





## “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

# Musculoskeletal System 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.

**Strand:**

Living Things

**Strand unit:**

Human Life

**Content Objectives:**

- Develop a simple understanding of the structure of some of the body's major internal and external organs.
- Explore and investigate how people move, i.e. body supported by a skeleton actions of muscles, bones and joints.
- Recognise that physical growth has taken place since birth.

## Learning Outcomes

**Children should be enabled to:**

1. Identify the main parts of the human skeleton and state the main functions of bones.
2. Describe the general structure and action of muscles (working in opposition).
3. State the function of tendons and the relationship between these and bones.
4. Outline some of the problems arising in the musculoskeletal system and describe possible methods of treatment.
5. Construct a paper model of the human hand.
6. Problem-solve ways of how to fix a tendon that has been cut in the hand.
7. Demonstrate the relationships between bones, tendons and muscles by use of model hand.

8. Appreciate that the suitability of biomaterials are based on the properties of the biomaterials and their ability to match the original tissue.

## Keywords & Definitions

	Keyword	Definition
1.	<b>Bones</b>	Make up the skeleton and provide support and protection to the body.
2.	<b>Muscles</b>	Tissues that contract to make the body move.
3.	<b>Tendons</b>	Connect muscle to bone.
4.	<b>Contraction</b>	Shortening of a muscle.
5.	<b>Lengthening</b>	Relaxing of a muscle.
6.	<b>Medical Device</b>	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.
7.	<b>Biomaterials</b>	Material that can be engineered to help the body to heal itself.
8.	<b>Biomedical Engineering</b>	The combination of engineering and medicine to help improve people's health.

## Learning Activities

### Children will:

- Complete The K and W parts of the KWL chart.
- Engage in talk and discussion on the musculoskeletal system.
- Participate in a group activity to construct a model hand and repair it using a selection of materials.
- Present their work to the class.
- Engage in talk and discussion on biomaterials and medical devices.
- Evaluate their work using a worksheet.
- Fill in the L Part of the KWL Chart.

## Extra Info / Files

	Web Address	Brief Description
1.	<a href="http://www.youtube.com/watch?v=94Q-fvCAJzQ">www.youtube.com/watch?v=94Q-fvCAJzQ</a>	"Muscle Basics: What Athletes Need to Know About the Muscular System"
2.	<a href="http://www.youtube.com/watch?v=0vILiPT_Otw">www.youtube.com/watch?v=0vILiPT_Otw</a>	"Bone Basics: How They Heal and How to Keep them Healthy"
3.	<a href="http://www.youtube.com/watch?v=hdes6W7600w">www.youtube.com/watch?v=hdes6W7600w</a>	"The Basic Science of Tendons and Tendinitis"
4.	<a href="http://theinteractivehand.worldsecuresystems.com/">theinteractivehand.worldsecuresystems.com/</a>	Website exploring the hand including tendons and bones.

## Resources Provided

- Teacher Lesson Plan
- PowerPoint to guide lesson
- Hand template
- Interactive KWL worksheet
- Evaluation worksheet
- Optional: "Mending Legends"-A 26 minute documentary produced by CÚRAM exploring the physical and psychological impact of tendon injuries amongst sports players, and highlighting the progressive attitudes towards scientific research in Ireland. A trailer to the film can be viewed using the following link: <https://vimeo.com/189779551>.

The film is available on request by contacting Sarah at [sarah.gundy@nuigalway.ie](mailto:sarah.gundy@nuigalway.ie).

## Materials Needed

- Hand template printed out on thicker paper (can use regular paper)
- Scissors
- String
- Straws (large)
- Tape
- Toothpicks
- Paperclips
- Thread, yarn or ribbon

- Ice lolly sticks
- Elastic bands
- Pipe cleaners

## Instructions

- Divide the class into groups of two, three or four depending on class size and amount of materials.
- Each student is given a hand template, scissors, string, a straw and tape.
- Each student or group of students is given a “Biomedical Engineering Kit” containing any assortment of the following: Toothpicks, paperclips, thread, yarn, ribbon, ice lolly sticks, elastic bands, pipe cleaners, and/or string.
- Each student cuts out the hand following the dashed lines on the hand template.
- The students cut up a straw into three pieces to fit onto the bones of the finger.
  - Make sure the students cut the straws small enough in order to leave enough space between them when they are taped to the paper finger!
- The students tape a piece of string to the red bone at the tip of the finger.
- The students put the string through the three pieces of cut up straw.
- The students tape the three pieces of cut up straw to the blue, green and yellow bones of the paper finger.

- Make sure the students leave a big space between the straws!
  - Make sure the students do not tape the string!
- The students bend the paper between the straws for the finger to move easier.
- Once the finger is finished, the students use scissors to cut the string between two straws.
  - The cut to the string acts like a damaged tendon.
- The students repair the "tendon" using the biomaterials available in the "Biomedical Engineering Kit".
- Option: Hand templates can be cut out, and string and straws can be cut up for students ahead of the lesson 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.
- If available, a three dimensional model of the skeleton is beneficial for the lesson.
- There is no right or wrong answer to how the students fix their tendon. The idea is to get them thinking about what materials would be appropriate to maintain movement in the finger.
- Some students just use another piece of string to fix the tendon which is perfectly acceptable and is analogous to a tendon replacement using the palmaris longus as discussed in the PowerPoint presentation!

## 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 – construction of medical devices
- 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

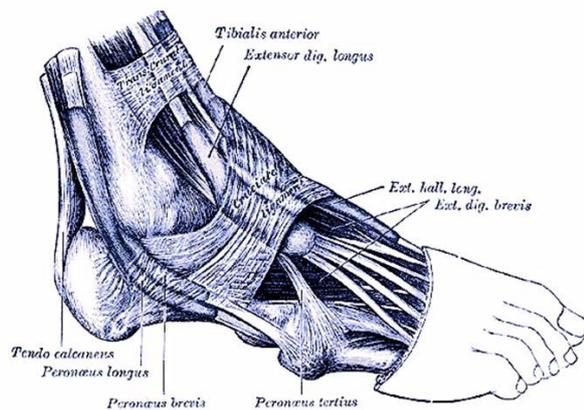
## Differentiation by:

- Teaching style
- Support
- Task

# PowerPoint Presentation – Musculoskeletal System

## Introducing the **MUSCULOSKELETAL** system

Slide 1



**cúrom**  
Centre for Research in Medical Devices

**Teachers in Residence Programme**  
Andrew Fogarty and Clive Monahan

Slide 2

## Class discussion around the Musculoskeletal System

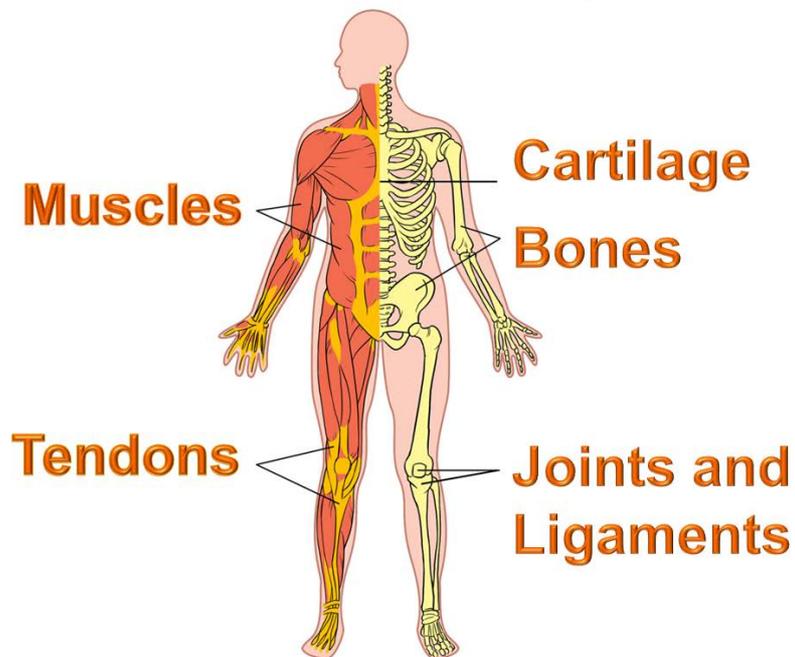
- Why do you require a skeleton?
- What is it made from?
- Is it living tissue?
- Can you name bones?
- How does the skeleton allow for movement?
- Explain the functions of muscles?
- What are tendons?
- What can go wrong with the musculoskeletal system?

K-W-L Chart

What I Know	What I Want to Know	What I Learned

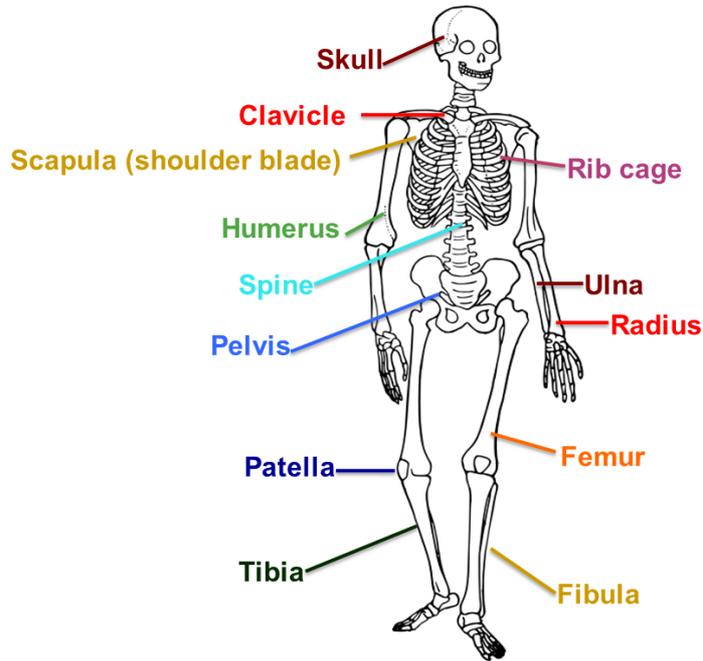
Slide 3

## Musculoskeletal System



Slide 4

# Bones-Human Skeleton



Slide 5

## How many bones do you have?

You have:

300 bones at birth

206 bones by adulthood

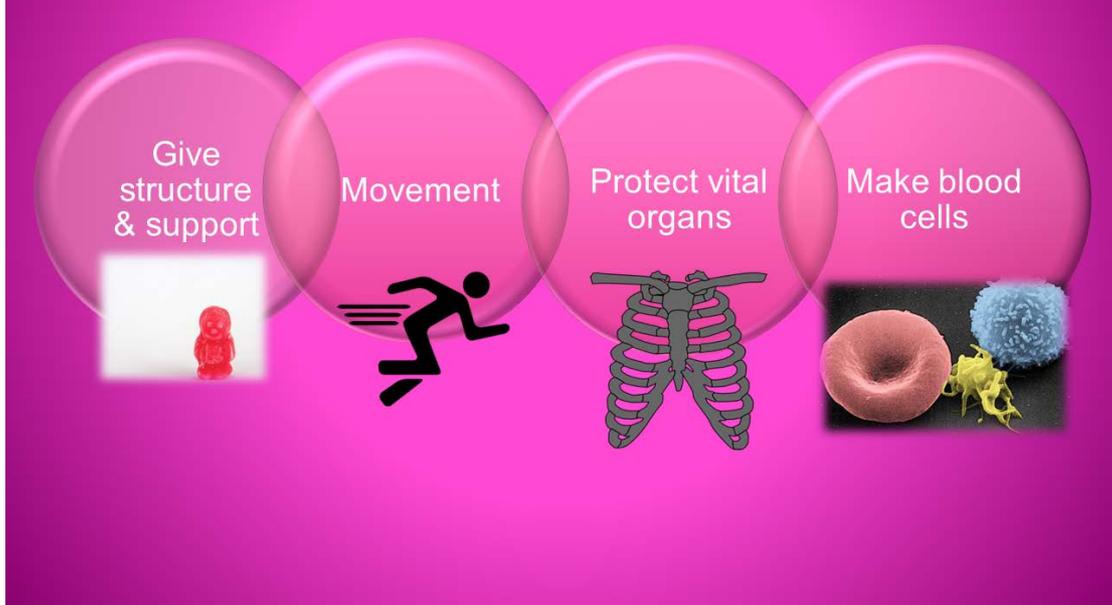


Where do they go?

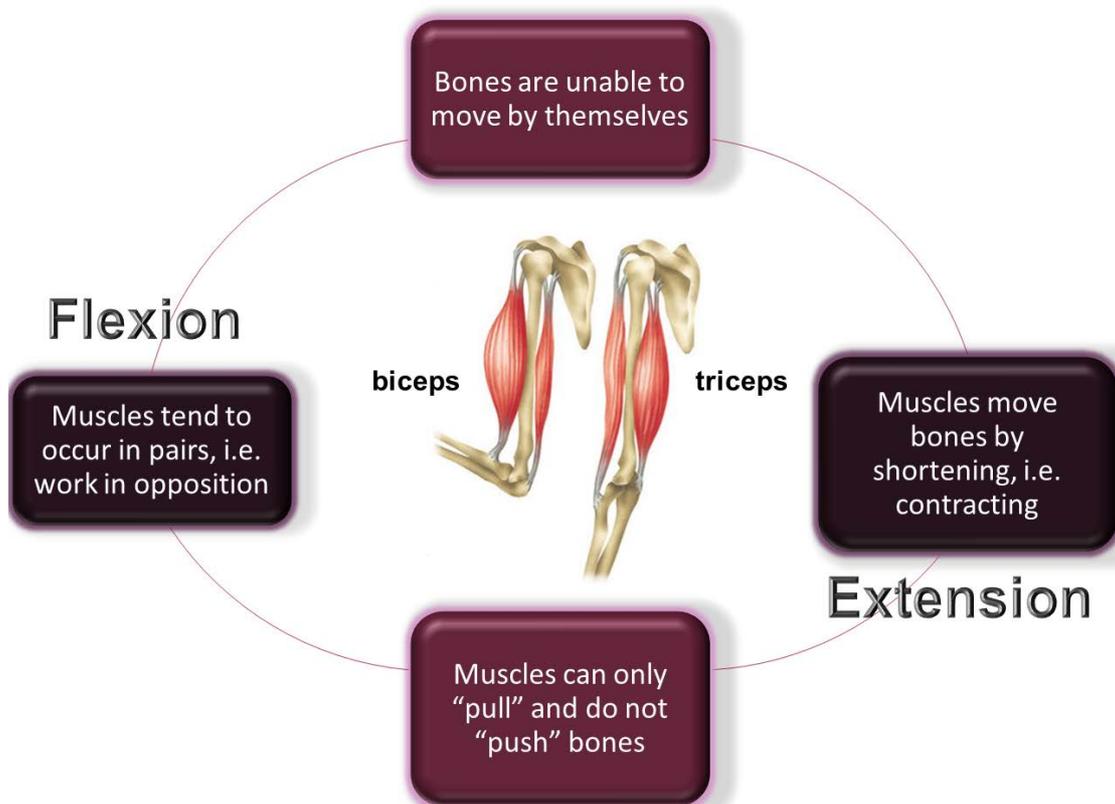


Slide 6

# Bones-Functions



Slide 7



Slide 8

As you bend your elbow  
and raise your hand  
slowly which muscle is  
contracting?



**Biceps or triceps?**

Slide 9

## **Tendons-Connect Bones to Muscles**



Slide 10

## Do you have this tendon in your wrist?

Most people have it

14% of people do not have it

Was used by humans years ago to flex the wrist

Not needed anymore and can be removed

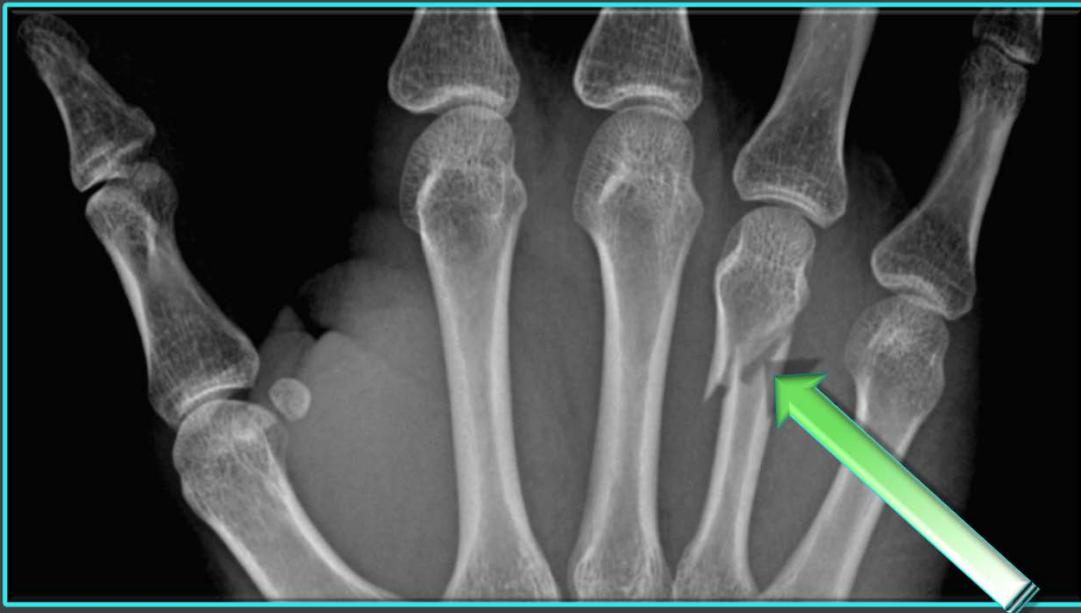
Can be used to replace damaged tendons



Palmaris Longus

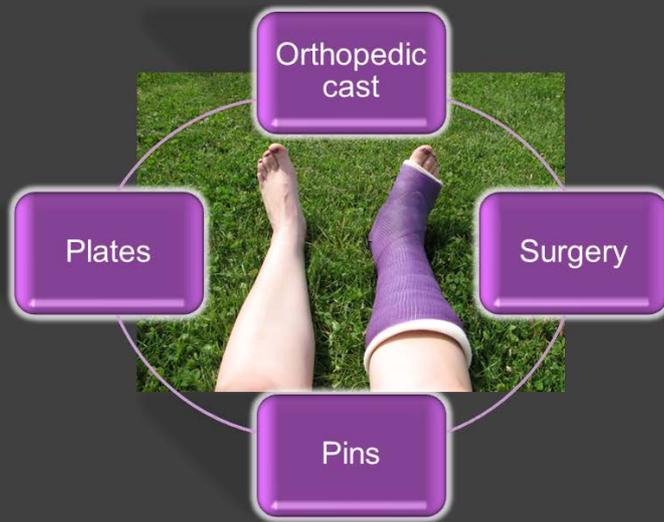
Slide 11

## Broken Bones

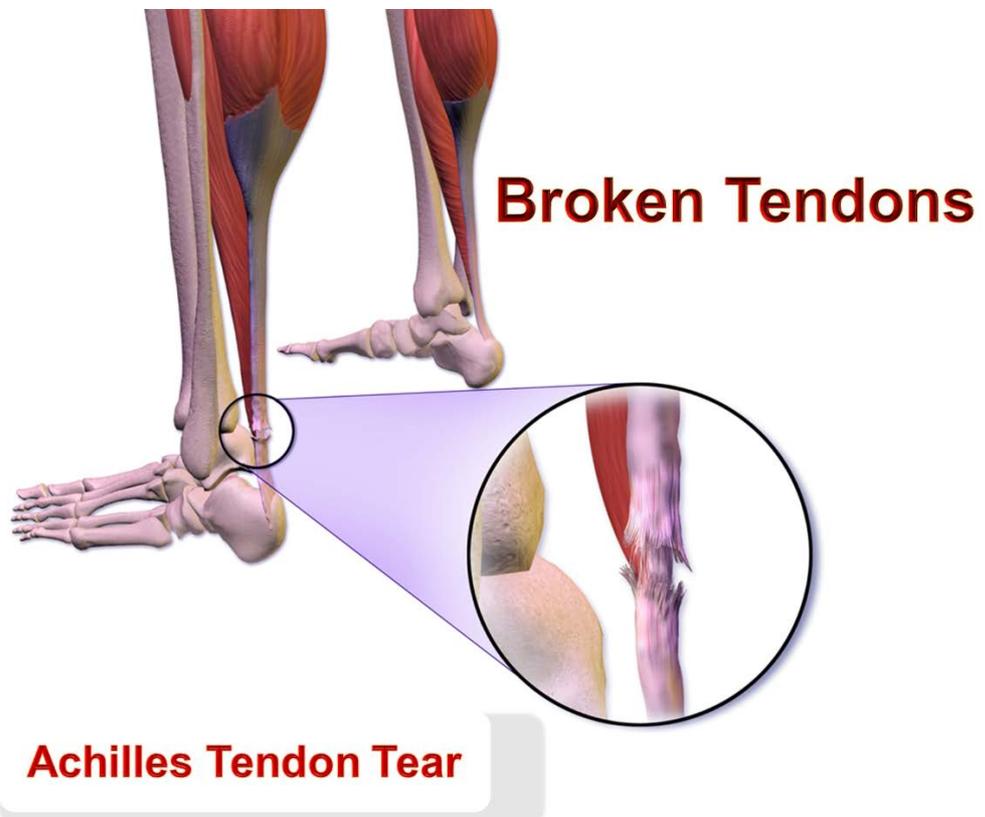


Slide 12

# Broken Bones-Treatment



Slide 13



Slide 14

# Biomedical Engineering



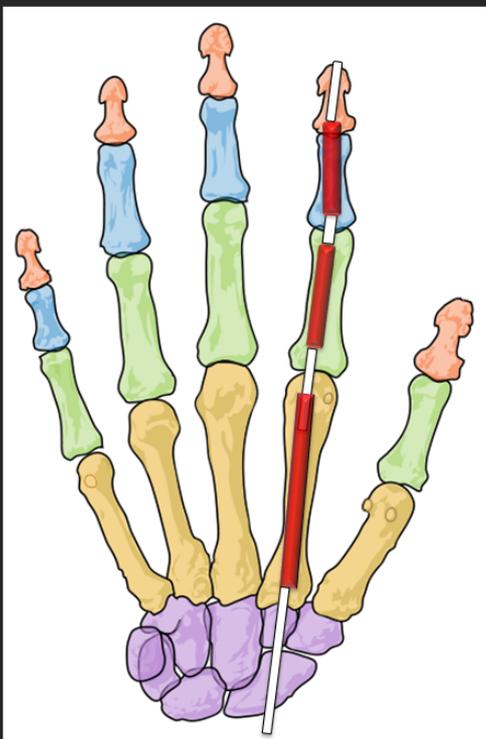
Engineering and medicine coming together to help improve people's health



Biomedical Engineers design and create medical devices.

Today **you** will be a Biomedical Engineer to repair damaged tendons.

Slide 15



## Step 1- Make a finger

Straws (Bones)



String (Tendons)

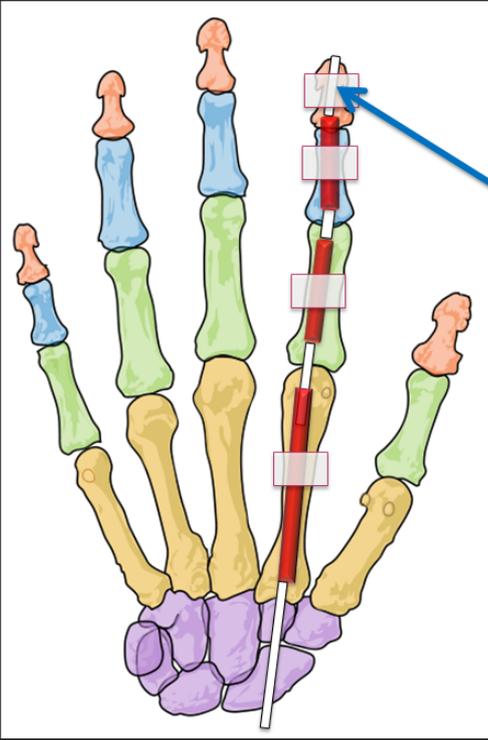


The finger gets 3 straws that act as bones

The finger gets 1 string that acts as the tendons

Make sure you leave a big space between the straws!

Slide 16



**Step 1-  
Make a finger**

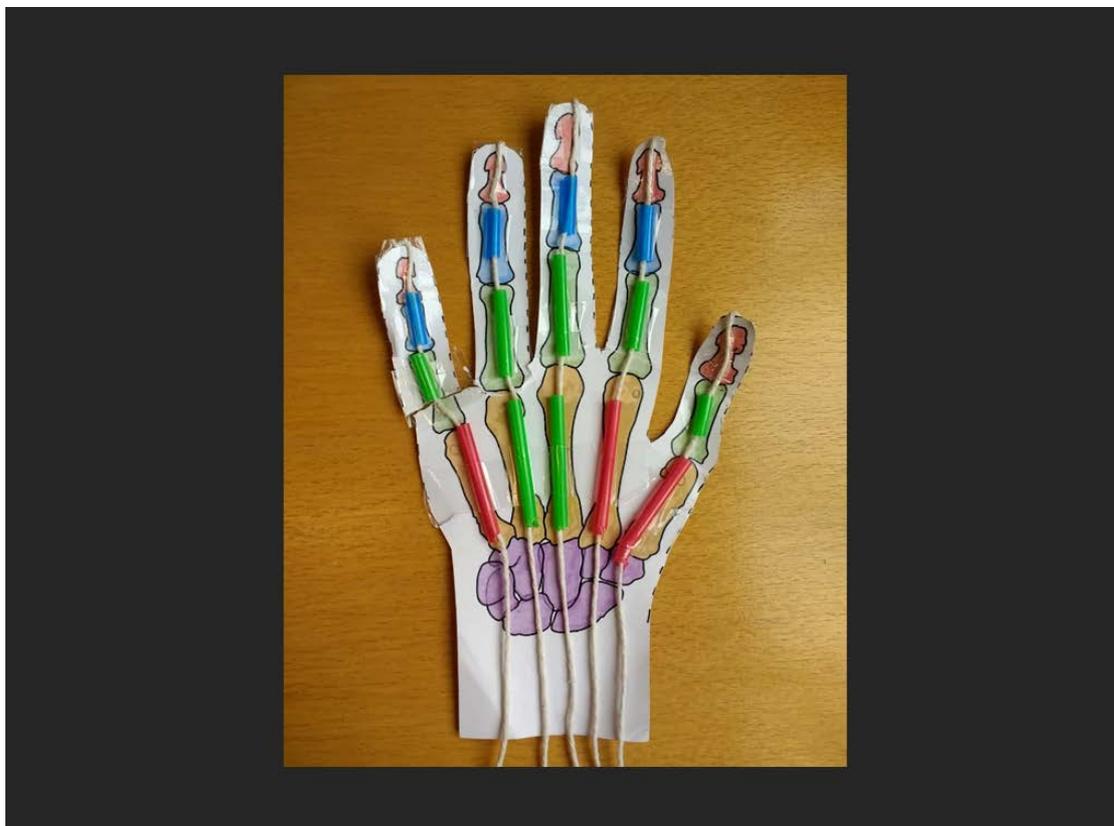
Tape the string to the tip of the finger here

Tape the 3 straws to the paper

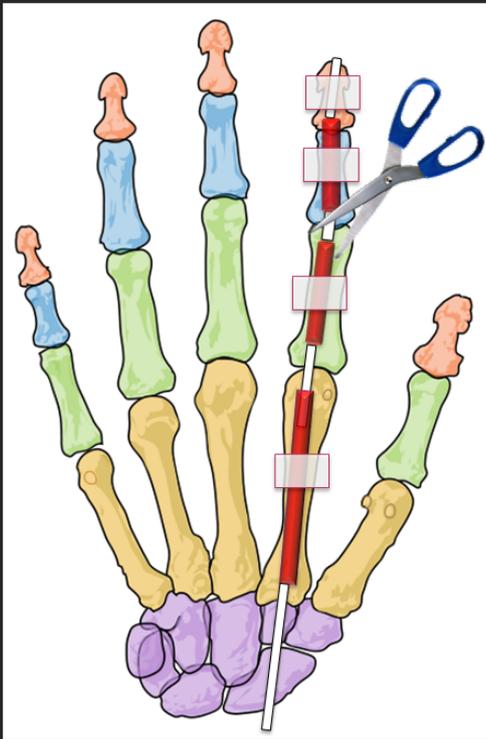
Do not tape the string!

Bend the paper between the straws for the finger to move easier

Slide 17



Slide 18



## Step 2- Damage and repair tendon

Use your scissors to cut the string between two straws

Repair your "tendon" using the biomaterials available in your Biomedical Engineering Kit

Slide 19



Paper hand cut-out

Straws

String

Paperclips

Rubber bands

Toothpicks

Thread

Scissors

Tape

Slide 20

# EVALUATION

- 1.) Draw a picture of the medical device that you created to fix your tendon using your “Biomedical Engineering Kit”.
- 2.) Do you think your medical device is successful? Why or why not?
- 3.) If you were building the medical device again, what would you do differently?

Slide 21

K-W-L Chart		
Topic: <u>Musculoskeletal System</u>		
What I Know	What I Want to Know	What I Learned

www.k12worksheets.com

Slide 22



Centre for Research in Medical Devices

Slide 23

#### References:

1. Human\_skeleton\_diagram.png via Wikimedia Commons
2. Achilles\_Tendon\_Tear.png via Wikimedia Commons
3. PL Tendon.png via Wikimedia Commons
4. Flexors and Extensors via [www.flickr.com](http://www.flickr.com)
5. Musculoskeletal System via [www.flickr.com](http://www.flickr.com)
6. Gray's Anatomy

#### 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.

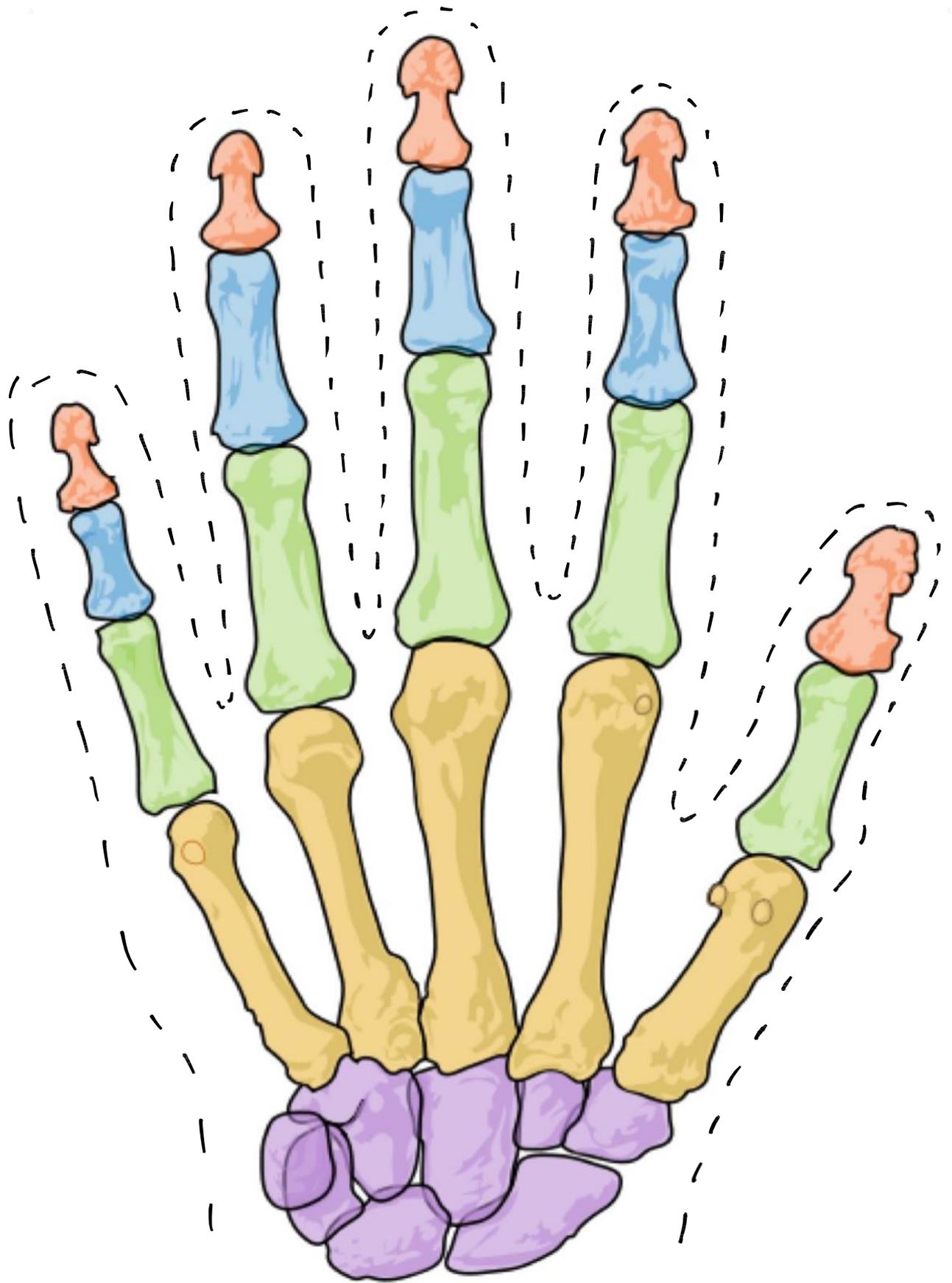
Slide 24

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 25



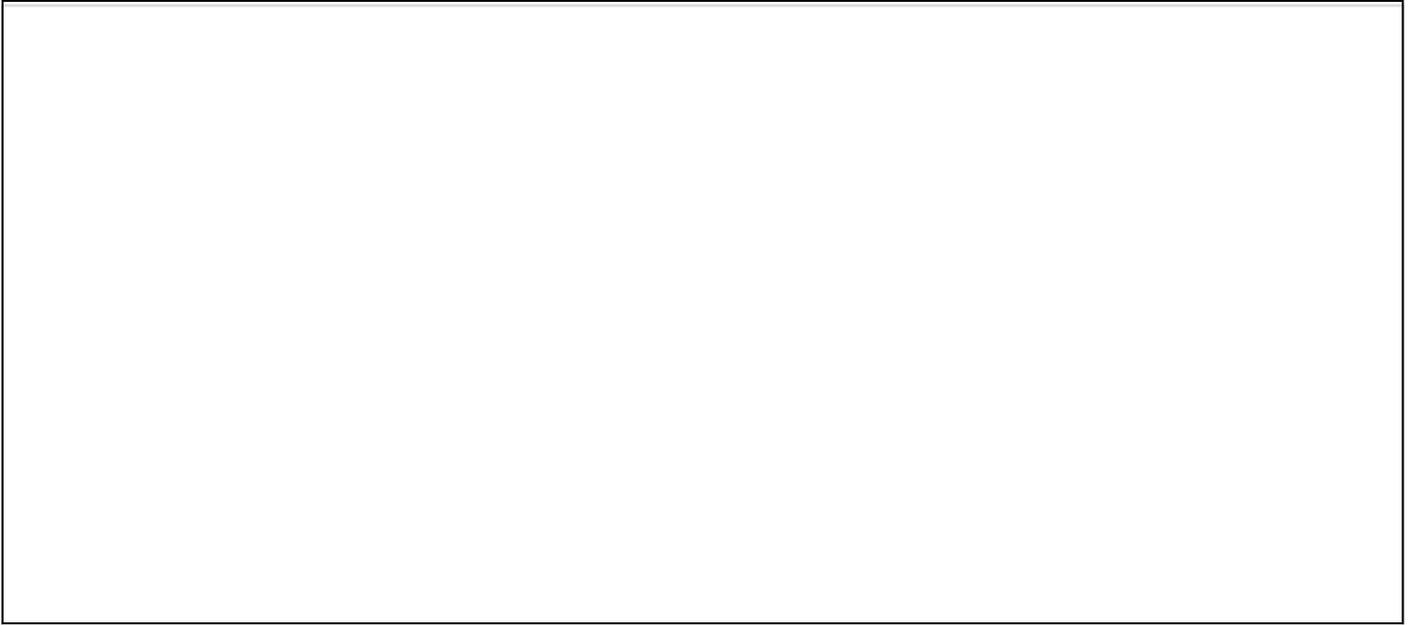
# K-W-L Chart

Topic: Musculoskeletal System

What I Know	What I Want to Know	What I Learned

## THE MUSCULOSKELETAL SYSTEM

Draw a picture of the medical device that you created to fix your tendon using your "Biomedical Engineering Kit".



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

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

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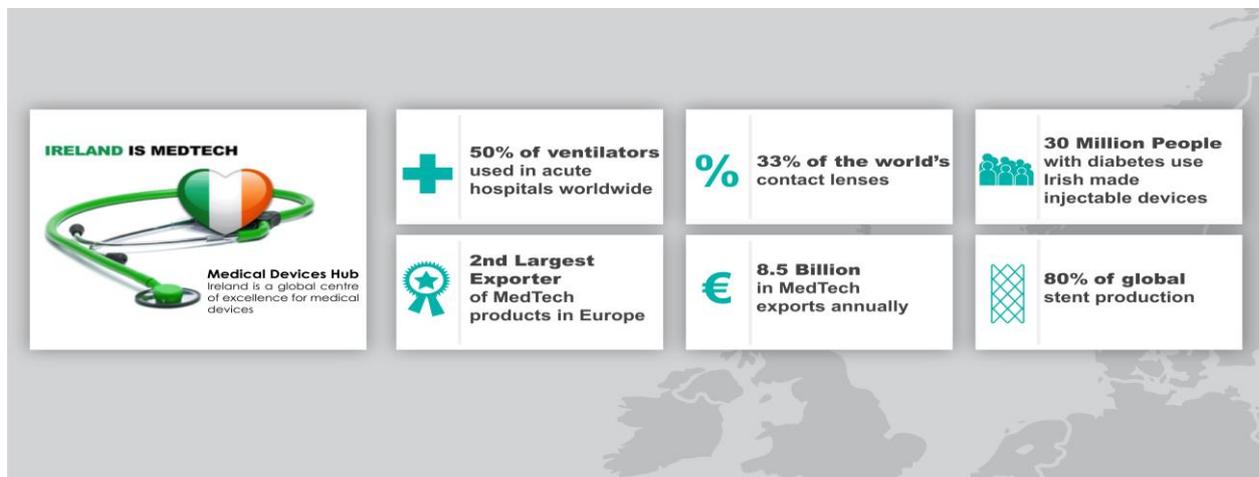
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## FACTS ABOUT MEDTECH IN IRELAND

- 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.

A wide range of products relevant to treating damaged musculoskeletal tissues are manufactured in Ireland. These include hip and knee implants, bone cement, and surgical blades used for cutting and shaping bones. In fact, 75% of global orthopaedic knee production comes from Ireland. Stryker is one of the world's leading MedTech companies producing medical devices to treat the musculoskeletal system. Stryker has four manufacturing sites and a Research and Development Innovation Centre based in Cork and Limerick. Zimmer Biomet, with facilities in Galway and Shannon, supplies hospitals and orthopaedic surgeons with implants for hips, knees, extremities, spine and trauma.



Source: IDA Ireland, 2017

## ACKNOWLEDGEMENTS

The participants of the 2017-2018 Teachers in Residence Programme: Vivienne Kelly, Louise Lynch, Mary McDonald, Anna McGuire, Sinéad O'Sullivan, Karen Conway, Claire Cunningham, Ali Donald, Anne Hession and Mairead McManus.

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.

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