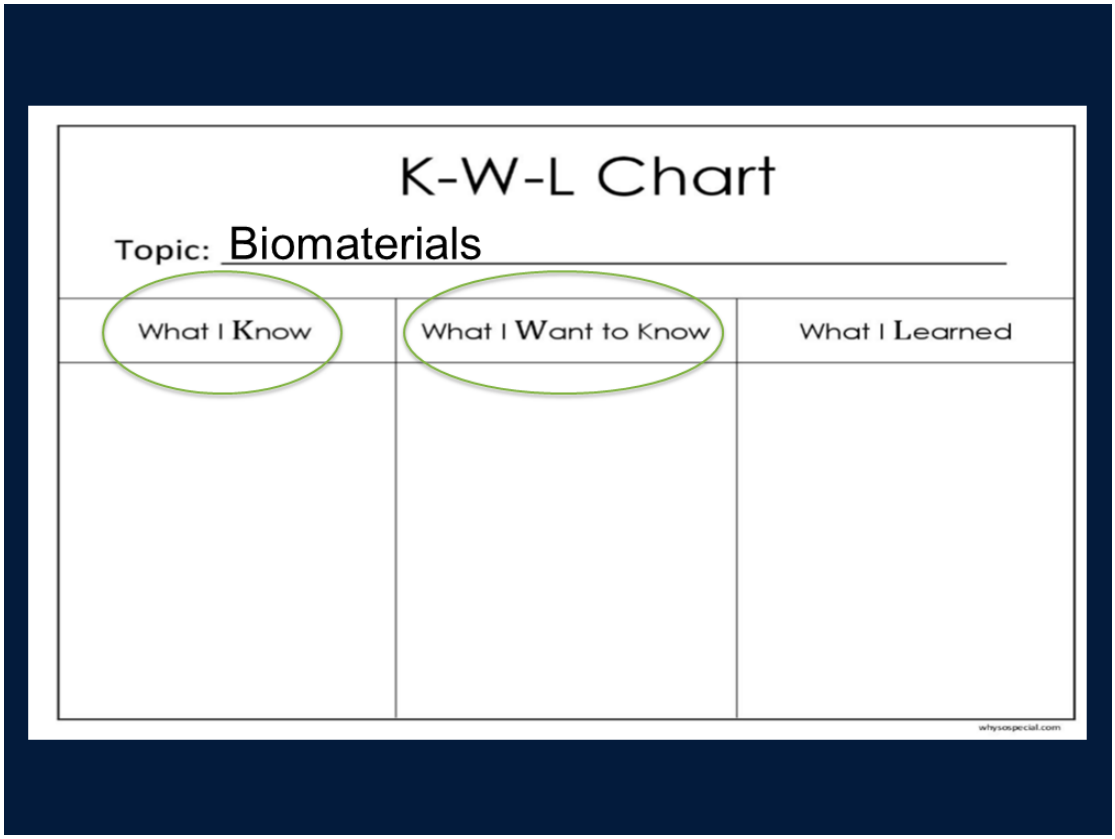

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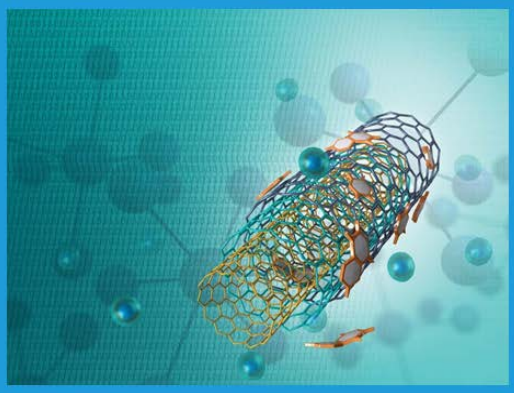
WHAT ARE BIOMATERIALS?

- A biomaterial is made from a **natural** or **synthetic** material that can be engineered to help the body heal itself
- A biomaterial can be introduced into the body as part of a medical device or used to replace an organ
- A biomaterial can be temporary or permanent



Slide 7

Slide 8

SYNTHETIC BIOMATERIALS

Materials made by humans, like plastic or metal

Good:

They are easy to make and exactly the way you need

Bad:

Sometimes the body does not like them

Slide 9

SYNTHETIC BIOMATERIALS

Type	Where would you use them in the body?	Examples
Metal	Hips, knees, shoulders, ankles	Wires, screws, plates, artificial joints, stents
Polymer	Face, trachea, kidney, liver, heart, teeth/dentistry, hips, knees	Tubes, dentures, adhesives, sealants, sutures, coatings
Ceramic	Teeth/dentistry, joints	Crowns, dentures, artificial joints, bone repair
Composite	Teeth/dentistry, limbs	Prosthetic limbs, dental cement, crowns

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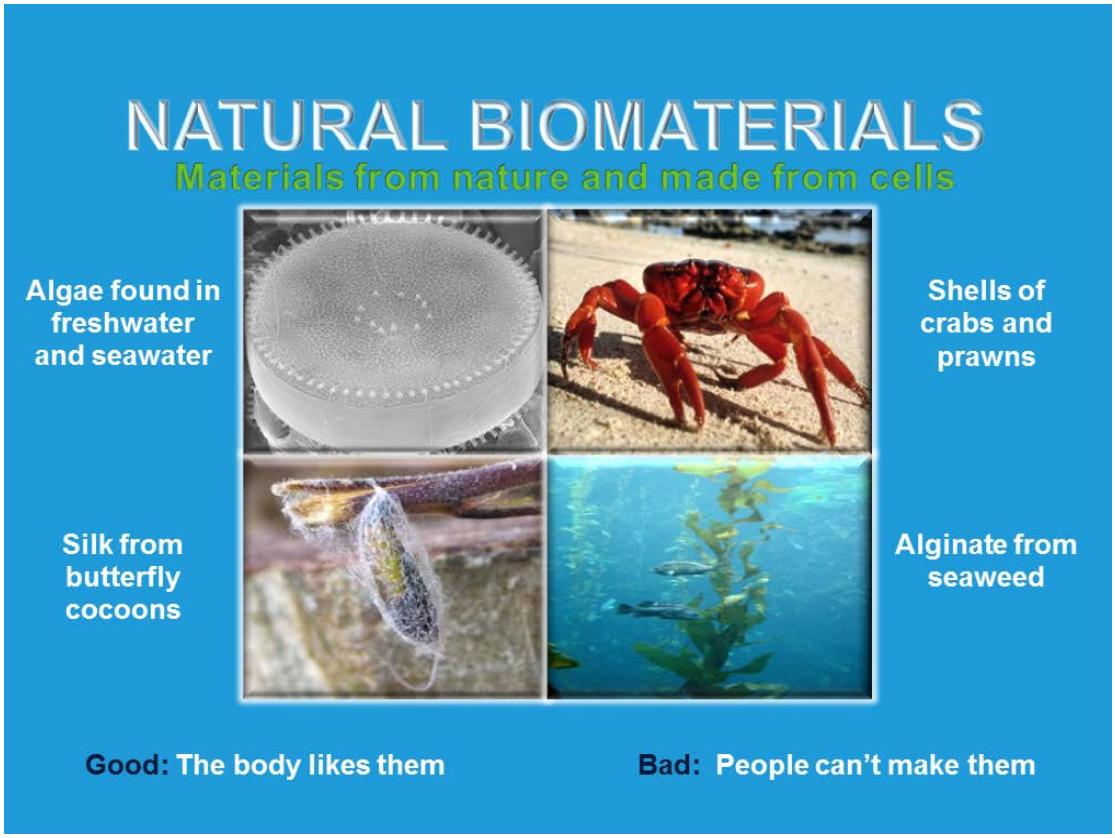

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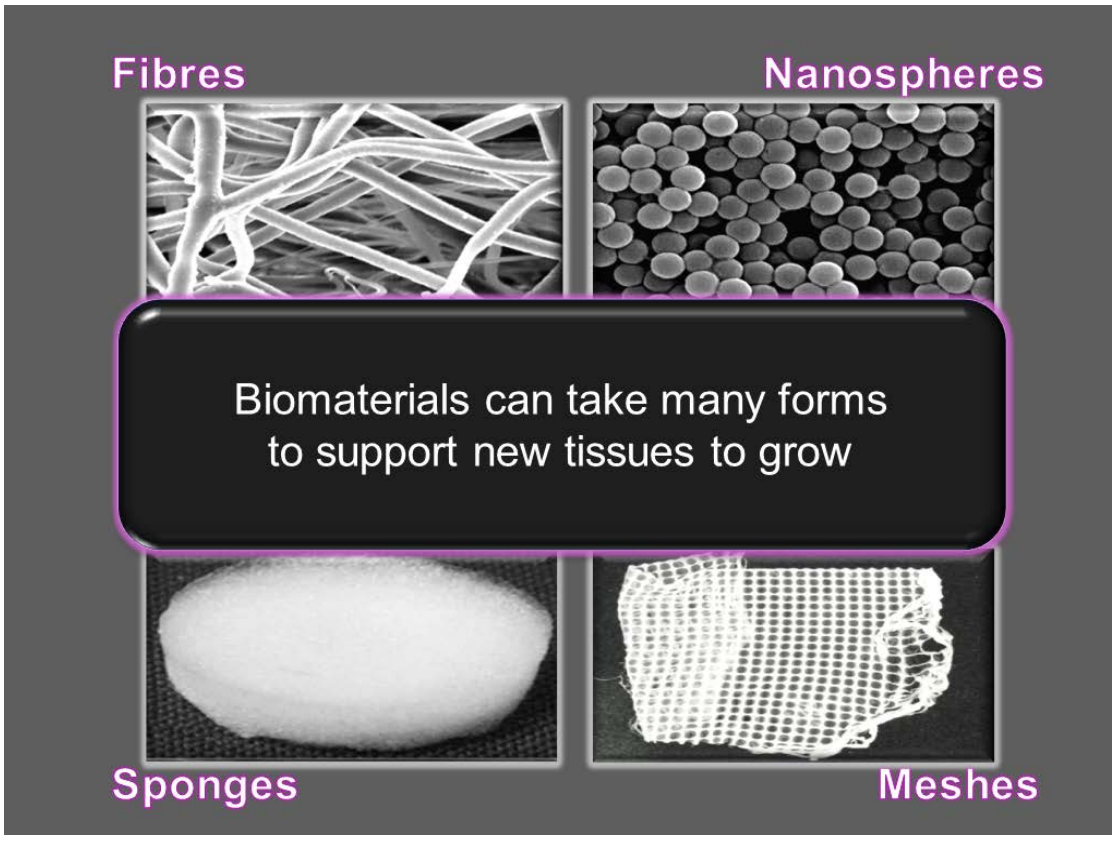

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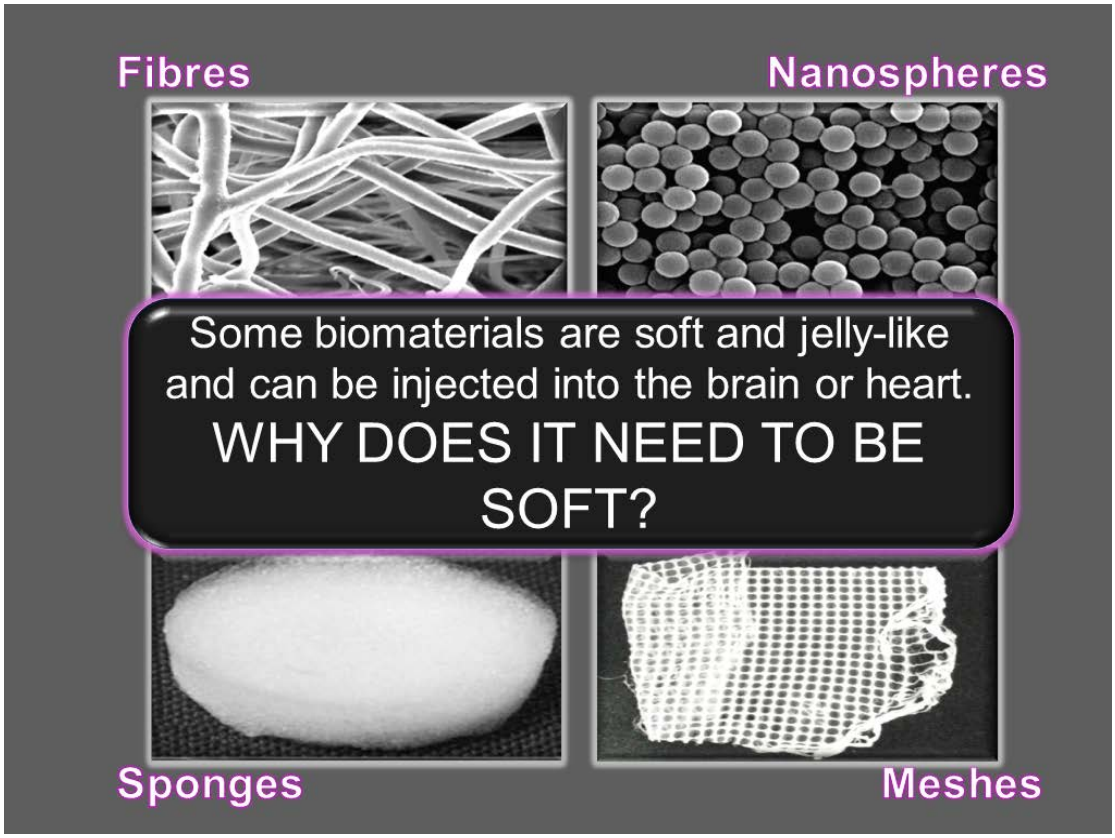

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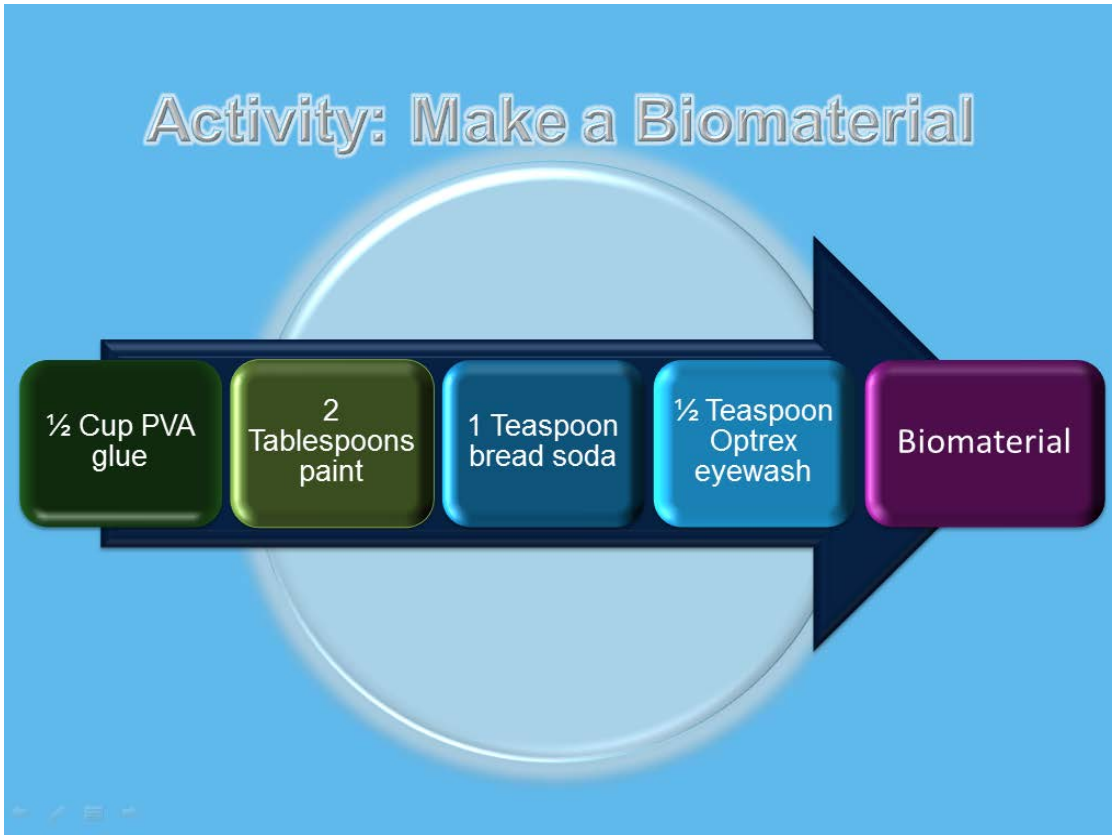

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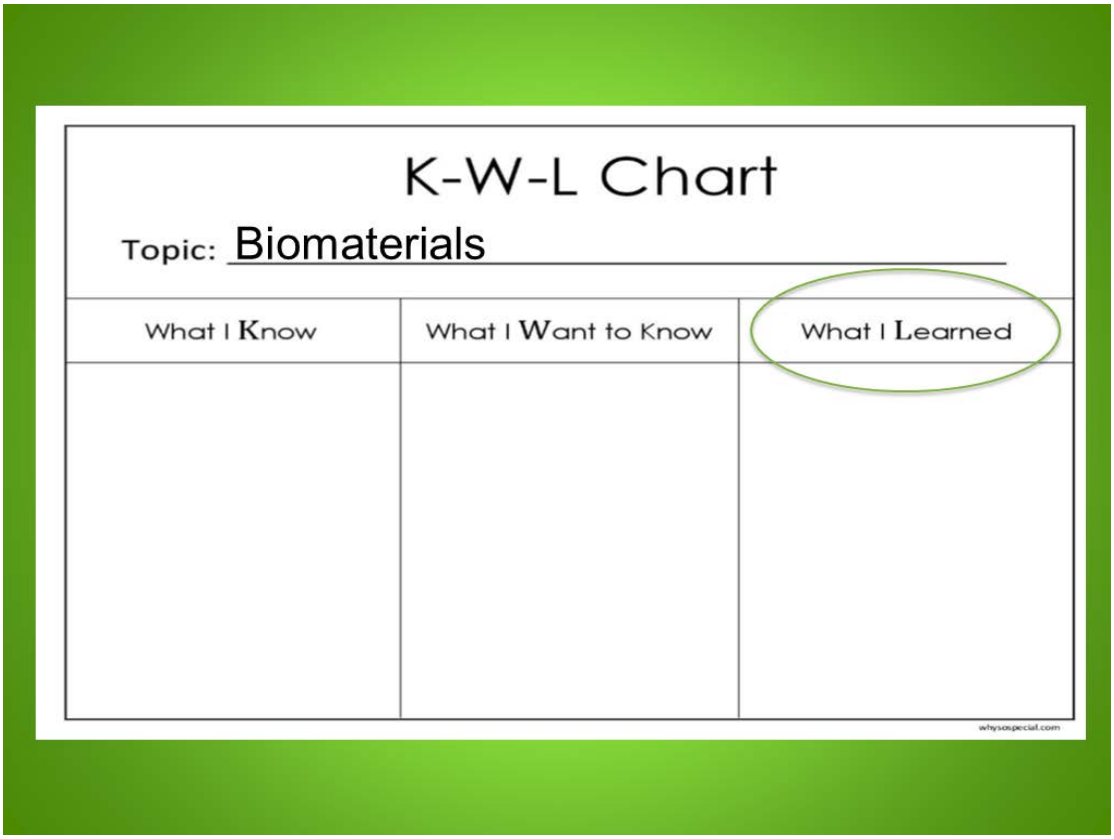
EVALUATION

1.) Draw a picture of the biomaterial that you created.

2.) Do you think that the biomaterial was created successfully? Why or why not?

3.) If you were making the biomaterial again, what would you do differently?

Slide 15



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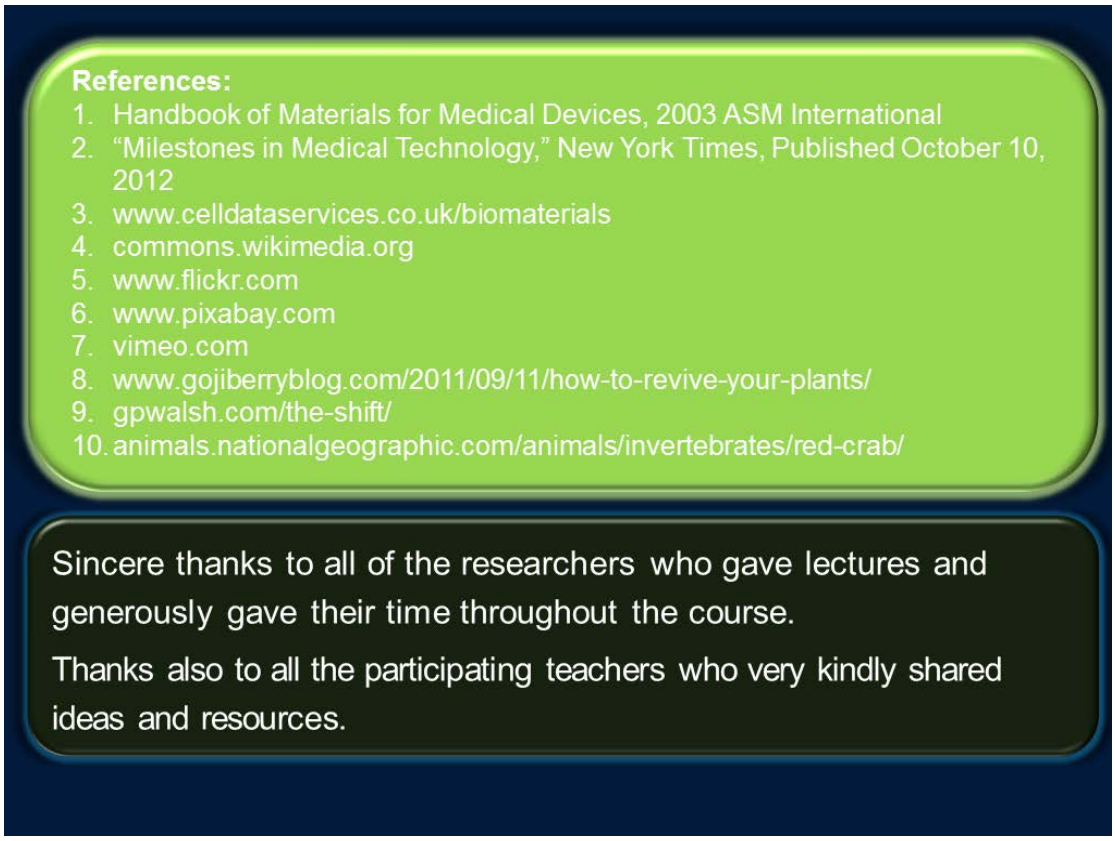

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K-W-L Chart

Topic: Biomaterials

What I **K**now	What I **W**ant to Know	What I **L**earned

BIOMATERIALS EVALUATION WORKSHEET

Draw a picture of the biomaterial that you created.

Do you think that the biomaterial was created successfully? Why or why not?

_____

_____

_____

_____

If you were making the biomaterial again, what would you do differently?

_____

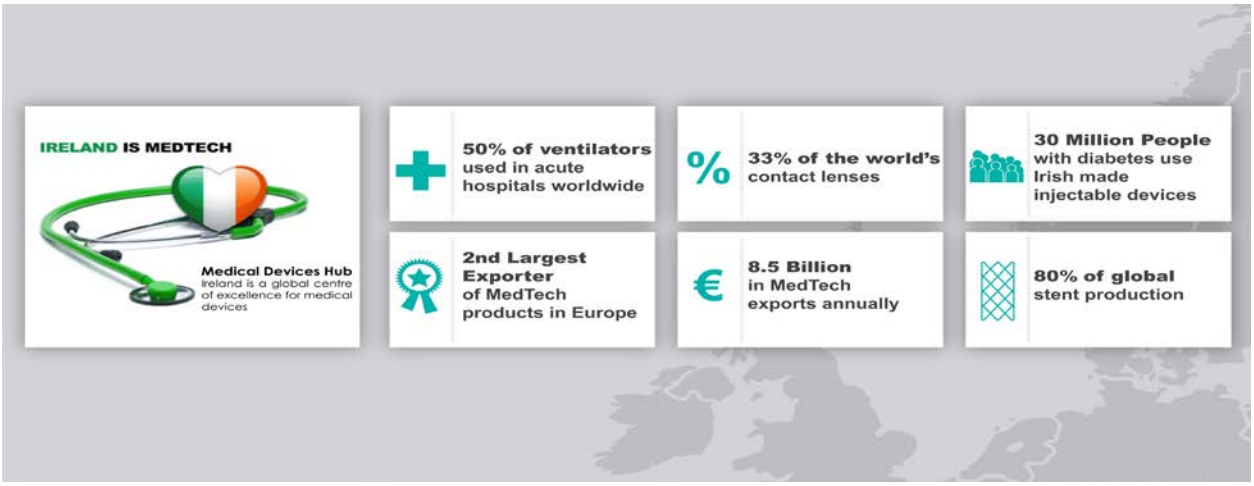
_____

_____

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.

Companies plan to promote growth in the biomaterials and medical devices sector. Therefore, many opportunities for jobs will exist within this industry in Ireland. This area of work is multidisciplinary and requires people with a range of training including scientists, engineers, IT specialists, and medical graduates. Many types of jobs exist within this industry from inventing new devices, testing devices, maintaining equipment, and working with clinicians and patients. Major employers in Ireland include Johnson and Johnson, Boston Scientific, Medtronic, and Abbot Laboratories.



Source: IDA Ireland, 2017

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