



# Strength in Science

## The Effects of Exercise on the Brain

### Secondary Level Lesson Plan







## ‘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: <https://curamdevices.ie/public-engagement/teachers/>.

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 'Sarah Gundy'.

Dr. Sarah Gundy

CÚRAM Teachers in Residence

Programme Manager



# The Effects of Exercise on the Brain

## Junior Cycle Physical Education Curriculum Links

### Junior Cycle Syllabus in Physical Education (2003)

#### **Area of study 8: Health-related activity**

Topics:

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

## 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:

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. Demonstrate an understanding of the effects of exercise on the body.
2. Show an understanding of the role of physical activity in establishing and maintaining health.
3. Plan for and participate in regular physical activity.
4. Understand what a neuron is.
5. Understand how a neuron sends and receives a message.
6. Know the general function of neurotransmitters.
7. Know the cause of Parkinson's disease - lack of dopamine.
8. Understand how unfamiliar exercise techniques stimulate the brain to form new neural pathways.

## Keywords and Definitions

	Keyword	Definition
1.	<b>Neuron</b>	A specialised cell that can send and receive messages using neurotransmitters.
2.	<b>Synapse</b>	A gap between two neurons that a message must jump across.
3.	<b>Neurotransmitter</b>	Chemicals made by neurons that carry messages across synapses.

4.	<b>Dopamine</b>	A type of neurotransmitter made by neurons in the brain.
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## Learning Activities

### Students will:

- Watch a video discussing:
  - How neurons communicate using neurotransmitters, in particular dopamine.
  - Current Irish research in treating diseases in the brain.
  - How different exercises strengthen and vary neural pathways in the brain.
- Demonstrate how dopamine carries a message across a synapse with students acting as neurons.
- Perform exercises to keep the brain healthy.

## Resources Provided

- Teacher lesson plan
- Short film "The Effects of Exercise on the Brain"
- Flyers for students "The Effects of Exercise on Your Brain"

**Note:** These resources will also complement any dance activities or lessons taught in P.E. classes.

## Demonstration

### Materials Needed:

- Three plastic eggs that can hold objects in side (For example, Kinder eggs)
- A piece of paper with "Jump" written on it
- A piece of paper with "Three times" written on it
- A piece of paper with "Forwards and backwards" written on it
- **Note:** If you do not have plastic eggs, you can just use larger pieces of paper to write on and then crumple them up into small balls.
- 2 Yoga mats

## Instructions:

- Prepare three plastic eggs carrying separate parts of the message on the pieces of paper "Jump three times forwards and backwards":
  - Egg 1 = "Jump"
  - Egg 2 = "Three times"
  - Egg 3 = "Forwards and backwards"
- Form a first line of three students all standing on a Yoga mat-This mat represents neuron 1.
- Form a second line of three students all standing on the other Yoga mat-This mat represents neuron 2.
- The space between the two Yoga mats represents the synapse.
- Only two of the students in neuron 1 get a plastic egg containing a message inside of it:
  - Egg 1 = "Jump"
  - Egg 2 = "Three times"
- **Note:** The two plastic eggs represent low levels of dopamine as part of the message is missing.
- The two students in neuron 1 throw the plastic eggs across the "synapse" (the space between the two Yoga mats) to two students in neuron 2.
- The students in neuron 2 perform the task given by combining the messages in the two plastic eggs.
- Since only two plastic eggs crossed the synapse, the students in neuron 2 did not receive the entire message and will not be able to perform the task properly. (They will "jump three times", but not "forwards and backwards")
- All three of the students in neuron 1 get a plastic egg containing a message inside of it:
  - Egg 1 = "Jump"
  - Egg 2 = "Three times"
  - Egg 3 = "Forwards and Backwards"
- **Note:** The three plastic eggs represent correct levels of dopamine as the message is complete.



- The three students in neuron 1 throw the plastic eggs across the "synapse" to three students in neuron 2.
- The students in neuron 2 perform the task given by combining the messages in the three plastic eggs.
- Since three plastic eggs crossed the synapse, the students in neuron 2 received the entire message and will be able to perform the task properly. (They will "jump three times forwards and backwards")

## **Warm-Up**

### **Meet in the Middle**

#### **Equipment/Space Needed:**

- Large hall

#### **Instructions:**

- The students are told to find a partner.
- The partners go to opposite ends of the hall with the length of the hall between them.
- The teacher gives a command that the students must perform. For example, "Give your partner a high five".
- The teacher says "Ready, steady, go!"
- The students sprint towards the middle of the hall to meet their partners.
- When the students meet their partners in the middle, they perform the teacher's command.
- After performing the command, the students leave their partners and sprint back to the opposite ends of the hall.
- The teacher adds on to the previous command for the students to perform. For example, "Give your partner a high five with the right hand, then a high five with the left hand."
- The teacher says "Ready, steady, go!" and the process is repeated.
- The teacher keeps adding to the sequence of commands for the students to perform which works their brains and warms them 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**

### **Do As I Say, Not As I Do**

#### **Equipment/Space Needed:**

- Large hall

#### **Instructions:**

- The teacher stands at the front facing the class.
- The teacher tells the class the activity is focused on improving their response to auditory messages.
- The teacher assigns movements to numbers that will be called out. For example:
  - 1 = Touch the floor with both hands.
  - 2 = Jump up with hands above the head.
  - 3 = Do three jumping jacks.
- Everyone jogs on the spot until the teacher calls out a number.
- Everyone, including the teacher, does the corresponding movement for the number called. For example, the teacher calls out "1" and everyone touches the floor with both hands.
- This is repeated with the teacher calling out the different numbers for about a minute until the students understand the concept.

- The teacher starts to call out numbers, but does movements that do not correspond to the numbers. For example, the teacher calls out "1", but jumps up instead.
- The students try to keep doing the corresponding movements for the numbers called, and try not to copy the movement the teacher does.
- Anyone that does not do the corresponding movement for the number that is called is out of the game
- The last person standing is the winner.
- The game is repeated with students at the front of the class calling the numbers.
- Variation: The student leading the class can assign new movements to the numbers being called out.

## Activity 2

### Chinese Whispers Choreography

#### **Equipment/Space Needed:**

- Large hall
- Option: Music with varying tempos

#### **Instructions:**

- The teacher tells the class the activity is focused on improving their response to visual messages.
- Half of the students stand in a line. These students are the performers.
- The other students watch the performers. (This is part of the fun!)
- The teacher and the first person in the line face one another. Everyone else in the line turns away so they cannot see what the teacher and first person are doing.
- The teacher does three to four moves of simple choreography.
- **Note:** Over exaggerate the movements and try to have fun with them! For example, driving a car:
  - 1 = Put the key in the ignition.
  - 2 = Turn the key in the ignition.

- 3 = Grab the steering wheel.
  - 4 = Turn the steering wheel.
- The first and second people in the line turn and face one another.
- The first person tries to repeat the movements the teacher did to the second person.
- This is repeated until the movements are passed on to the last person in the line.
- The teacher shows the students the original movements so they can see how much the movements changed by being passed down the line of students.
- The students who were watching become the performers and vice versa, and the game is repeated.
- Variation 1: The student at the front of the line makes up the three to four moves of simple choreography instead of the teacher.
- Variation 2: Have music playing in the background so that the students can try to perform the movements to the beat. You can also change the tempo of the music by playing a really slow song, and then a really fast song.

## Activity 3

### Less Dominant Dodgeball

#### **Equipment/Space Needed:**

- Large hall
- 10-12 Dodgeballs
- Pieces of yarn/string or wristbands for students to wear

#### **Instructions:**

- The teacher asks the students to raise their hands if they are right-handed.
- The right-handed students tie a piece of yarn/string around their right wrists.
- The teacher asks the students to raise their hands if they are left-handed.
- The left-handed students tie a piece of yarn/string around their left wrists.

- **Note:** This is important to ask before the students know the rules of the game to avoid them using their dominant arms!
- The students are divided into teams of two.
- The students play dodgeball, but can only use their less dominant arm to throw the ball. For example, right-handed students can only throw with their left hands, and left-handed students can only throw with their right hands.
- Variation: This can be done with any game! For example, play a game of football with students using their less dominant foot, or a game of rounders with students using their less dominant hands for batting and throwing.

## Cool-Down

### Stretches

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

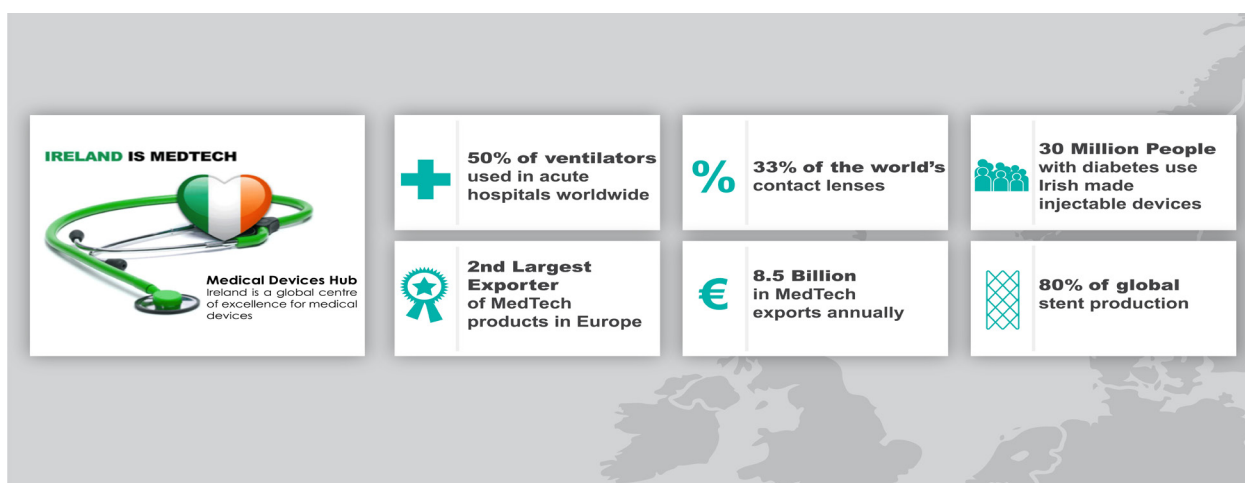
- Hamstrings
- Quadriceps
- Gastrocnemius and soleus (calves)
- Deltoids (shoulders)
- Biceps and triceps (upper arms)
- Trapezius (upper back)
- Pectoralis major and minor (chest)

# FACTS ABOUT NEURODEGENERATIVE 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.

**Parkinson's disease is the second most common neurodegenerative disease with 10 million people affected worldwide, and around 8,000 people in Ireland. Multiple Sclerosis (MS) is another neurodegenerative disease with an estimated 2.5 million sufferers worldwide. More than 9,000 people in Ireland are living with MS, and approximately three times as many women than men are diagnosed with it.**

MedTech companies with bases in Ireland produce Medical Devices to repair damage to both the Central Nervous System and Peripheral Nervous System. Boston Scientific's branch in Clonmel designs, develops and manufactures Deep Brain Stimulators and Spinal Cord Stimulators. Medtronic, headquartered in Dublin, is also a producer of Deep Brain Stimulation and Spinal Cord Stimulation products. Additionally, Stryker (with branches in Cork and Limerick) produces two conduits to repair peripheral nerve damage.



Source: IDA Ireland, 2017

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