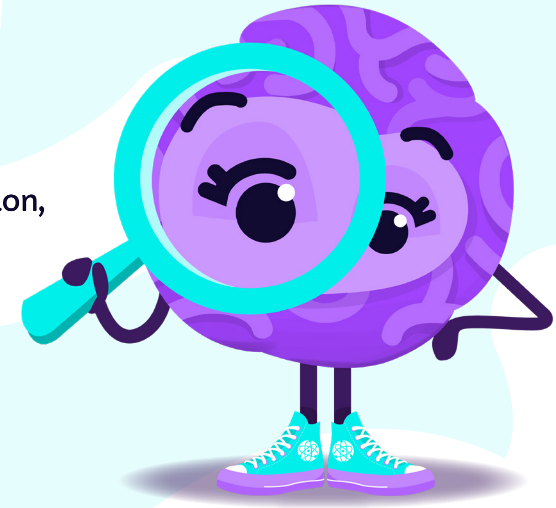
# Lesson Plan

## BUILD A NEURON

## Objective: learning goals



- Understand what neurons are
- Know that neurons transmit messages in one direction, and that one neuron can activate the next.
- Explore how to construct a working machine
- Think about conservation of energy- changing from potential to kinetic & back again
- Develop teamworking skills
- Become familiar with the engineering process- plan, create, test, improve.

## Lesson Plan

### Introduction presentation

Using the powerpoint presentation supplied, show students the neuron images and explain to them that this is what their brain cells look like. These are what send messages around their brain and to the rest of their body to allow them to talk, walk, think and make decisions.

Point out the long part of the neuron- the axon. Electrical messages travel along here, from one end to the other.

### Activity

To illustrate this, you can get the class to pretend to be a neuron and do a Mexican wave, with the signal starting at one end of the classroom and travelling to the other, like at a sports game.

Once the signal has reached the end of the first neuron, it releases chemicals which carry the signal across a gap to the second neuron. These connections form a huge web of neurons, which makes up your brain.

Tell the students they are going to build their own neurons, and then connect them up into a big network, just like a brain.

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Watch

These are both very complex examples, but great ones to provide inspiration and ideas!

> How to Pass the Salt While Maintaining Proper Social Distance - YouTube

> OK Go - This Too Shall Pass - Rube Goldberg Machine - Official Video - YouTube

### Discuss: How did the engineers of those machines ensure they kept going?

Depending on age group, you can discuss ideas around conservation of momentum, energy transfer, losses and friction (see notes at the end of this lesson plan). You may want to discuss these at the beginning, or bring them up as students run into issues during the building process.

### Activity- plan your neuron

- Introduce the engineering design process: Plan, Create, Test, Improve. Explain that when engineers design something new, it always goes through testing processes.
- Put students in groups, and give each student a worksheet which will help them plan their machine.
- Explain that their design won't always work first time and that's ok. By testing, and making mistakes, they can learn how to do it better the next time.

### Activity- build a neuron

- Give the students time in small groups to build their own neuron. You may want to assign them a maximum size for their neuron.
- If you want to connect them up, it can also help to specify how each machine should start and end- e.g. by the pull of a string.
- Once they have all built something, you can try to connect them up- can you get the signal travelling all around the room, through multiple neurons?

### Closing discussion

- Bring the class back together to discuss what they learned from building their machines. What worked well? What would they do differently next time? What were the limitations they were working with (e.g. not having certain materials, needing more time, more space etc).
- Highlight that these are the kinds of issues and discussions engineers and scientists have about their work all the time!

### Share your creations

- Record a video of your class's neurons and tweet it to @BraintasticSci using #BraintasticSci
- Share your students' questions about their amazing brains and we'll try to answer them in our #CuriosityCorner videos.

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### Notes

**Momentum**

All moving things have momentum, which is made up of their mass multiplied by their velocity. The heavier something is (the more mass it has) and the faster it is going (higher velocity), the more momentum it has. When one thing hits another, it can transfer momentum- the momentum always stays constant (apart from losses, see below), so if a heavy ball hits a light ball, the light ball will move faster than the heavy ball was, to conserve momentum. The opposite is also true. If you rolled a tennis ball at a bowling ball, the bowling ball may start to move, but very slowly. If you rolled a bowling ball into a tennis ball, the tennis ball would shoot off at high speed!

Ask students to think about momentum when attempting to set one object moving by hitting it with another.

**Energy transfer**

One of the most important laws in physics is the law of conservation of energy- in a closed system, energy can't be created or destroyed, it only changes form. In the case of a Rube Goldberg machine, it changes form many times. Energy might start in the form of gravitational potential energy, with a ball balanced high up above a slide. When the ball is released, it converts into kinetic energy as it starts moving. The kinetic energy may then be transferred to a domino, then another, then another. Or it could transform back into potential energy, if an elastic band is stretched, or something is raised up to a higher platform. But the total amount of energy will stay the same- in theory at least.

Ask students to think about what forms of energy are at play at each point in their machine.

**Losses**

The law of conservation of energy suggests that it might be possible to build a perpetual motion machine, where energy is converted back and forth into different types. Sadly, in the real world, this is impossible. This is because there are always some losses, some energy that is wasted when it is transformed. This might be heat produced by a moving string, or the noise that occurs when one ball hits another. Energy of this type is lost from the system, so, over time, the energy will run out, unless extra is put in.

Ask students to think about how to prevent too much energy being wasted in their machine.

**Friction**

Friction is a really common reason for losing energy in your system. Friction occurs when two surfaces rub against each other- when a book is pushed along a table, for example. Friction converts kinetic (movement) energy into thermal (heat) energy. The rougher the surfaces are, the more friction there is, and the more force you need to apply to move the object. Ask students to think about how they can reduce friction to help their machine move, or where they might be able to use friction to help them (for example, you might be able to balance something at the top of a slope by sitting it on sandpaper, so that it only begins to move when a force is applied.)

If your students are struggling with friction, it may help to suggest they try rolling objects instead of sliding them- rolling things experience much lower losses.