Teachers in Residence

The Musculoskeletal System

Primary Level Lesson Plan

curam 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

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.	**Bones**	Make up the skeleton and provide support and protection to the body.
2.	**Muscles**	Tissues that contract to make the body move.
3.	**Tendons**	Connect muscle to bone.
4.	**Contraction**	Shortening of a muscle.
5.	**Lengthening**	Relaxing of a muscle.
6.	**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.
7.	**Biomaterials**	Material that can be engineered to help the body to heal itself.
8.	**Biomedical Engineering**	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.	www.youtube.com/watch?v=94Q-fvCAJzQ	"Muscle Basics: What Athletes Need to Know About the Muscular System"
2.	www.youtube.com/watch?v=0vlLiPT_Otw	"Bone Basics: How They Heal and How to Keep them Healthy"
3.	www.youtube.com/watch?v=hdes6W76OOw	"The Basic Science of Tendons and Tendinitis"
4.	theinteractivehand.worldsecuresystems.com/	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.

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

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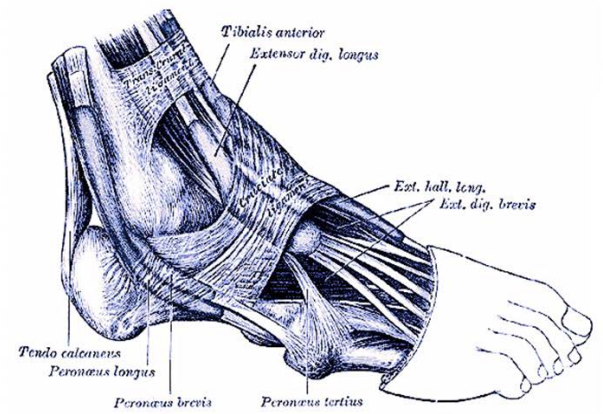

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Centre for Research in Medical Devices

Teachers in Residence Programme
Andrew Fogarty and Clive Monahan

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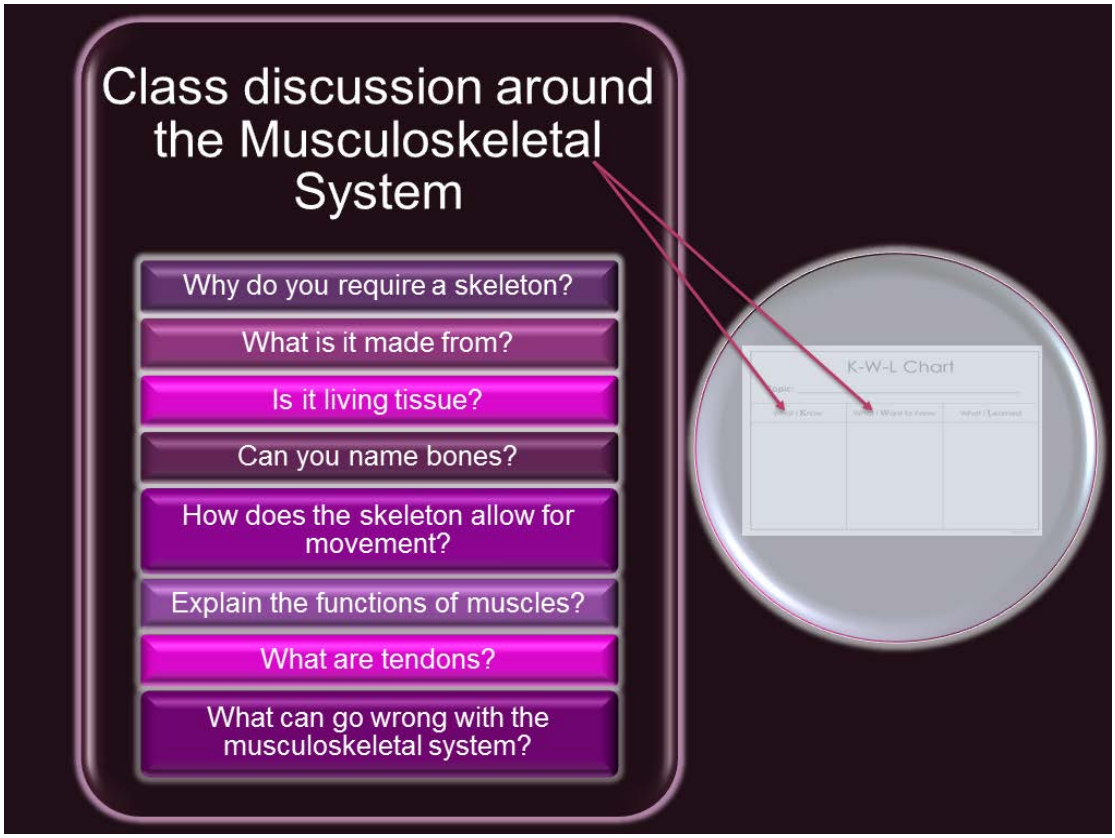

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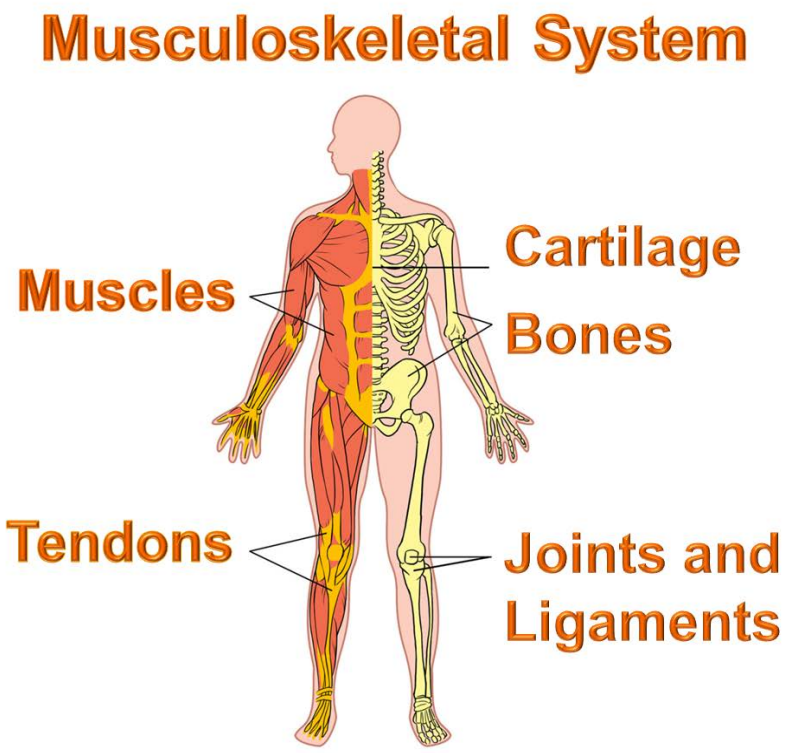

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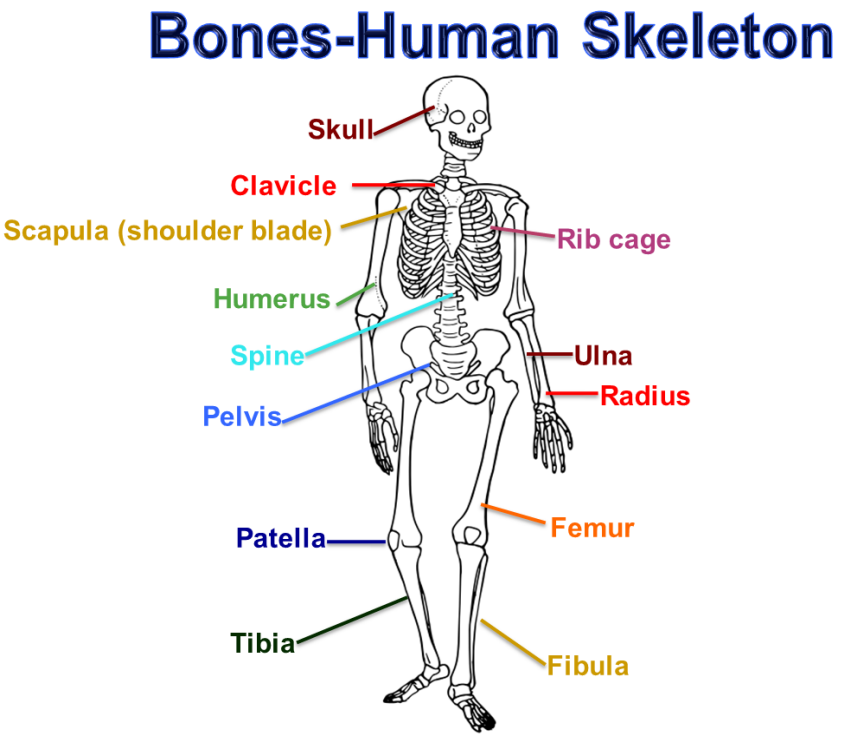

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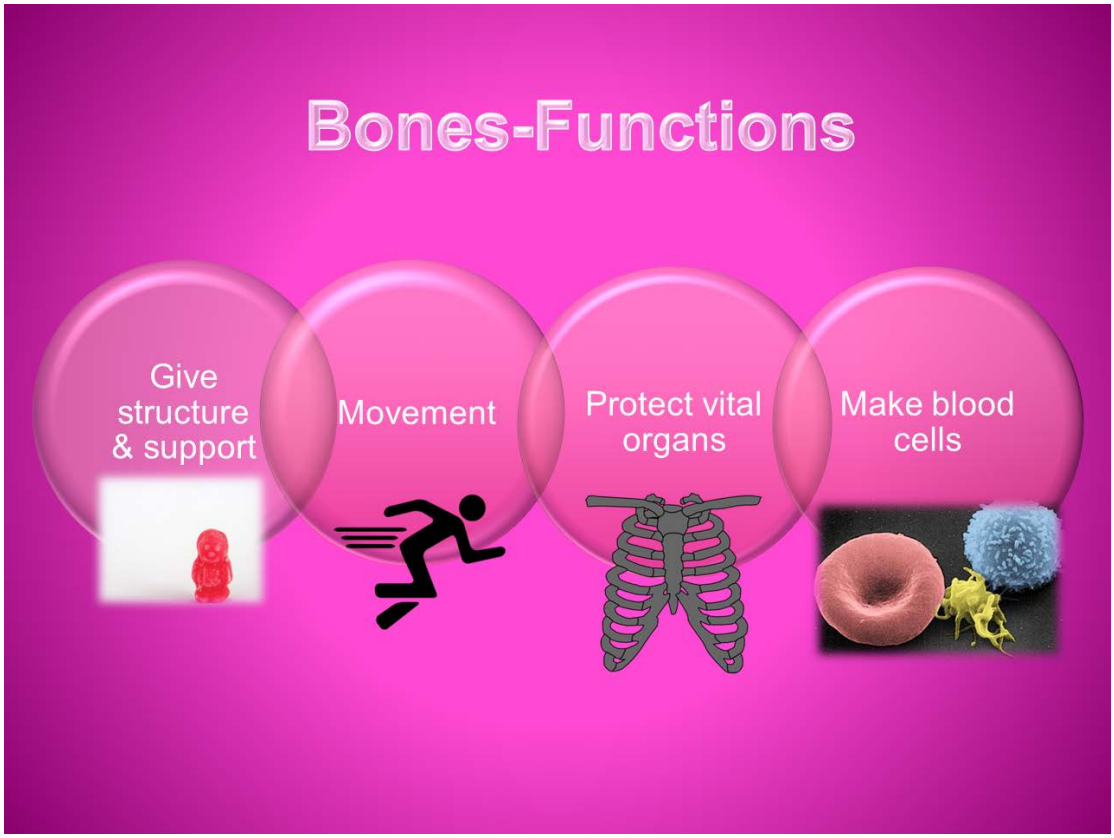

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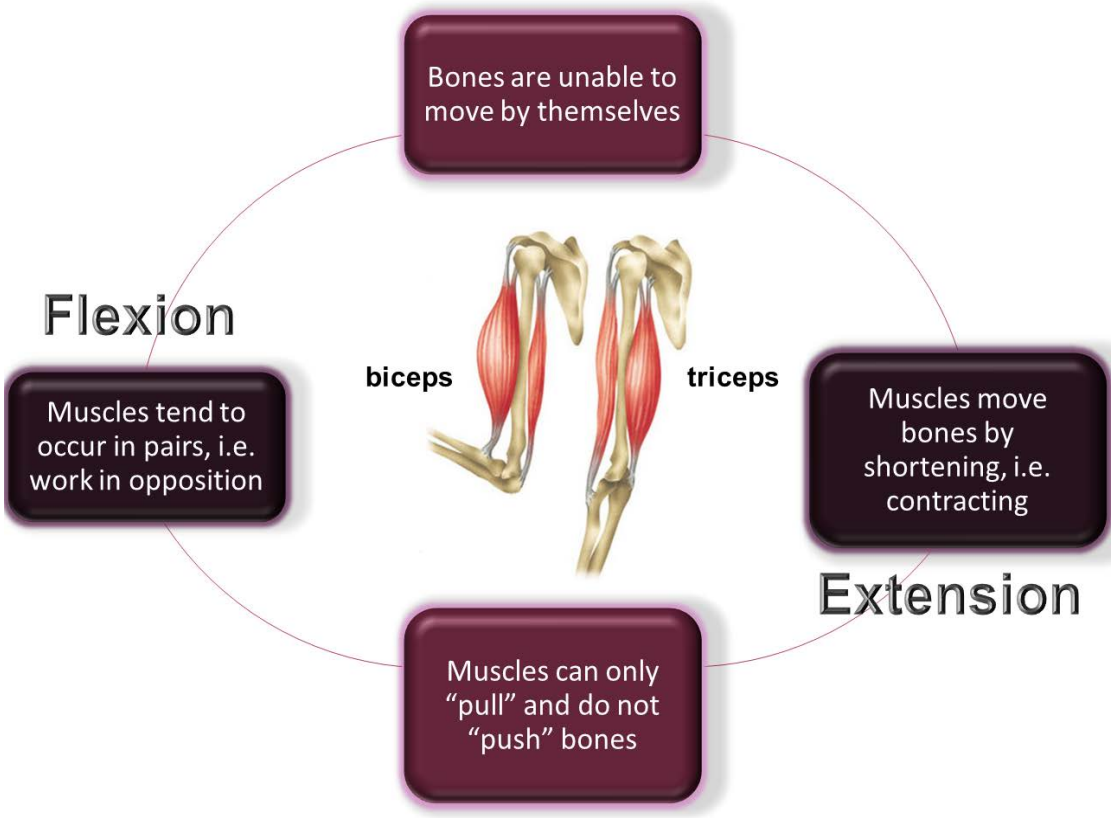

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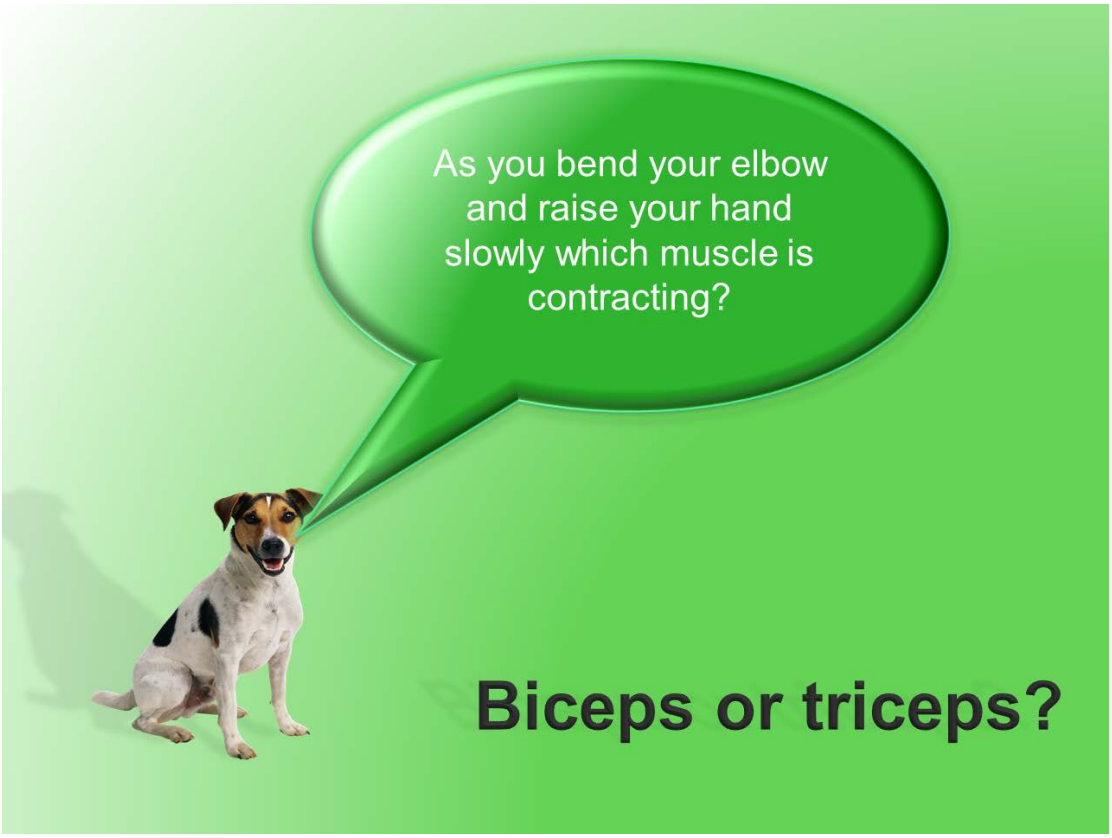

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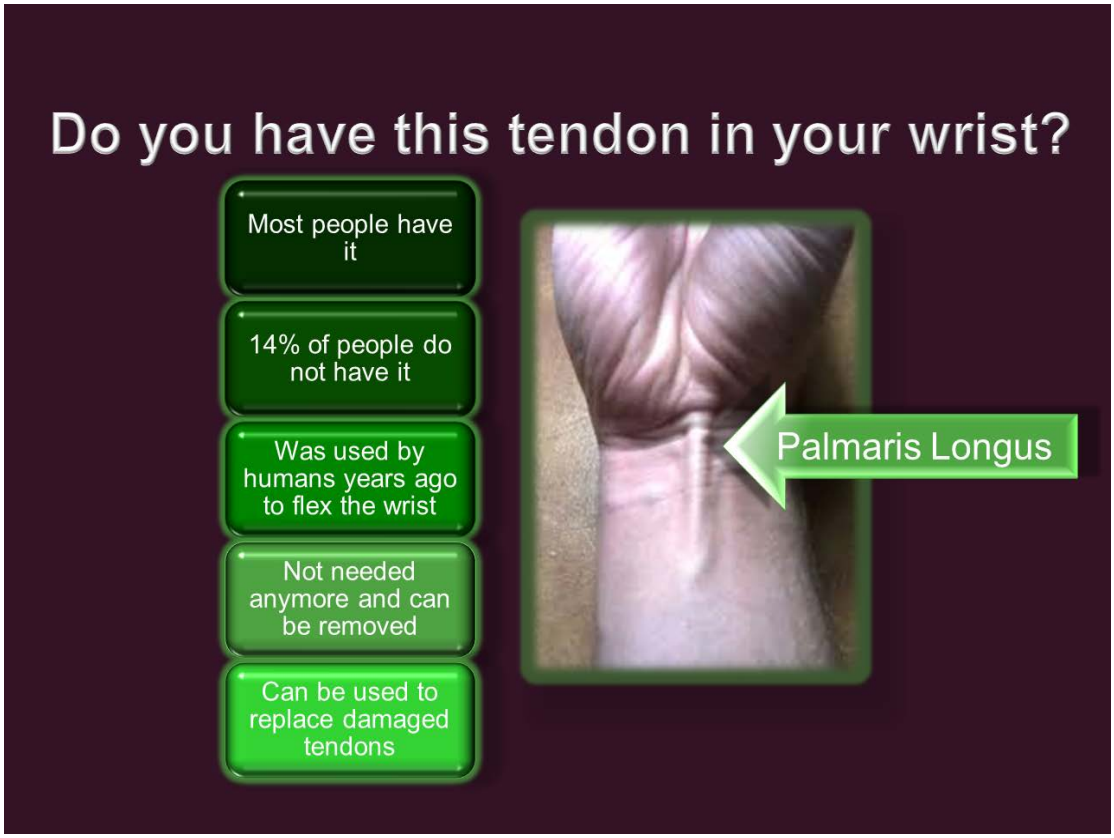

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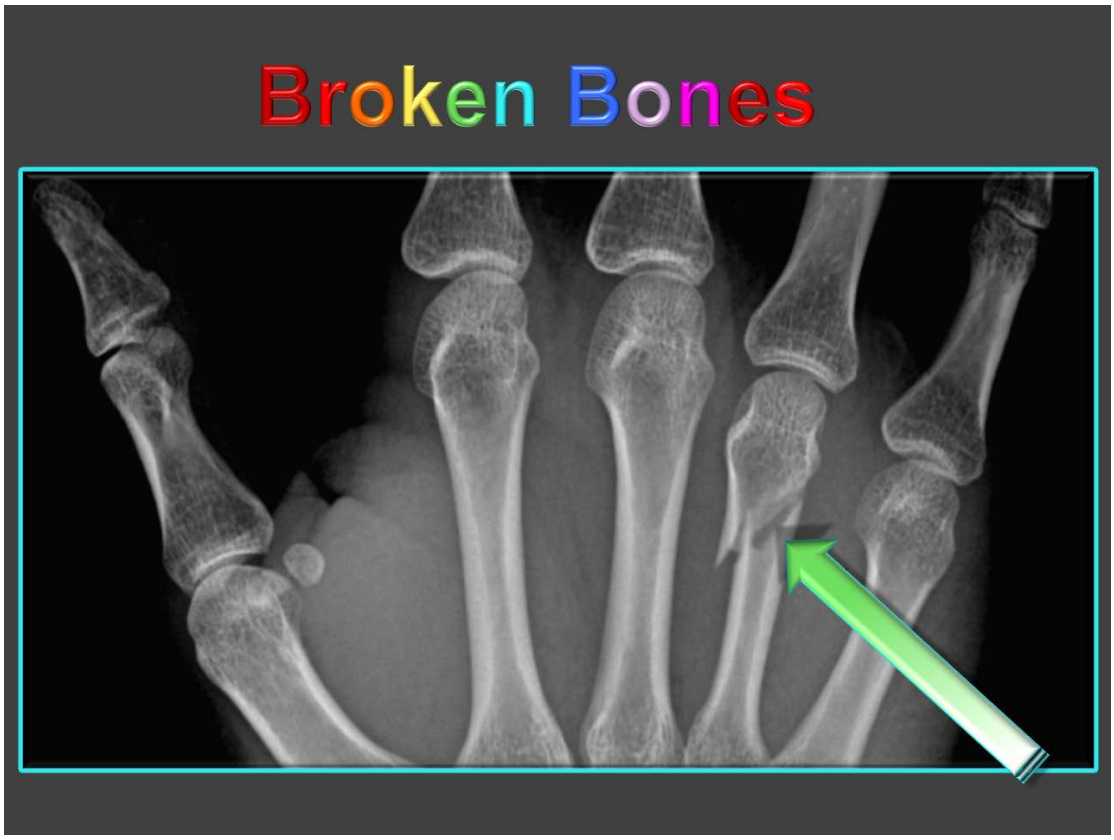

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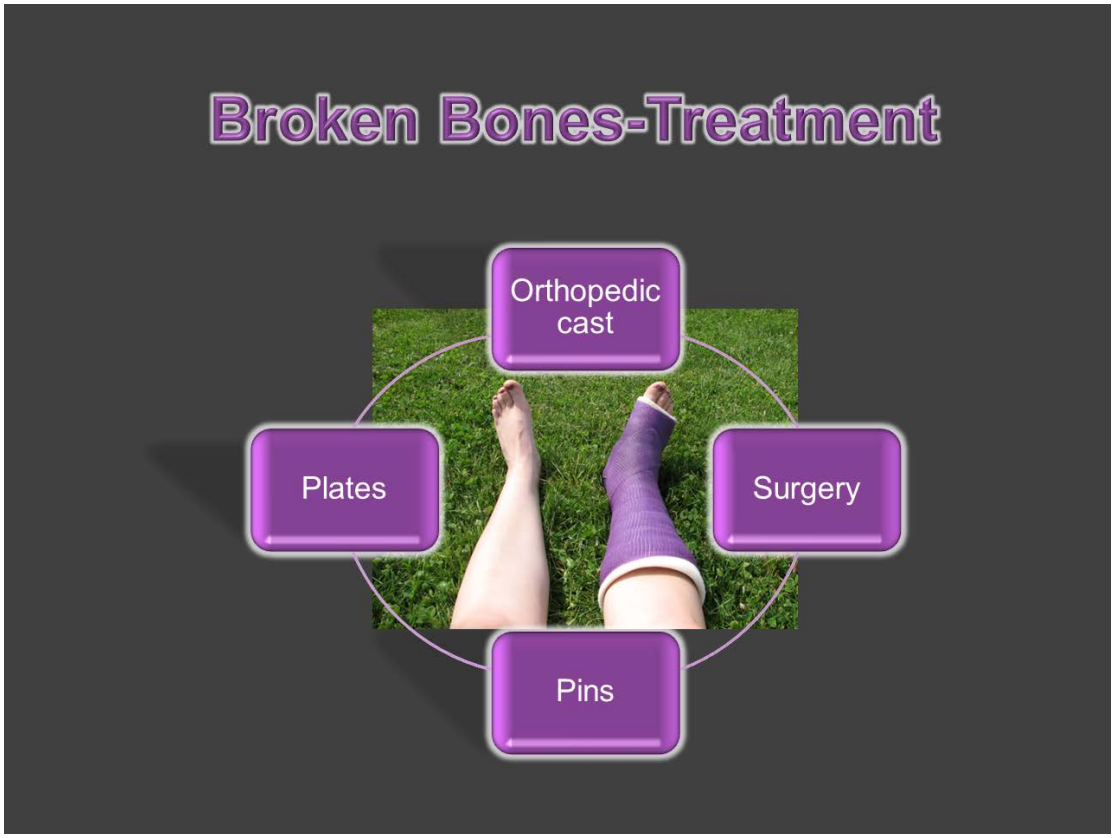

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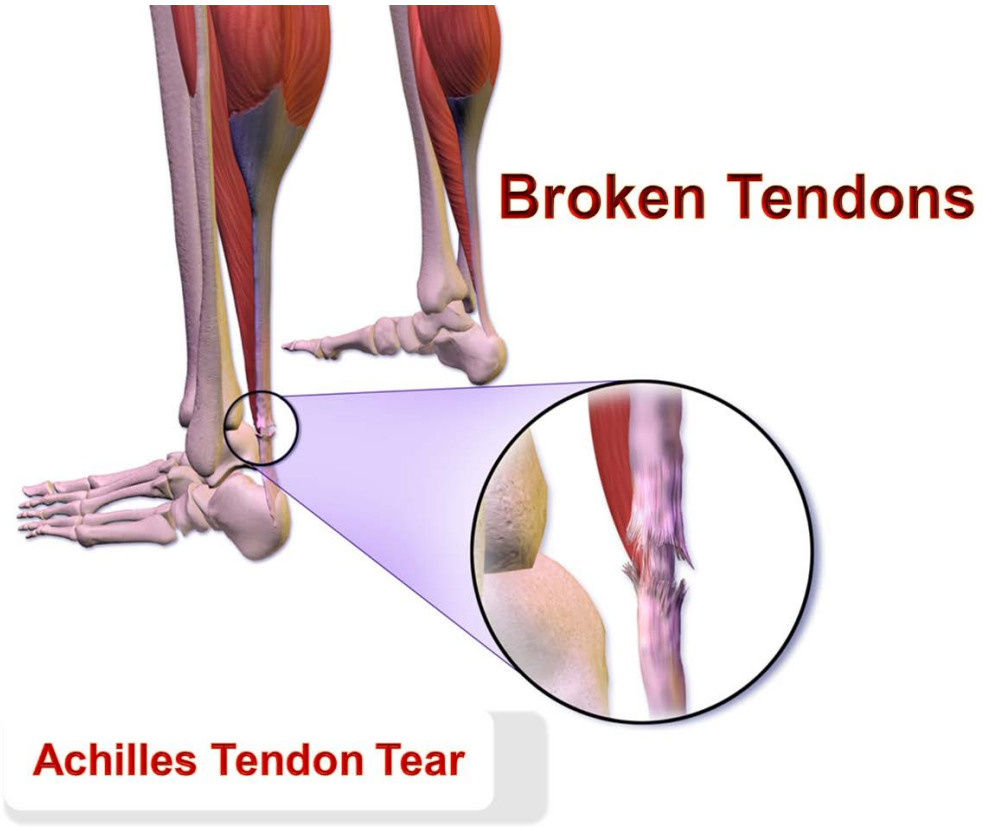

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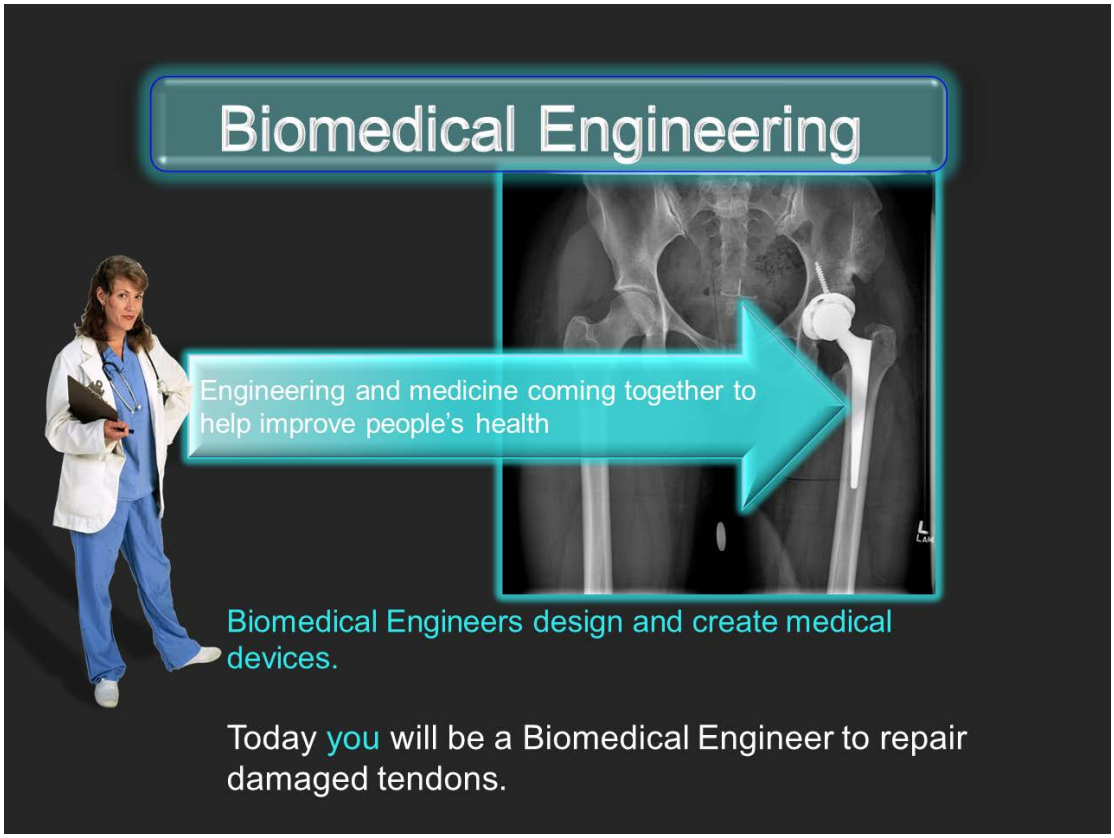

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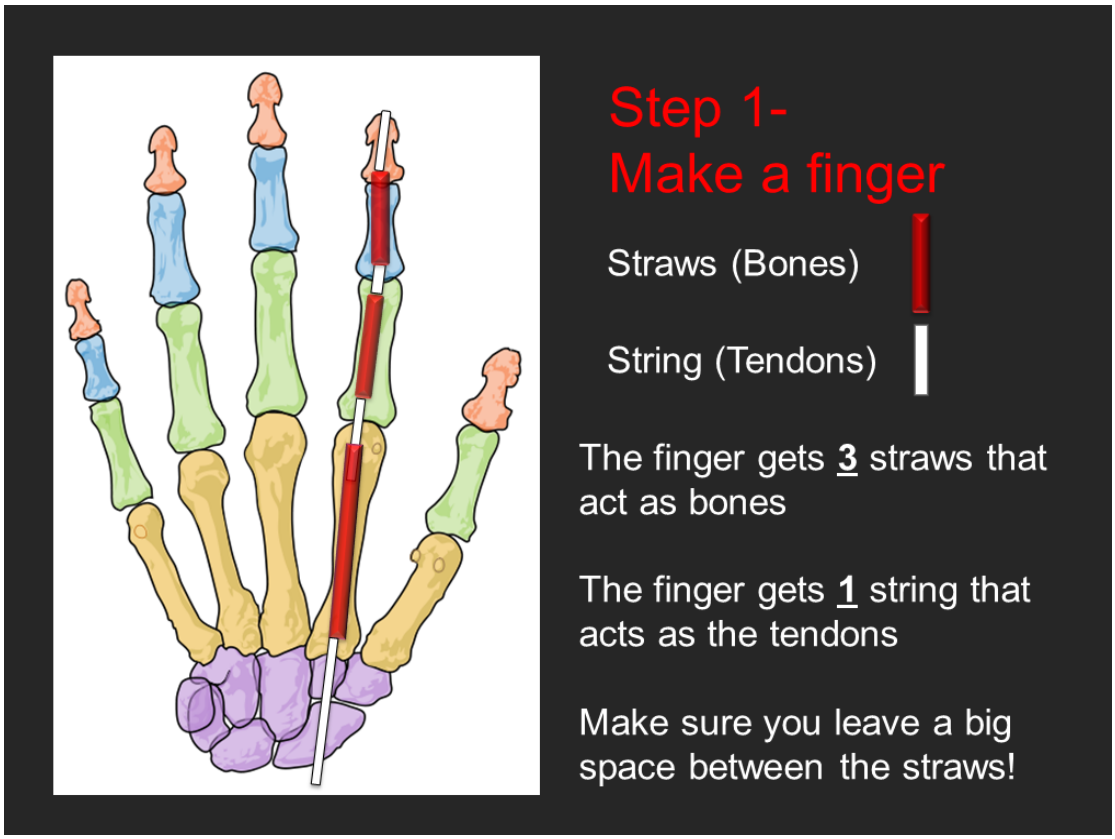

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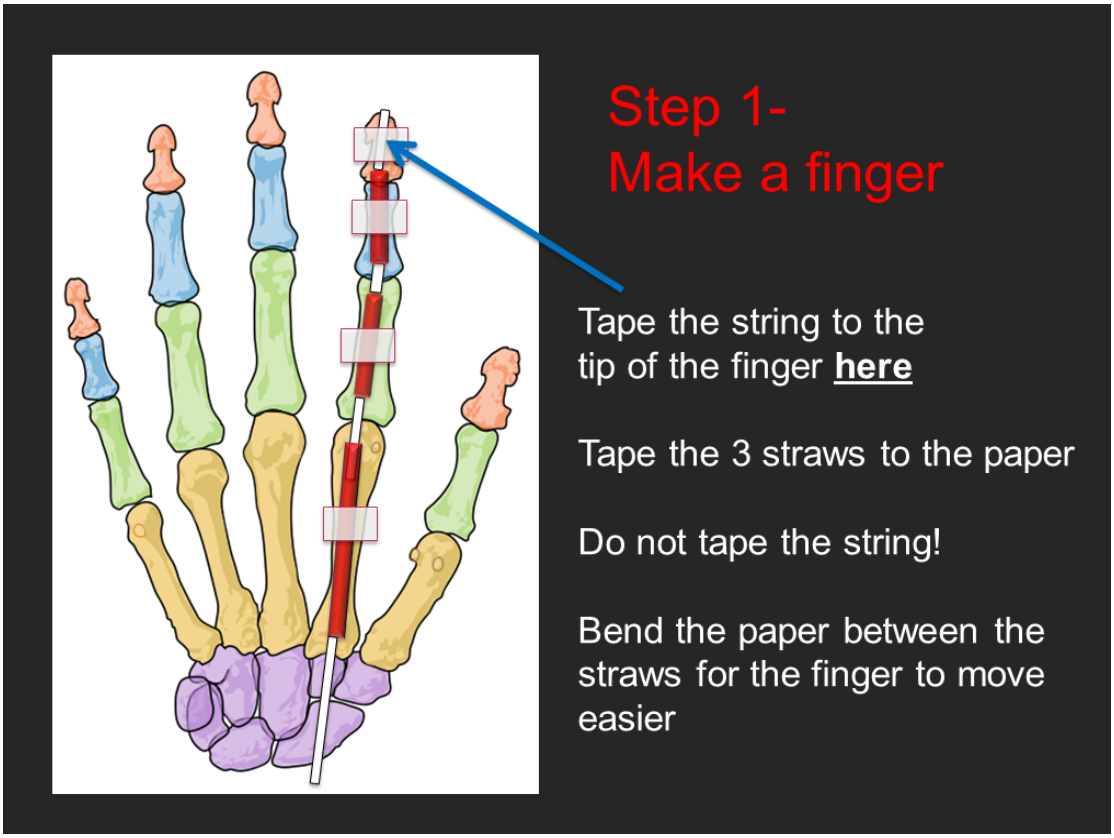

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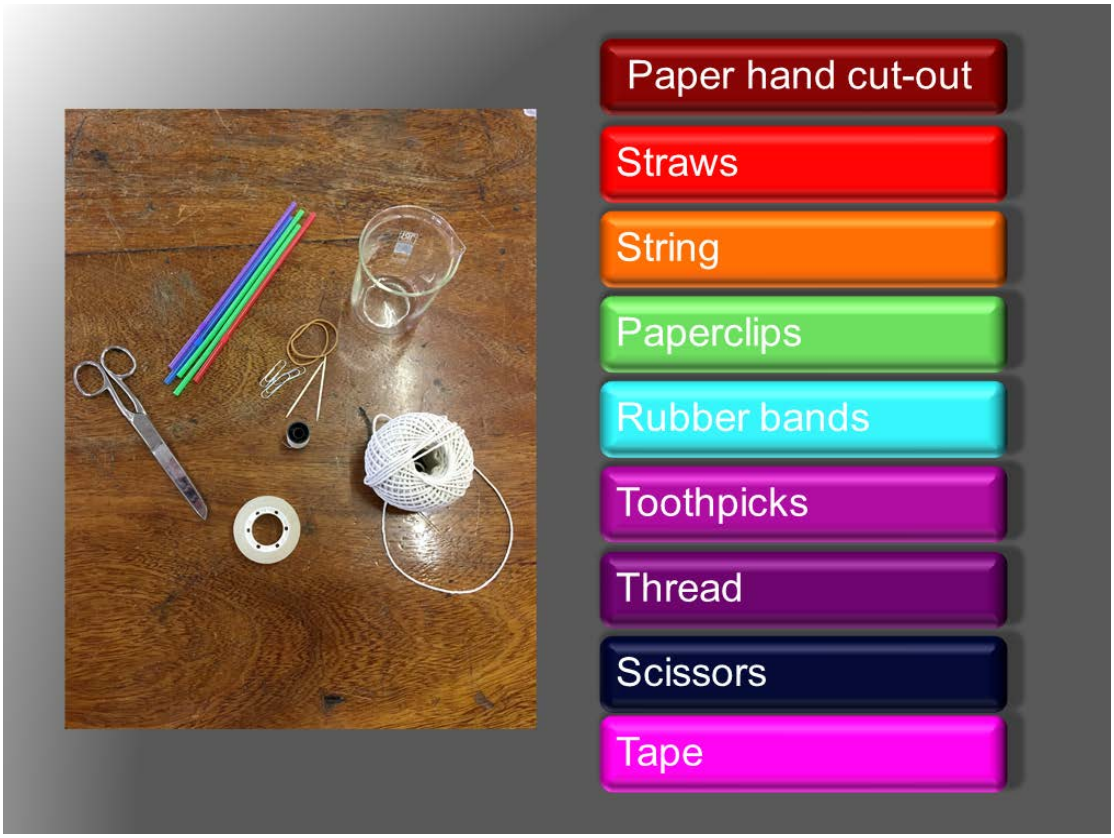

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EVALUATION

1.) Draw a picture of the 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?

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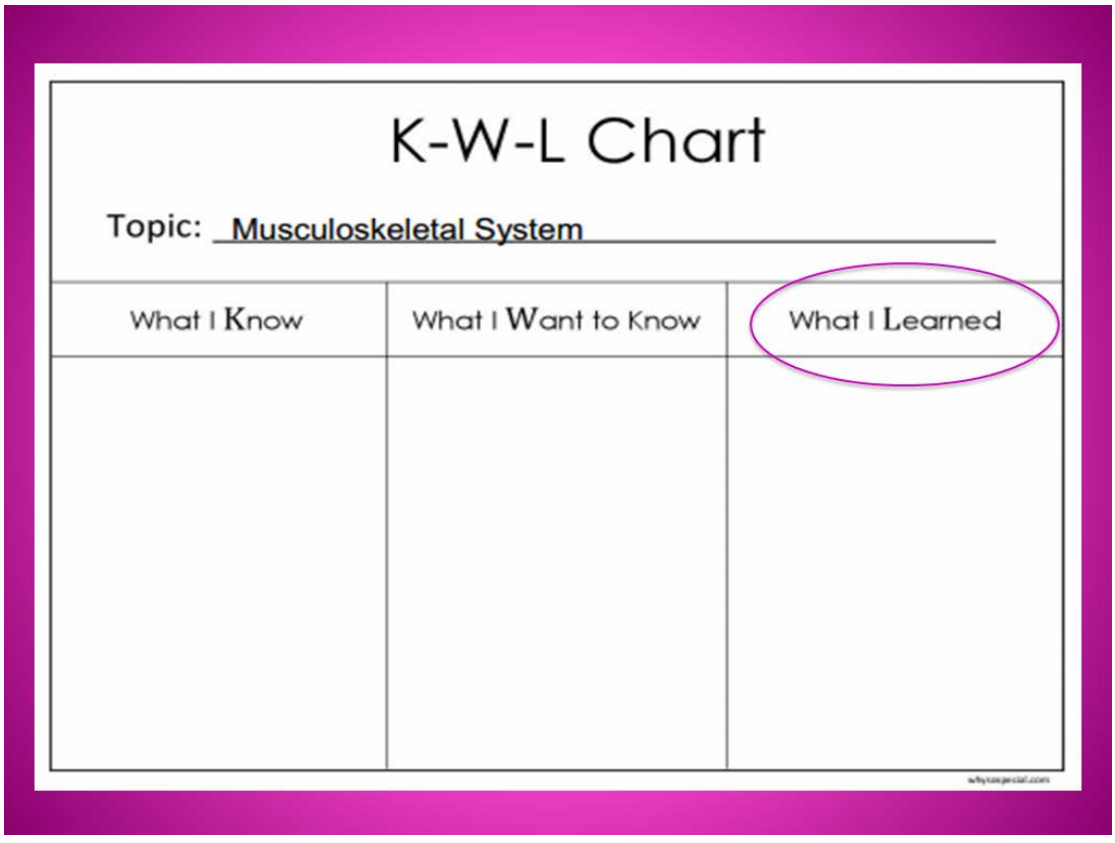

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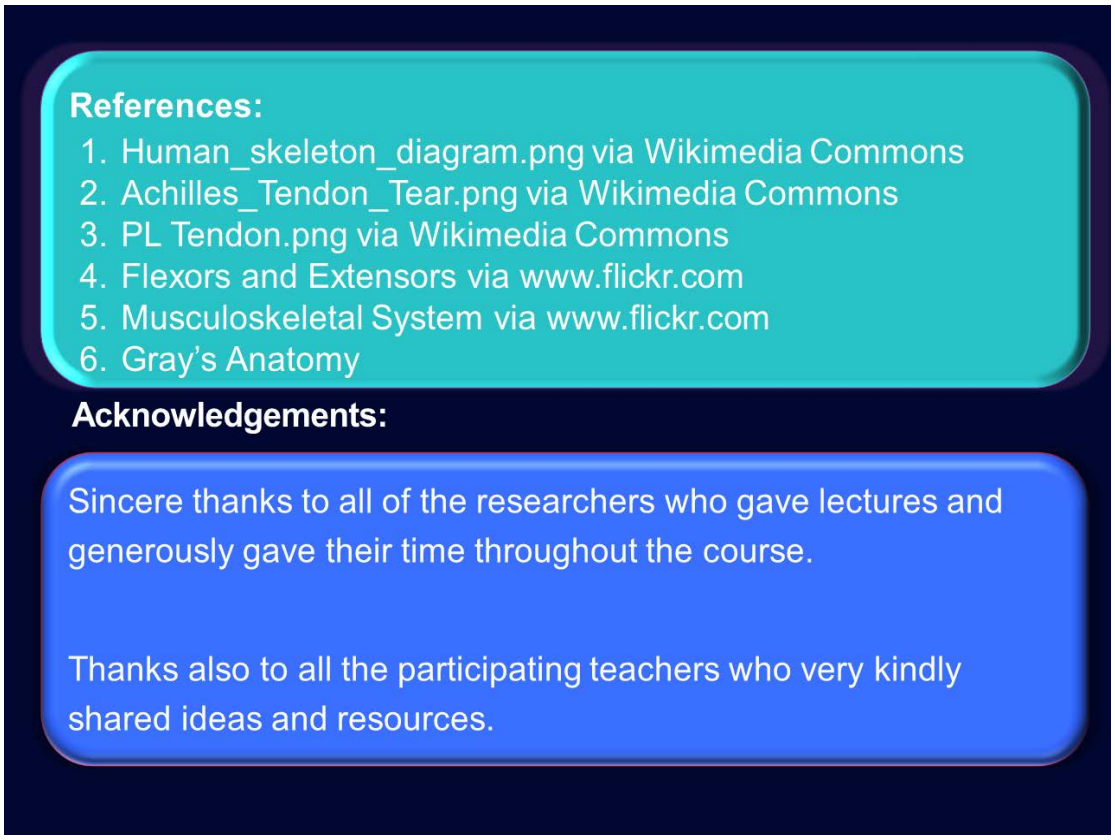

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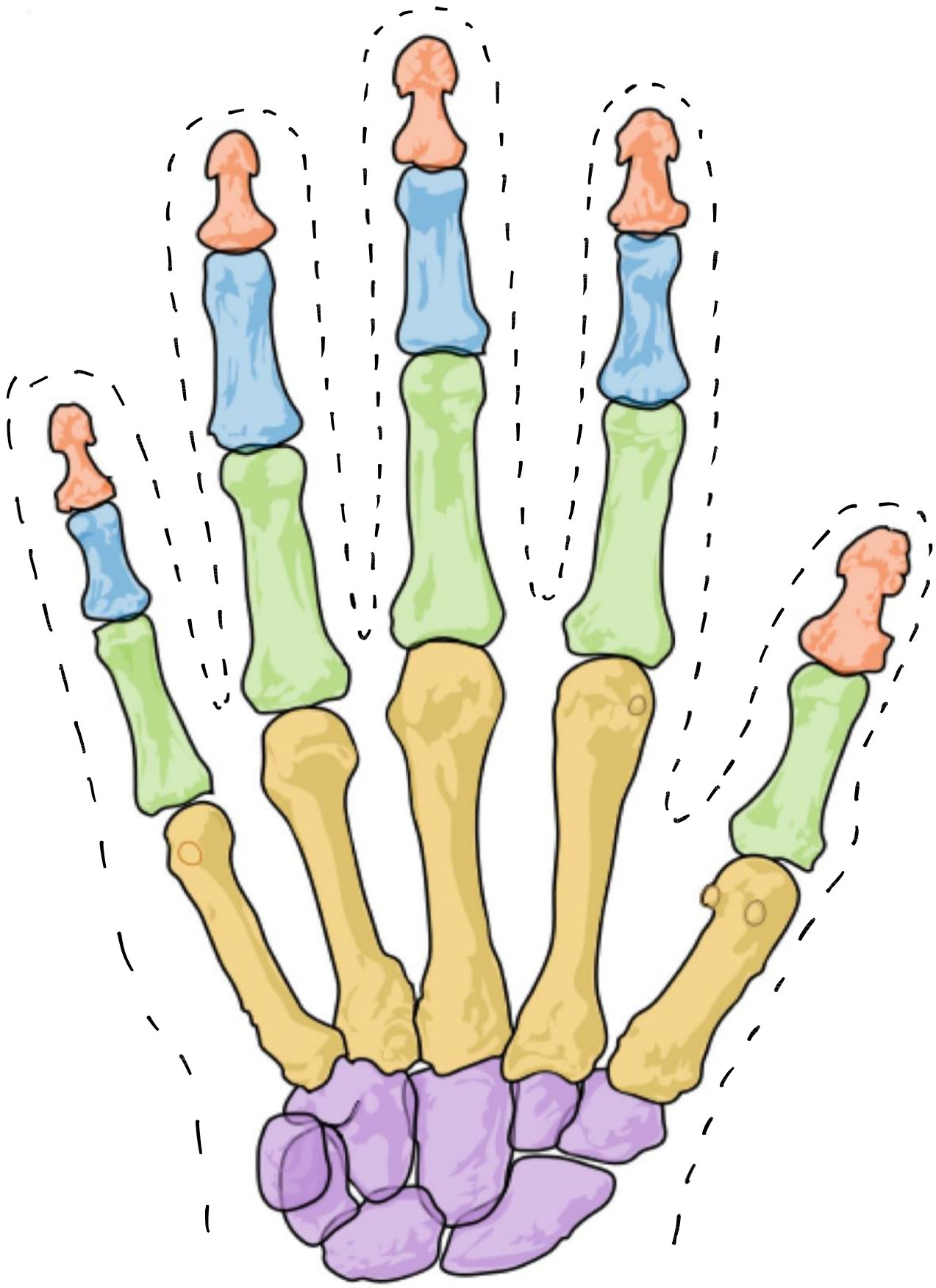


K-W-L Chart

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?

_____

_____

_____

_____

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

_____

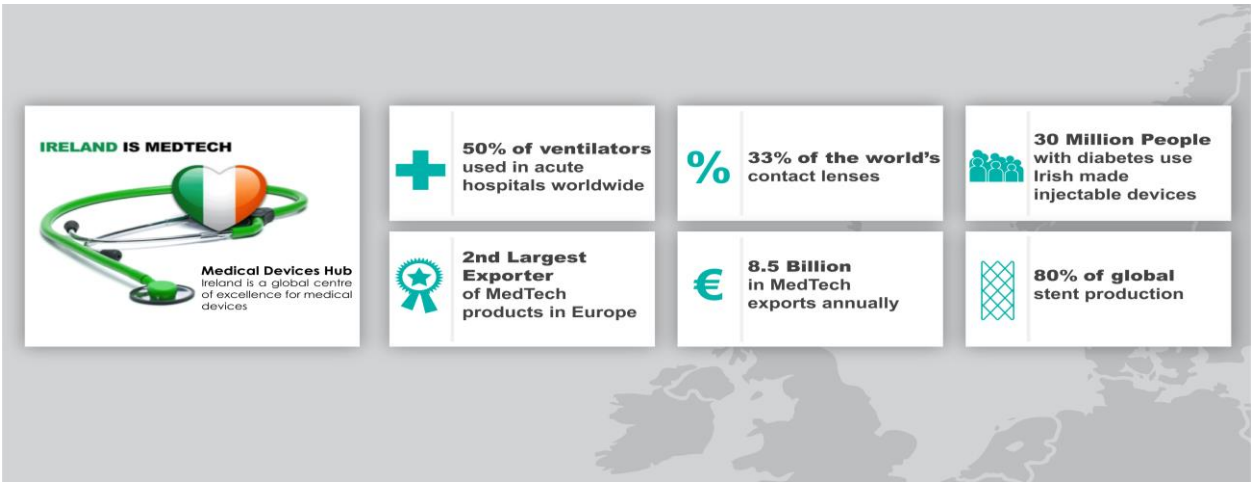
_____

_____

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.

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. Styker 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

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