

### OVERVIEW

Aimed at **key stage 4** pupils.

In this activity, pairs of socks are used to represent pairs of chromosomes in the cell.

### CURRICULUM LINKS

- 📌 **KS3:** Life processes are supported by the organisation of cells into tissues, organs and body systems
- 📌 **KS4:** The ways in which organisms function are related to the genes in their cells
- 📌 **KS4:** Human health is affected by a range of environmental and inherited factors, by the use and misuse of drugs and by medical treatments

### LEARNING OBJECTIVES

- 📌 Humans have 23 pairs of chromosomes, which are inherited from our parents
- 📌 Chromosomes determine whether you are male or female
- 📌 If people have the wrong number of chromosomes, it causes conditions such as Down's Syndrome
- 📌 Chromosomes can be seen through a microscope and look like a stripy thread
- 📌 Chromosomes are made of a very long piece of DNA

### PREPARATION

- 📌 Gather the following resources:
  - 📌 23 pairs of socks of varying sizes (ideally striped) and cut off half a sock to represent the Y chromosome
  - 📌 Alternatively, use the printable pictures of socks from [Jeans for Genes](#)
- 📌 Print worksheets

### Activity

- 📌 Introduce the class to chromosomes and explain that they look similar to stripy socks if you see them down a microscope.
- 📌 Hand out individual socks to the class and give them 2 minutes to find their pair (some pupils will get more than one sock).
- 📌 22 should pair easily, but the pupils will notice that one pair are not the same (X and Y).
- 📌 Then ask the class to arrange their socks into size order.
- 📌 The sock that was cut (Y chromosome) should have a loose thread, so you could use that to explain that chromosomes are made of a very long piece of DNA (wool is equivalent to DNA).
- 📌 Class then complete worksheet
- 📌 This activity could be used in conjunction with: "**The biggest cell you've ever seen**" and "**The sock x-change**" activities on the [Genes Are Us](#) website.

## Activity

continued

### Points to potentially mention to pupils:

- 📌 Explain that the socks represent the chromosomes in their cells, and that almost every cell in their body (except for the sex cells) will contain 23 pairs of chromosomes. One copy of the pair comes from your Mum and the other copy of the pair comes from your Dad.
- 📌 Chromosomes carry genetic information (ie. they are made of DNA and have lots of genes along their length). The dystrophin gene that causes the condition that Connor has (Duchenne Muscular Dystrophy) is located on the X chromosome.
- 📌 Clarify that women have two copies of the X chromosome whereas men have one X and one Y.
- 📌 We have used socks, as chromosomes look a bit like stripy socks under a microscope. If you were to look at the pupil's chromosomes under a powerful microscope everyone in the class would look identical (we all have the same stripy bands on our chromosomes and you would not be able to see any mutations under a microscope).
- 📌 Chromosomes vary in size greatly - with over 4000 genes on the biggest chromosome (no. 1) and less than 600 on the smallest chromosome (no. 21).
- 📌 Cytogeneticists are scientists who look at people's chromosomes under a microscope and pair them up in size order, as the class have done. This then allows them to identify whether a patient has the correct number of chromosomes or whether they have any sections of chromosome missing or duplicated. Some conditions are caused by having extra chromosome (e.g. Down's Syndrome is caused by having an extra copy of chromosome 21) or by having a missing a chromosome (Turner Syndrome occurs when girls are born with only one X chromosome, rather than two).

## ANSWERS

Chromosomes are found in the **nucleus** of a cell. Chromosomes are made up of long pieces of **DNA**. They contain all of the **genetic** information necessary to make an organism. Humans have **46** chromosomes, including the sex chromosomes. Females have **22** pairs of chromosomes plus two **X** chromosomes. Males are different because they have one X and one **Y** chromosome. Some scientists study chromosomes, by staining them and looking at them under a **microscope**.

## EXTENSION

This activity could be used as an introduction to demonstrate the division of genetic material during mitosis and meiosis with higher level groups. You can find out more about chromosomes and arrange them into pairs on a computer animation on the Utah Genetics Science Learning Center's website: <http://learn.genetics.utah.edu/content/begin/traits/karyotype/index.html>

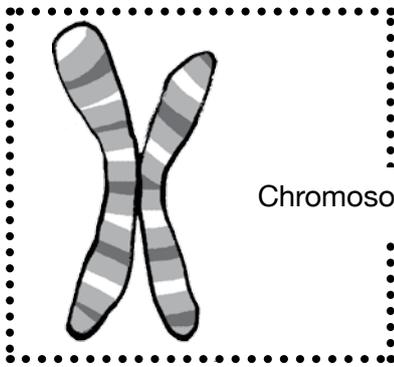
FOR MORE RESOURCES LIKE THESE AND TO SIGN UP FOR JEANS FOR GENES DAY, VISIT US AT [WWW.JEANSFORGENES.ORG](http://WWW.JEANSFORGENES.ORG)

CREATED IN COLLABORATION WITH



# PAIRING THE SOCKS

You can see chromosomes under a powerful microscope and they are often stained to help scientists identify which chromosomes is which. Once chromosomes are stained, they look a bit like pairs of stripy socks (as shown in the images below).



Chromosomes



Stripy Socks

You have just completed an activity using socks to represent chromosomes, but how much do you know about chromosomes?

Use the following words to complete the paragraph.  
You only need to use each word once:

Y
DNA
22
Genetic
Microscope
Nucleus
46
X

Chromosomes are found in the ..... of a cell.  
 Chromosomes are made up of long pieces of .....  
 They contain all of the ..... information necessary  
 to make a human. Humans have ..... chromosomes  
 altogether, including the sex chromosomes.

Females have ..... pairs of chromosomes plus two  
 ..... chromosomes. Males are different because they  
 have one X and one ..... chromosome.

Some scientists study chromosomes, by staining them and  
 looking at them under a .....

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