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Immunity, vaccines, and antibodies: protection against infection

How can we identify who is vaccinated and predict their risk of infection?

Introduction

- Immunity is the ability of our bodies to detect and fight against infections; the immune system is responsible for creating this immunity
- Antibodies are produced by immune cells in response to infections or vaccination and are key in protecting us against infections we've been exposed to before
- Young babies can have weak immune systems and are vulnerable to infections
- Our immune systems work less when we get old, and we become more vulnerable to infections and respond less well to vaccines
- Immunity levels in people are indicated by **the presence of antibodies in the blood**
- **Increased antibodies** correlate with **increased protection** against infections
- **Vaccinations provide immunity** against specific infections; they stimulate the production of antibodies. So, someone that is fully vaccinated will have increased antibodies compared to partially vaccinated individuals.
- **A person's age, their antibody levels and vaccination status** can help predict whether they are protected from an infection

The **aim of the activity** is to **help students understand how vaccines provide protection, how we detect levels of antibodies in the blood and t understand some factors that influence immunity.**

The pupils should predict and then identify which of three individuals are protected against a virus.

The activity is based on a test used in research and in medicine, which detects antibodies in the blood. This test is called an ELISA.

List of materials required

- ✓ Red cabbage juice (*extracted from boiling red cabbage or by blending red cabbage leaves with water and straining it*)
- ✓ White vinegar
- ✓ Water
- ✓ Small containers (4x per pupil group)
- ✓ Plastic transfer pipettes (or any object that can help transfer drops of liquids between containers)
- ✓ Tags to indicate a baby; an adult; an elderly person
- ✓ Adult supervision
- ✓ Small groups of 2-4 pupils

Time required

Preparation: >1hr for preparation of cabbage juice and the containers.

In class: around 20 minutes, depending on the number of students and time taken to compare and explain.

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THE ACTIVITY

Preparation for the experiment, repeat for each group of pupils

- ✓ Label three separate containers indicating:
  1. The baby's container, unvaccinated
  2. The middle-aged adult's container, fully vaccinated
  3. The elderly adult's container, poor response to vaccine
- ✓ Fill the labelled containers as follows:
  - **The baby container should have water only**
  - **The adult container should have half vinegar and half water**
  - **The elderly container should have one drop of vinegar in water**
  - All containers should have the same volume of liquid in total, about 1-2ml
- ✓ Fill separate containers, one for each group of pupils, with cabbage juice ready to give to the groups of pupils

The labelled containers filled with water and vinegar are meant to represent the blood of the different individuals. The cabbage juice is the antibody detector.

During the activity

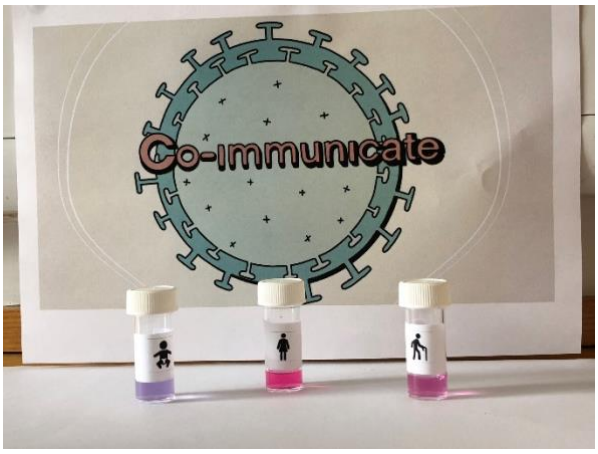
1. Provide each group of pupils with the three different containers and one cabbage juice container
2. Indicate to pupils that a pink colour change indicates high protective antibody levels
3. **Pupils can use the pipettes to transfer 2-3 drops of cabbage juice into each containers**
4. Pupils record the colour change within each container and the differences in colour between the containers
5. Pupils can also compare their findings to other groups
6. Students identify which container belongs to **a) a fully vaccinated individual b) a poorly vaccinated individual c) an unvaccinated individual.**

STEP 3

Post-activity

What to expect?

- The container labelled baby should turn purple: indicating no antibodies and therefore no vaccination.
- The container labelled middle-aged adult should turn bright pink: indicating high antibody levels and a full vaccination program.
- The container labelled elderly adult should turn a milder pink: indicating some antibodies and a poor vaccination.



Questions to prompt discussion

- Which of the individuals is the most protected? Why are they the most protected?
- Why are certain individuals unable to take vaccines e.g. babies?
- How can we protect those that are not vaccinated or cannot respond as well to vaccines?
- What influences the production of antibodies in response to vaccines?