TEACHER'S NOTES

THE SOCK X-CHANGE

OVERVIEW

Aimed at key stage 4 pupils.

This activity uses socks to demonstrate how X-linked inheritance works.

CURRICULUM LINKS

- **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

- Duchenne Muscular Dystrophy is a genetic disorder that is carried on the X chromosome
- Genetic disorders can be passed on by 'carriers' who are not affected by the condition themselves

PREPARATION

- Gather the following resources:
  - Pairs of socks, with some socks cut in half to represent the Y chromosome. If socks are not available, coloured counters or other materials can be used.
  - A sticker needs to be attached to one sock (X) to indicate the presence of the dystrophin gene for Duchenne Muscular Dystrophy.
- Print worksheets

Activity

- Show the pupils **Connor's film** from the Genes Are Us website
- Divide the students into pairs or small groups and give each group 4 socks
  - 3 representing X chromosomes (one of which has a sticker)
  - 1 representing the Y chromosome

  These represent the chromosomes present in Connor's parents.
- Follow the instructions on the worksheet to randomly select new pairs of socks. They must then work out which gender a child with those chromosomes would be, and whether they would be affected by DMD.
- Students then complete the worksheet based on the information in the video and from the activity.

				
	MALE	MALE	FEMALE	FEMALE
	Should see a tally of roughly 5 in each box, but obviously the odds are that some groups won't get an even split.			
	YES	NO	NO	NO
	NO	NO	YES	NO

ANSWERS

1. On which chromosome do you find the dystrophin gene?

X chromosome

2. How many copies of the dystrophin gene do females have?

2 copies

3. If you are a female carrier of Duchenne Muscular Dystrophy - what is the chance of having a baby affected by DMD?

1 in 4 with every pregnancy

4. How would you feel if your first baby was affected by Duchenne Muscular Dystrophy?

The pupils might suggest lots of ideas, such as: Devastated. Probably had no idea it could happen to you (this often happens to families when no relatives have been affected before). Guilty for passing it on. Determined to make their lives as happy as possible.

5. How would you feel about having another baby?

The pupils might suggest lots of ideas, such as: Scared about it happening again and chances are quite high of it happening again. Interested in finding out about having screening to stop myself passing it on. Just accept what happens and make the best of it.

EXTENSION

The sock activity could be modified to demonstrate dominant and recessive inheritance.

Alternatively, you could try role plays with the pupils eg. Connor's parents meeting with a genetic counsellor following Connor's diagnosis? What sort of questions would the family ask? How might the counsellor explain about the inheritance of DMD?

FURTHER information

See Genes Are Us Teacher Factsheet on DMD for basic information. For more detailed information, link to the patient support group: Muscular Dystrophy Campaign:

www.muscular-dystrophy.org

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PUPIL WORKSHEET

THE SOCK X CHANGE

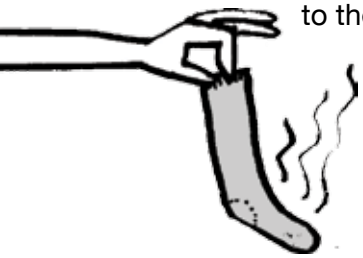
Duchenne Muscular Dystrophy (shortened to DMD) is a genetic condition that follows an X-linked inheritance pattern.
Your teacher has given you some socks. In this activity these socks represent chromosomes.
You are going to think about the way chromosomes are passed on from parent to child.

INSTRUCTIONS

- One person is invited to be Mum in this activity. Give this person a pair of matching socks (these represent two X chromosomes). XX = female.

  You will notice that one of the socks has a sticker attached. This indicates the location of a faulty copy of the dystrophin gene. This woman is a carrier of DMD.

- Another person is invited to be Dad. Give them the large and the small sock (these represent one X and one Y chromosome). XY = male.
- This Mum and Dad are going to have a baby. Each parent passes on half of their chromosomes to their child, so we need to select which chromosomes they pass on.



- People with the socks need to hold the socks behind their backs and mix the socks up randomly between their hands.
- After 30 seconds of mixing the socks – someone selects the right hand or left hand and this decides which chromosome is passed on to the baby.
- Work out whether you have had a boy or girl and complete the table below with your results.
- Repeat the 'sock selection' 20 times and note down the results in the table below.

X chromosome = **blue**
Y chromosome = **green**
Working copy of dystrophin gene = **yellow**
Faulty copy of the dystrophin gene = **red**

The shapes to the left represent the X and Y chromosomes

Fill in the empty columns of this table.

Gender (male or female)				
Tally how many times the socks you selected fitted these combinations				
Affected by DMD (Yes or No)				
Carrier of DMD (Yes or No)				

THE SOCK X CHANGE

QUESTIONS

1. On which chromosome do you find the dystrophin gene?

2. How many copies of the dystrophin gene do females have?

3. If you are a female carrier of Duchenne Muscular Dystrophy - what is the chance of having a baby affected by DMD?

4. How would you feel if your first baby was affected by Duchenne Muscular Dystrophy?

5. How would you feel about having another baby?