



Strength in Science

The Effects of Exercise on the Heart and Blood Vessels

Secondary Level Lesson Plan



SFI Research Centre for Medical Devices

‘Strength in Science’

Physical inactivity is one of the leading risk factors for poor health and is now identified by the World Health Organization (WHO) as the fourth leading risk factor for global mortality. In Ireland, physical inactivity is thought to be responsible for 8.8% of the burden of disease from coronary artery disease, and 10.9% of type 2 diabetes.

Currently, only 8% of female secondary students in Ireland receive the Department of Education and Skills (DES) recommended 60 minutes of Physical Education (PE) per week. The goal of the ‘Strength in Science’ project is to develop cross-curricular resources for science and PE teachers that are linked with the Junior Cycle Science and PE curricula that will **increase girls’ interest in both learning science and participating in exercise**. We hope to make science more personal and relevant to teenage girls by linking how the biology and physics involved in exercise affects their health.

The lesson plan kits present fun and unique ways to participate in exercise and the scientific effects that different exercises have on the body. The suggested activities can be used to teach the Health-Related Activity area of study in the Junior Cycle PE Curriculum. Alternatively, the videos and flyers can be used to complement activities in other PE areas of study such as Athletics, Gymnastics, and Dance. All lesson plan booklets, films, and optional resources are free to download at: <http://www.curamdevices.ie/curam/public-engagement/teachers-in-residence/>.

The kits were developed through collaboration between researchers, science teachers, PE teachers, fitness instructors, and Junior Cycle students. This is a pilot scheme and we are keen to receive your feedback so that we can improve the resources and make them as useful for teachers as possible. We are excited to hear how these kits “play out” in the sports hall setting!

Sincerely,

A handwritten signature in blue ink, appearing to read 'S. Gundy'.

Dr. Sarah Gundy

CÚRAM Teachers in Residence

Programme Manager

The Effects of Exercise on the Heart and Blood Vessels

Junior Cycle Physical Education Curriculum Links

Junior Cycle Syllabus in Physical Education (2003)

Area of study 3: Athletics

Topics:

Running

Area of study 8: Health-related activity

Topics:

Activity and the body

Health benefits of physical activity

Health related fitness

Warm-up and cool-down

NCCA Junior Cycle Short Course in Physical Education (2016)

Strand 1: Physical activity for health and wellbeing

Strand 3: Individual and team challenges

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:

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. Students should be able to *describe* the structure, function, and interactions of the organs of the circulatory system.
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

Students should be able to:

1. Run at a steady pace, suitable to level of fitness, for a set length of time.
2. Display an appreciation and enjoyment of athletics.
3. Demonstrate an understanding of the effects of exercise on the body.
4. Show an understanding of the role of physical activity in establishing and maintaining health.
5. Plan for and participate in regular physical activity.
6. Understand the difference between an artery, vein and capillary.
7. Understand how blood travels to and from the heart and lungs.
8. Know what an aneurysm is.
9. Understand how high blood pressure damages blood vessels.
10. Understand how exercise makes the heart stronger to pump more blood with less effort.

Keywords and Definitions

	Keyword	Definition
1.	Artery	Blood vessels that carry blood with oxygen away from the heart. One exception is the pulmonary artery which carries blood without oxygen from the heart to the lungs.
2.	Vein	Blood vessels that carry blood without oxygen to the heart. One exception is the pulmonary veins which carry blood with oxygen from the lungs to the heart.
3.	Capillary	The smallest of the blood vessels where oxygen and nutrients are delivered to cells, and waste products are collected from cells.
4.	Aneurysm	An outward bulging, like a bubble or balloon, in a blood vessel that is caused by a weak spot in the blood vessel wall.

Learning Activities

Students will:

- Watch a video discussing:
 - How high blood pressure damages blood vessels.
 - Current Irish research in treating diseases of the blood vessels.
 - How exercise makes your heart stronger to pump more blood with less effort.
- Perform exercises to keep the heart and blood vessels healthy.

Resources Provided

- Teacher lesson plan
- Short film "The Effects of Exercise on the Heart and Blood Vessels"
- Flyers for students "The Effects of Exercise on Your Heart and Blood Vessels"

- 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>.

Note: These resources will also complement any running or interval training activities or lessons taught in P.E. classes.

Warm-Up

Warm-Up Your Heart

Equipment/Space Needed:

- Large hall

Instructions:

- The teacher stands at the front and facing the class.
- The teacher assigns movements to numbers that will be called out. For example:
 - 1 = Sprint
 - 2 = Jump
 - 3 = Touch the ground
- Everyone jogs around the hall.
- The teacher calls a number and everyone does the corresponding movement for the number called. For example, the teacher calls out "1" and everyone sprints.
- This is repeated with the teacher calling out the different numbers for about a few minutes until the class is warmed up.

Stretches

After the warm-up, get the students to perform dynamic stretches targeting the following muscle groups in preparation for the activities:

- Hamstrings
- Quadriceps
- Gastrocnemius and soleus (calves)
- Deltoids (shoulders)
- Biceps and triceps (upper arms)
- Trapezius (upper back)
- Pectoralis major and minor (chest)

Activity 1

Bean Bags and Blood Vessels

Equipment/Space Needed:

- Large hall
- A sheet of paper with "HEART" written on it (per team)
- A sheet of paper with "BODY" written on it (per team)
- A sheet of paper with "LUNGS" written on it (per team)
- Tape or blue tack
- 2 baskets (per team), about the size of a typical laundry basket
- 5-10 blue bean bags (per team) which represent carbon dioxide in the blood
- 5-10 red bean bags (per team) which represent oxygen in the blood
- **Note:** Bean bags can be substituted with balls or even crumpled pieces of red and blue paper.

Preparation:

- Secure the sheet of paper with "BODY" written on it to the first basket using tape or blue tack.
- Put the blue bean bags into the "BODY" basket.
- Secure the sheet of paper with "LUNGS" written on it to the second basket using tape or blue tack.
- Put the red bean bags into the "LUNGS" basket.
- Put the "BODY" and "LUNGS" baskets on one side of the room.

- On the other side of the room, secure the sheet of paper with "HEART" written on it to the wall using tape or blue tack.

Instructions:

- Students are grouped into teams of 4 (or a number divisible by 4).
- Half the students on a team line up on one side of the hall, and the other half line up on the other side of the hall.
- The teacher says "Ready, steady, go".
- Student 1 from each team takes a **blue** bean bag (carbon dioxide) from the "BODY" basket. (Student 1 represents blood carrying carbon dioxide and the sprinting path a vein from the body to the heart).
- Student 1 sprints across to the other side of the room where a teammate, Student 2, is waiting with his/her hand on the "HEART" sign that is taped to the wall.
- Student 1 hands over the **blue** bean bag to Student 2.
- Student 2 releases his/her hand from the "HEART" sign and sprints across to the other side of the room. (Student 2 represents blood carrying carbon dioxide and the sprinting path the pulmonary artery from the heart to the lungs).
- **Note:** Student 2 can only release his/her hand from the "HEART" sign and start sprinting when he/she has the **blue** bean bag.
- Student 2 puts the **blue** bean bag into the "LUNGS" basket.
- Student 3 grabs a **red** bean bag from the "LUNGS" basket.
- **Note:** Student 3 can only grab a **red** bean bag from the "LUNGS" basket after Student 2 has released the **blue** bean bag.
- Student 3 sprints across to the other side of the room where a teammate, Student 4, is waiting with his/her hand on the "HEART" sign that is taped to the wall. (Student 3 represents blood carrying oxygen and the sprinting path the pulmonary vein from the lungs to the heart.)
- Student 4 releases his/her hand from the "HEART" sign and sprints across to the other side of the room. (Student 4 represents blood carrying oxygen and the sprinting path the aorta from the heart to the body).
- Student 4 puts the **red** bean bag into the "BODY" basket.

- The sequence is repeated until the "BODY" basket is full of the **red** bean bags and the "LUNGS" basket is full of **blue** bean bags.
- Whatever team fills the "BODY" basket with the **red** bean bags and "LUNGS" basket with the **blue** bean bags first wins.

Activity 2

Oxygen Tag

Equipment/Space Needed:

- Large hall
- 8-10 **blue** bean bags (per team) which represent carbon dioxide in the blood
- 8-10 **red** bean bags (per team) which represent oxygen in the blood
- **Note:** Bean bags can be substituted with balls or even crumpled pieces of **red** and **blue** paper.

Instructions:

- The teacher divides the class into three teams with equal numbers of students:
 - 1) Oxygens
 - 2) Carbon Dioxides
 - 3) Cells
- Each student from the Oxygens team gets a **red** bean bag.
- Each student from the Carbon Dioxides team gets a **blue** bean bag.
- The teacher says "Ready, steady, go"!
- The students on the Carbon Dioxides team try to tag the students on the Cells team.
- If a student from the Cells team gets tagged by a student from the Carbon Dioxides team, they have to stop running and stay on the spot they were tagged, i.e. the student is "frozen".
- The frozen student cannot move unless they are tagged by a student from the Oxygens team.

- If the Carbon Dioxides team manages to freeze all of the students on the Cells team at the same time, then they are the winners.
- If the Oxygens team manages to prevent all of the students on the Cells team from being frozen at the same time after a predetermined amount of time, then they are the winners.
- Once the winning team is determined, have the students change teams and play again. For example, students who were on the Cells team switch to the Carbon Dioxides team; students who were on the Carbon Dioxides team switch to the Oxygens team; and students who were on the Oxygens team switch to the Cells team.

Cool-Down

Stretches

Get the students to perform static stretches targeting the following muscle groups that were worked during the activities:

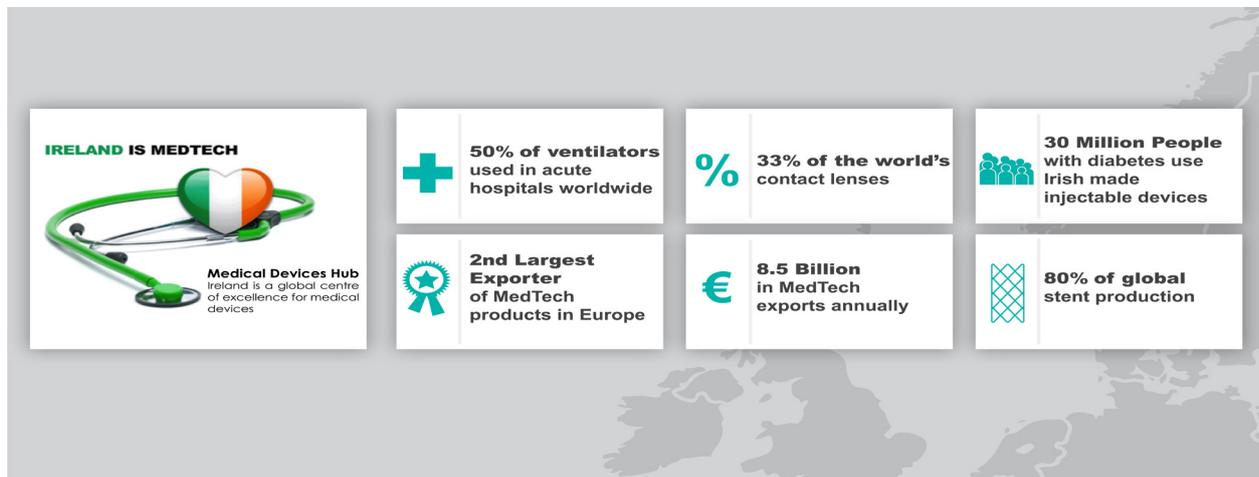
- Hamstrings
- Quadriceps
- Gastrocnemius and soleus (calves)
- Deltoids (shoulders)
- Biceps and triceps (upper arms)
- Trapezius (upper back)
- Pectoralis major and minor (chest)

FACTS ABOUT CARDIOVASCULAR DISEASES AND 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.
- 13 of the top 15 MedTech companies have operations in Ireland.
- Galway employs one third of the country's MedTech employees.

Cardiovascular disease is the most common cause of death in Ireland, accounting for 36% of all deaths. 22% of premature deaths (under age 65) are from cardiovascular disease.

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 4,000 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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