DAY 2 – 50 minutes

HOW DOES A ROBOT MOVE?

Let us briefly review what we have learnt so far.

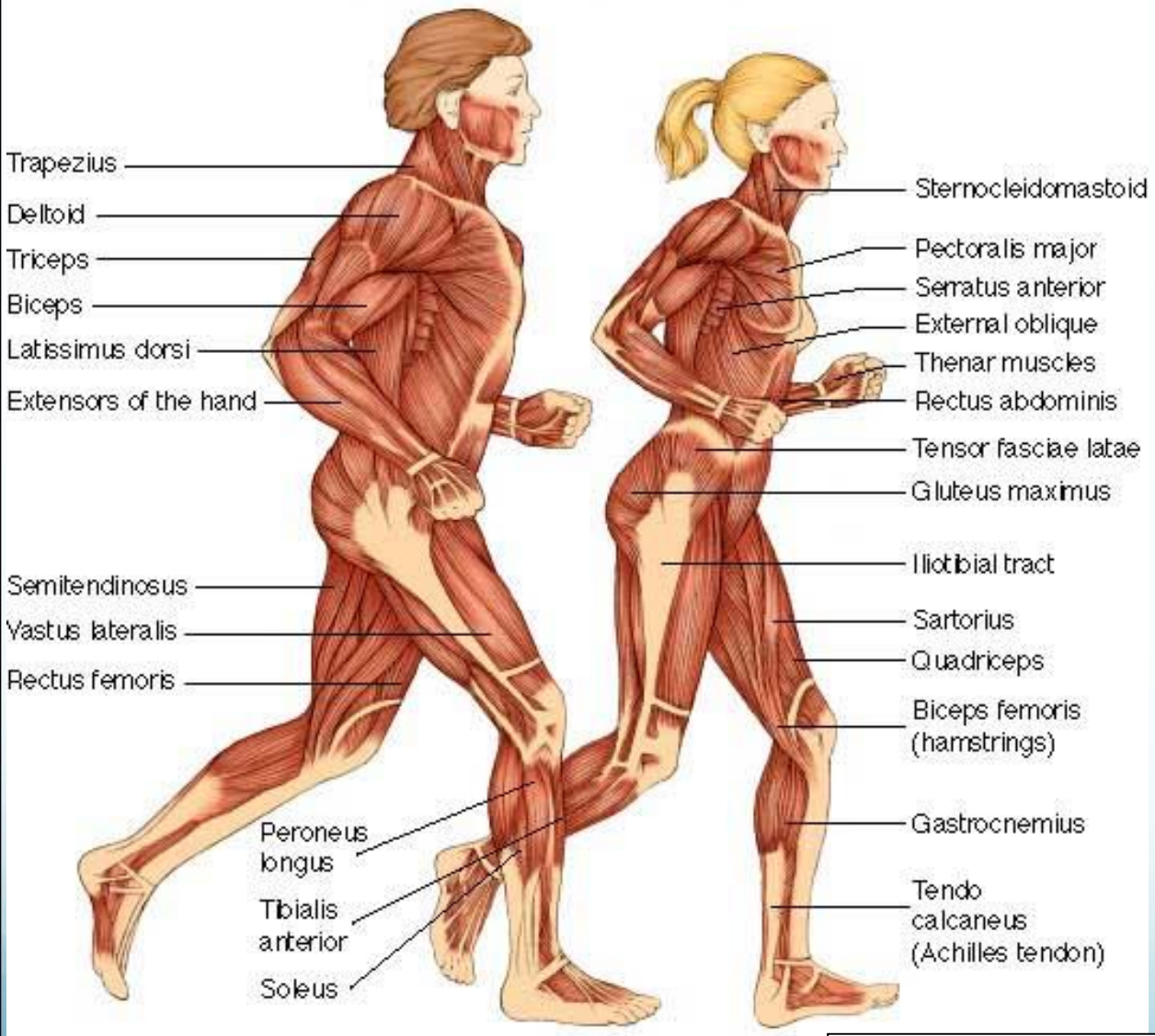


Image 1 , Ref - see slide 25

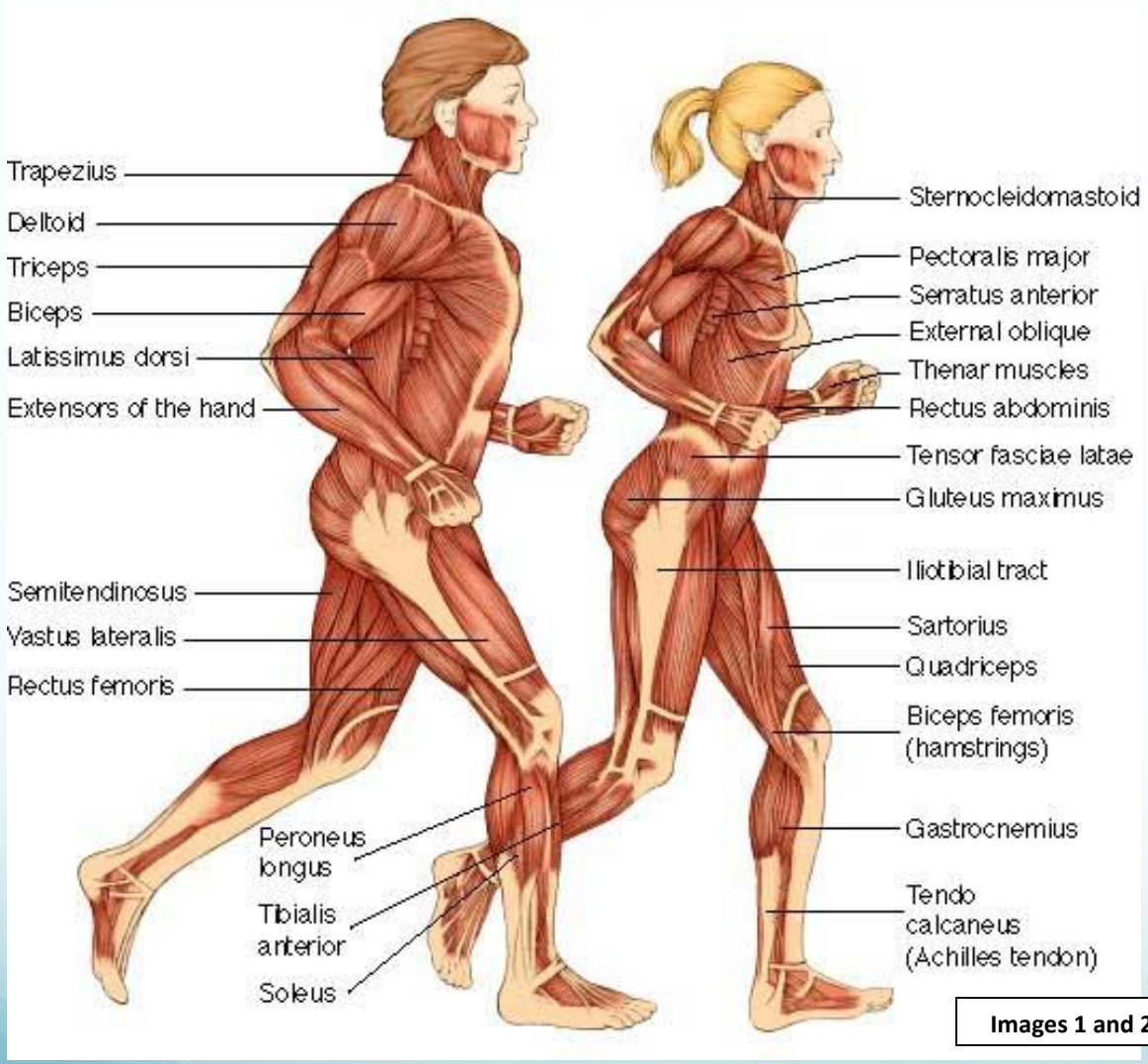
Understanding how we move and how we make decisions

(i) what parts of our body do we use to move?

(ii) what part of our body do we use to make decisions? For instance, how do we decide how to walk?

Can each one of you identify a muscle in your body?

Let us now compare movement in humans to movement in robots



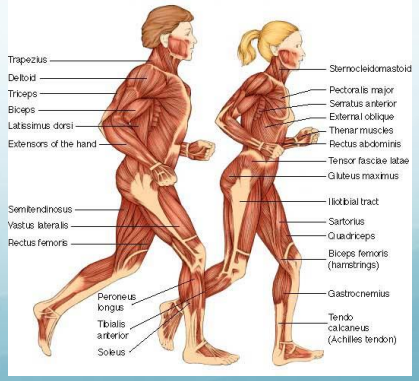
Images 1 and 2, Ref - see slide 25

What is the equivalent of a muscle in a robot? How does a robot move? You will learn about these topics in this lesson

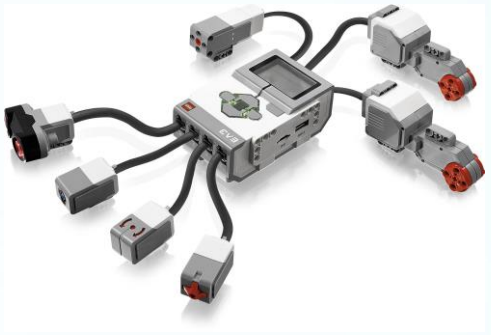
Quick review of Human Body.

Let's start comparing it to robots!

- **Human Sensors**
  - **5 senses are all detected by sensors on your body – what are they?**
  - **Answer: Touch, Smell, Sight, Hearing, Taste**
- **Brain**
  - **Your brain makes decisions based on information from body's sensors or simply through choice and commands body to perform actions-**
  - **What is the equivalent in robots?**
  - **Answer: A computer**
- **Body/Structure**
  - **Bones give you stability, muscles allow you to move**
  - **What is the equivalent in robots?**
  - **Answer: Any parts, such as wheels, motors, metal pieces, nuts, bolts**
- **Nervous system**
  - **Sends signals from the sensors to the brain**
  - **Sends signals from the brain to the muscles**
  - **What is the equivalent in robots?**
  - **Answer: Wires**



ROBOT AND ITS COMPONENTS



Sensors

- Sensors in robots are similar to sensors in humans
  - They take information from their surroundings
- There are two types of sensors
  - Type 1: A sensor that simply detects if something is there
    - Example: A sound sensor that tells you whether it heard a sound
  - Type 2: A sensor that tells you more information about what it detects
    - Example: A sound sensor that tells you how loud a sound is.

- Can you give an example of a type 1 and type 2 touch sensor?

- **Answer:**
  - **Type 1 tells you if it got touched or not**
  - **Type 2 tells you how hard it got touched**

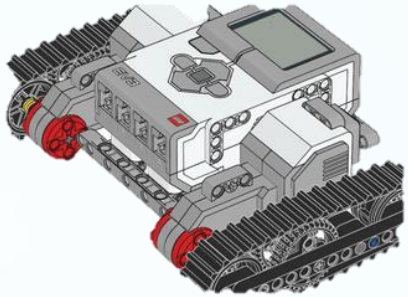
Pre-Activity

Instructions for Teachers

- Teacher is to make a taskbot prior to activity (design activity is approx. 45 min.)
- Recommended that teacher invite 4-6 interested kids in roboticd from all grades to build taskbot using LEGO EV3 Kit
- Teacher to use pdf titled, “How to build a LEGO EV3 Taskbot”
- Recommended that a taskbot/ LEGO Kit is shared per 3 kids

Activity:
HOW DOES A ROBOT MOVE?

THE EV3 ROBOT



- The robot that this lesson works with is called the ‘Taskbot’
- This robot is made up of LEGO pieces
- The parts of the robot that make it move are called motors
  - These are like which part of the human body?
  - Answer: Muscles
- The motors spin and cause the wheels to push off against the ground, causing the robot to move

EV3 Brick, the "Brain" of your robot

- The EV3 brick has a small computer that acts as the brain of your robot
- This robot needs to be programmed in order for it to run. You can program the brick directly, or you can hook it up to a computer and download a program to your EV3
- **Why does a robot need a program to run?**
  - Answer: It cannot think for itself. It has to be told what to do
- The program tells the EV3 where to move and when to take in information from its sensors

What makes up the “nerves” of your robot?

- The “nerves” of your robot are its wires, which send signals to the motors from the computer and to the computer from the sensors

Comparing Human vs. EV3 Robot

	HUMAN	EV3 ROBOT
Sensing	FIVE SENSES – eyes, nose, ear, skin and tongue	SENSORS
Decision making	BRAIN	EV3 BRICK
Transmission of information	NERVES	WIRES
Moving	MUSCLES	MOTOR

How do the motors help the robot move?

- The computer sends a command through the wires to the motor to rotate forward.
- The motor turns the wheels.
- The wheel then pushes against the ground, and makes the robot move
- Do you see how this is similar to how the brain tells muscles to move?

How do the motors help the robot move? - continued

- The robot runs a program that has already been made and stored in its computer
  - REMEMBER: the computer cannot decide to move the robot by itself!!! It needs a program
  - The robot does not “know” anything. It only can do what you tell it to do, nothing more.

How do the motors help the robot move? - continued

- We are going to set our robots in front of a wall.
  - What our program should do is make the robot move forward until it gets close to the wall, then back up
- Remember, we have to be very specific with the robot.
  - **How can we make sure the robot knows when it's going to hit the wall?**
  - Answer: We use a sensor. This specific sensor is called the ultrasonic sensor.

How do the motors help the robot move? - continued

- The ultrasonic sensor sends out a signal and waits until it bounces off of some object and comes back.
- It then sends a message to the computer through the wires, telling the computer how long it took for the signal to come back.
- The computer calculates how far away the object is.
- Thus, the ultrasonic sensor can help the robot decide if it is close to hitting some object
- Now, let's program!

Programming the EV3 Taskbot

- Go to Programming ppt titled, “LEGO EV3 Software tutorial”
- NOTE: The teacher should run the program themselves first prior to the administering the lesson plan. The solution program shows exactly how the program should be laid out. If something is not working correctly the teacher can simply compare the students program to the solution program and change any discrepancies.

How do the motors help the robot move? – contd

- **Step 1 – start the robot computer by pressing the orange button. You will see a display.**
- **Step 2 – select EV3 programming and press the orange button**
- **Step 3 – then select the up arrow (make sure there is no number by the arrow) and press the orange button**
- **Step 4 – then select the ultrasonic sensor and press the orange button**
- **Step 5 – then select the down arrow with the number five below it and press the orange button**
- **Step 6- then select the loop icon and press the orange button**
- **You are done programming the robot! Can you explain what you told your robot?**

Activity (25 minutes)

- **Students should be grouped according to the number of available computers**
- **Pass out the worksheet on the next slide and allow 15 min for completion. Students can work on this activity with their group**

WORK SHEET

Movement in Robots- How does it compare to movement by humans?
(fill in after discussing each question below in groups of two or three)

1. Run your robot forward till it comes close to a wall. Why does it move back? Explain all the steps that makes the robot move back.

2. The way that a human decides to move is different from the way that a robot decides to move. Can you explain why?

3. The way that a human sends the signal to move to the muscles is very similar to the way that a robot sends the signal to move to the motors? Can you compare them?

4. The way that a motor moves a robot is different from the way that a muscle moves a limb in a human. Can you explain the difference?

WORKSHEET SOLUTIONS

Movement in Robots- How does it compare to movement by humans?
(fill in after discussing each question below in groups of two or three)

1. Run your robot forward till it comes close to a wall. Why does it move back? Explain all the steps that makes the robot move back.

The ultrasonic sensor senses an object in front and informs the computer about it. The computer program takes a decision to move left if there is an object in front, and so the wheels are turned left and the robot turns.

If the computer program were written so that the robot had to turn right, the robot could have turned right too! So, it is up to the programmer to tell the robot what to do

2. The way that a human decides to move is different from the way that a robot decides to move. Can you explain why?

The robot computer runs a fixed program that tells it what to do, and if so if anything goes wrong with the program (e.g., the sensor malfunctions) the robot shuts down. The is not true with the human brain since it can use its thinking capacity to find different solutions.

3. The way that a human sends the signal to move to the muscles is very similar to the way that a robot sends the signal to move to the motors? Can you compare them?

Our senses send a signal to the brain and the brain decides what muscles to move. The signal is sent from the senses to the brain and from the brain to the muscles via nerves. In a similar manner, the robot sensor sends signals to the robot computer via wires, and the program running on the robot computer decides whether to turn the motors on or not. If it decides to turn the motor, the computer sends a signal via the wires to the motor.

4. The way that a motor moves a robot is different from the way that a muscle moves a limb in a human. Can you explain the difference?
The muscle contracts and pulls on the bone to move it, while the motor rotates and causes the wheel to push off the ground to move it.

Where do we get the energy/power to move?
Energy Sources

- **Humans use nutrients from food, most importantly glucose- a type of sugar that is used very effectively by humans to get energy that powers our muscles**
- **Robots get their energy from the batteries that we install in them. They use the electricity provided by the battery to move their motors which are connected to wheels**

Human-Robot Comparison
Example: Movement

STEPS	HUMANS	EV3
Step 1:	Brain decides to walk	EV3 computer brick reads program command to move
Step 2	Brain sends signals through the nerves to the muscles commanding them to move	EV3 computer brick sends signals through the wires to the motors, commanding them to move.
Step 3:	Muscles contract, making the body move	Motors rotate, causing the robot to move
Step 4:	Brain decides to stop	EV3 computer brick reads program command to stop
Step 5:	Brain sends signals through nerves to the muscles commanding them to stop	EV3 computer brick sends signals through the wires to the motors, commanding them to stop.
Step 6:	Muscles stop contracting	Motors stop moving

Human vs. Robot Summary

	HUMAN	EV3 ROBOT
PARTS	The main parts of the human body include the brain, nerves, muscles, bones, and sensors/receptors of the body.	The main parts of an EV3 robot include the computer brick, the wires, the motors, the Lego building pieces, and the EV3 sensors
DECISION MAKING	The human brain makes decisions about what the body will do next	The EV3 computer brick reads the program its running to find out what to do next
SENDING INFORMATION	The brain sends signals through the nerves of the body to tell parts of the body what to do. Sensors in the body send signals to the brain to give it information about what they experience. (Ears send signals to the brain if they hear a sound. This signal also tells the brain whether the sound was loud or soft, high pitched or low pitched)	The EV3 computer brick sends signals through its wires to the motors to tell the robot where to go/ what to do. It also can send signals to its lamp to turn it on or off. Sensors of the EV3 send signals through its wires to the EV3 computer brick to give it information. (The touch sensor tells the brick whether something has bumped it or not)

POST-ASSESSMENT SHEET - Are we like robots?

1. What sensors or senses do we have in the human body (list as many as you can)?

2. Give an example of a machine (or robot) with sensors and describe how it works.

3. List how robots are similar to humans.

4. List how robots are different from humans.

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Image 2: ADA Description: LEGO EV3 Robot
Image file name: product_ev3erstorm_square.png
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