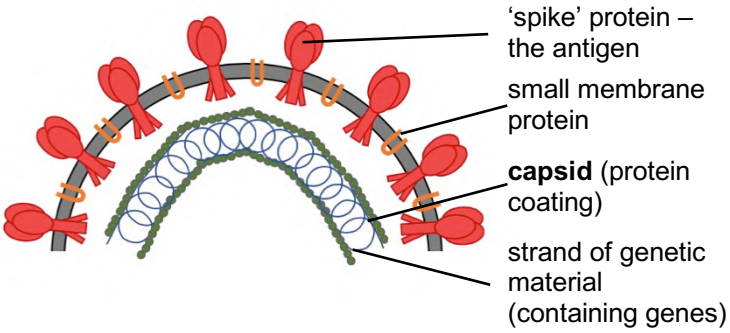
10 New vaccines & COVID-19

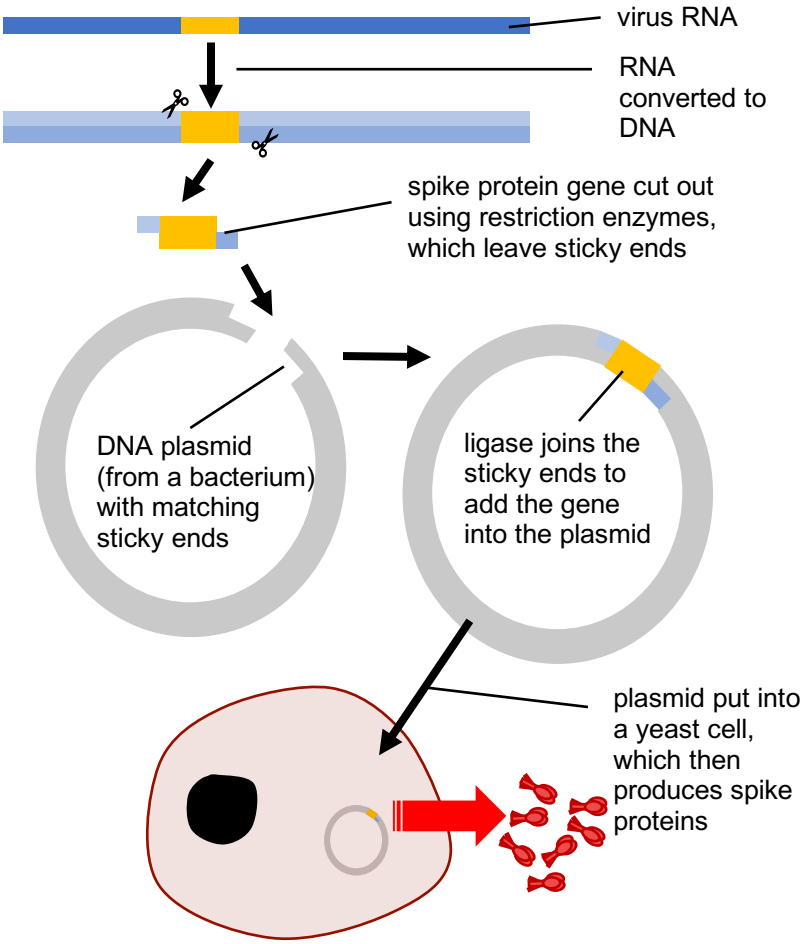
Vaccines



A **vaccine** makes someone immune to a certain **communicable disease.** 'Subunit vaccines' only contain the **antigens** from the pathogen. The 'spike' proteins on the SARS-CoV-2 virus are antigens. **Lymphocytes** in the body detect these antigens as being foreign. This triggers some lymphocytes to make specific **antibodies** that lock onto the antigens and inactivate the virus.

Genetic Engineering

A subunit vaccine for COVID-19 may just contain spike protein molecules. These vaccines are very safe and can be given to people with weak immune systems. They can be made by changing the **genome** (genetic material) of a yeast to form a **GMO**.



The genetic material in SARS-CoV-2 is a long molecule of RNA. This is similar to DNA but needs to be converted into DNA for **genetic engineering**. The **gene** for the spike protein is then cut out of the DNA using **restriction enzymes**, which leave jagged ends on the DNA (**sticky ends**).

A small loop of DNA (a **plasmid**) is then taken from a bacterium. A restriction enzyme cuts the plasmid open, giving it matching sticky ends to the gene. Another enzyme (**ligase**) joins the gene to the plasmid. This plasmid is now a new combination of DNA (**recombinant DNA**). It is then put into a yeast cell, where it causes the yeast to make spike proteins.

Recombinant subunit vaccines are cheap to produce but vaccines using only one antigen do not always work. Scientists are not sure that lymphocytes can be activated by the spike protein on its own (other parts of the virus may be needed). Yeast cells may not manufacture the spike protein in the same way as a human cell, so these spike proteins may not activate the correct lymphocytes.

Find out

I. 1. a. What does GMO stand for? _____

b. In which year was genetic engineering technology invented? _____

2. Go to https://bit.ly/2KPw6MF to see a 'map' of the genetic material from SARS-CoV-2 (after conversion into DNA). The parts of a DNA molecule that different restriction enzymes cut are shown when you hover over them (the enzymes have names like BamHI). The large solid red arrows indicate the positions of the genes. The gene for the spike protein is S.

a. Identify one restriction enzyme that does not produce sticky ends. _____

b. Name two restriction enzymes you would use to cut out gene S. _____

c. Give the name of another gene with a single letter. _____

d. Find out what it does. _____

Test yourself

3. a. A **vector** transfers material from place to place. Explain why the plasmid is a vector.

_____

b. Give the reason that the plasmid on page 1 is described as 'recombinant'.

_____

4. Human insulin is needed by people who have type 1 diabetes. It is produced using a genetically modified bacterium. Sketch a flow chart to show how this GMO was made.

5. Compare the advantages and disadvantages of creating a vaccine in this way.

_____

_____

_____

_____

Check-up

I. Check your answers.

II. Use an app to create a stop motion animation showing how genetic engineering is used to create a subunit vaccine. Include a voice-over.