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TEACHER'S NOTES
TESTING EMBRYOS

OVERVIEW

Aimed at key stage 4 pupils. This is a simple activity to introduce the process of removing one cell from an embryo to check its DNA (a technique known as pre-implantation genetic diagnosis).

LEARNING OBJECTIVES

- To review cell structure and the process of fertilisation
- To understand what IVF involves and that during this process one cell from an early embryo can be removed to test for serious genetic conditions (this technique is called pre-implantation genetic diagnosis)
- To explore some of the ethical challenges raised by this technique

CURRICULUM LINKS

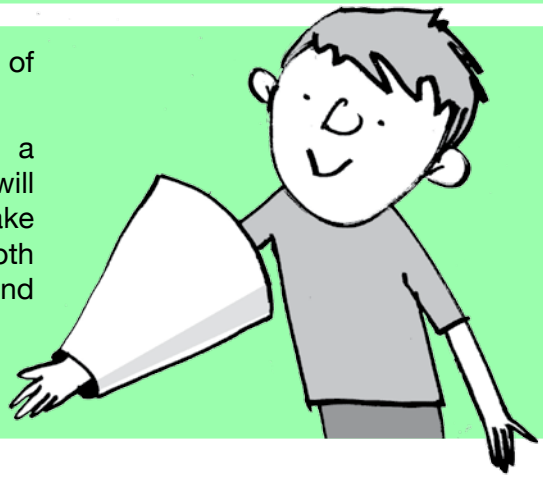
- **KS4**: The ways in which organisms function are related to the genes in their cells
- **KS4**: Human health is affected by a range of environmental and inherited factors, by the use and misuse of drugs and by medical treatments
- **KS4**: the use of contemporary scientific and technological developments and their benefits, drawbacks and risks
- **KS4**: to consider how and why decisions about science and technology are made, including those that raise ethical issues, and about the social, economic and environmental effects of such decisions

YOU WILL NEED

- Plain A4 paper (1 piece per pupil)
- Sellotape (3 rolls)
- Scissors (a class set)

PREPARATION

- Draw 3 sperm cells on one piece of A4 paper and cut them out.
- Make a cone shape by rolling a large piece of card or paper (this will represent the tip of a pipette.) Make sure that there is a hole at both ends (big enough to get your hand through – see picture.)



Activity

- Show films from **www.genesareus.org** to review how different genetic conditions can affect people.
- Explain that some people at risk of passing on serious genetic conditions to their children sometimes decide to use testing in pregnancy to avoid passing the condition on.
- Discuss the options available to people in this situation (see answers to Q1).
- In this activity, we will go through pre-implantation genetic diagnosis in detail to understand what is involved. We will pretend that the classroom is a petri dish and build some embryos out of pieces of paper. Everyone needs to draw a cell to contribute to this model.
- Give each pupil a plain piece of A4 paper and ask them to draw a large human cell. Ask them to cut it out and include and label important parts (for example, nucleus, chromosomes, cytoplasm).
- Explain that eggs need to be collected from a woman. In our case only three good egg cells

Activity

continued

were extracted. Ask 3 pupils to volunteer to use their cell to represent those eggs.

- Teacher uses the drawings of sperm cells to fertilise the egg cells. Use tape to stick the nucleus of a single sperm on top of the nucleus of each egg (the tail of the sperm could be ripped off, as they do not enter the egg).
- Explain that the chromosomes from the egg and sperm combine and from then on all the other cells of the embryo will have the same DNA.
- Explain that gradually the embryo will grow. After about one day the first round of cell division should happen. Ask volunteers to add one cell to original cell and stick them together.
- On day 2 another cell division should happen. Ask volunteers to add their cells and stick them all together (each embryo will now have 4 cells).
- Repeat so that the embryos are at the 8-cell stage and that all the cells are stuck together. The growth of the embryo to this stage will have taken about 3 days.
- Explain that not all embryos develop well and the process relies on growing the cells in the optimum conditions (right temperature, nutrients, and so on).
- Once the embryo is at this stage it is possible to carefully remove one of the cells (a biopsy) and test its DNA. Use the cone to represent the pipette tip and gently reach through the hole with your hand to remove one cell from the embryo. There are short films of this process available online to help explain the process.
- **Note: It is possible to do the biopsy at a slightly earlier or slightly later stage, but day 3 is the most common approach taken.)**
- The DNA inside this cell can be tested and this will tell us if any genes are changed in such a way that they will cause a serious genetic condition (for example, Huntington's disease, Duchenne muscular dystrophy).
- Tell the students that the test results on this occasion show that only one of the embryos is suitable to use (in other words - no harmful gene changes were detected). This embryo will be put into the uterus where hopefully it will implant. The other embryos cannot be used.
- This technique is called pre-implantation genetic diagnosis (PGD).
- It is important to explain that only a small number of babies are born this way and the Human Fertilisation and Embryology Authority (HFEA) tightly controls what is done. It is not possible to correct any mutations found, or 'design' the baby to have particular features.
- Ask students to complete the worksheet.
- **Note: Please be aware this topic could lead into discussions about some sensitive issues, such as testing in pregnancy (possibly leading to termination) and whether life begins once fertilisation has taken place.**

ANSWERS

1. What options are available to parents who are at risk of passing on a serious genetic condition? (list as many options as you can think of)

Parents in this position could decide to:

1. have children without using any testing
2. not to have children at all
3. adopt children
4. use donor eggs and/or sperm
5. get pregnant and use testing during the pregnancy (prenatal diagnosis) to find out if the foetus is affected (this could lead to them terminating the pregnancy if the foetus is affected).
6. test embryos before they are implanted in the uterus (PGD)

2. Explain what in vitro fertilisation means.

Creating an embryo outside the body.

3. When was pre-implantation genetic diagnosis first successful?

c) 1990

4. What can be tested for as part of PGD in the UK?

b) A specific list of serious conditions

5. Why do you think some people prefer the idea of PGD instead of prenatal diagnostic testing at 16 weeks into a pregnancy?

If someone has a prenatal diagnostic test at 16 weeks into a pregnancy and the foetus is affected by a serious condition, they may choose to terminate/abort the pregnancy. PGD involves much earlier testing and would avoid such difficult decisions at a later stage of the pregnancy.

6. Why do you think some people are concerned about PGD?

Pupils might express a number of concerns, but the main concern is likely to be the idea of extending testing so that all kinds of characteristics are checked (for example, genes associated with intelligence, athletic strength, hair colour, and so on). They might feel concern about the way the technology is currently used to test for serious genetic conditions. They might also express concern about the idea of embryos being discarded, but this does routinely happen in IVF anyway.

FURTHER information

- The Human Fertilisation and Embryology Authority (HFEA) website has excellent information introducing PGD and explaining what genetic conditions can be tested for: **www.hfea.gov.uk**
- One of the UK specialist centres offering PGD (Guy's Hospital in London) has detailed information about PGD and an excellent short film showing the biopsy process **www.pgd.org.uk**
- You might want to use online films to show embryological development. You could use the trailer from the film 'Gattaca' to prompt discussion, but you need to emphasise that the film is fiction.
- This activity could be used to stimulate a class discussion about the advantages and disadvantages of PGD. There is a free card game you can download to support group discussion on PGD **www.playdecide.eu**

EXTENSION

- This activity could also lead to a discussion about stem cell research and sourcing stem cells from embryos.

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STUDENT WORKSHEET

TESTING EMBRYOS

Parents who know they could pass on serious genetic conditions to their children have a number of options available to them. These are very difficult and personal decisions. They will be able to talk to health professionals about their options and decide what is right for them. There is no pressure for them to use testing in pregnancy if they do not want to.

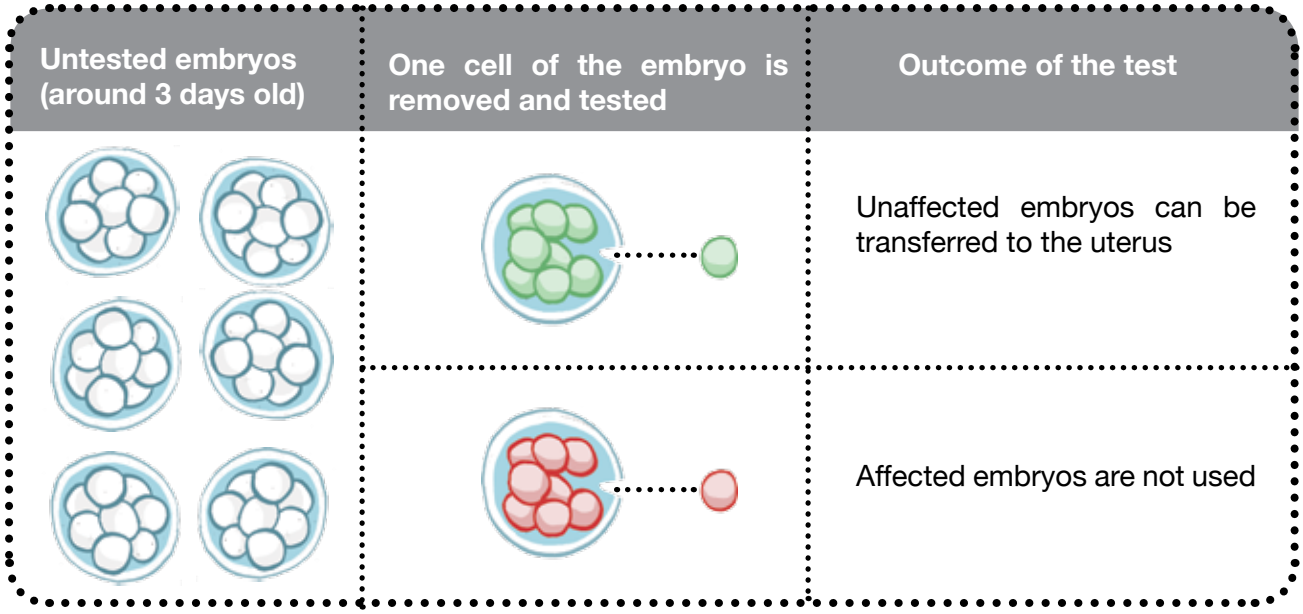
1 ***What options are available to parents who are at risk of passing on a serious genetic condition? (list as many options as you can think of)***

One of the options is to use a technique called pre-implantation genetic diagnosis (**PGD**). This allows embryos to be identified which do not have a gene change causing a serious genetic condition. **PGD** is not done very often and in the UK about 100 babies are born each year after this type of test.

PGD involves removing a cell from the early embryo to test its DNA. The first step in the process is for some embryos to be produced through *in vitro* fertilisation.

2 ***Explain what* in vitro *fertilisation means.***

How does **PGD** work?



3 ***When was pre-implantation genetic diagnosis (PGD) first successful for humans?***

a) 1963
b) 1978
c) 1990

4 ***In the UK, what can be tested for as part of PGD?***

a) Anything parents want – if they are prepared to fund it
b) A specific list of serious conditions

5 ***Why do you think some people prefer the idea of PGD instead of prenatal diagnostic testing at 16 weeks into a pregnancy?***

6 ***Why do you think some people are concerned about PGD?***