**Review Worksheet ANSWERS – Vaccines**

1: Define vaccination

(3 marks)

*Vaccination is the artificial (0.5) introduction of antigen (0.5) to provoke antibody-mediated (0.5) immunity (0.5) to a specific pathogen (0.5) without causing disease (0.5).*

2: Live Attenuated vaccines use a weakened form of the pathogen to provoke immunity without causing disease symptoms. Describe how the pathogen is weakened to make the vaccine.

(6 marks)

*The pathogen is grown in chick embryos (1). After the pathogen has been grown in one chick embryo, it is then extracted and grown in another chick embryo, in series (1). During this time, the pathogen becomes more adapted to chicken cells (1) and less adapted to human cells (1), so that it can no longer cause disease (1). The vaccine is then manufactured using the weakened pathogen. (1)*

3: How are inactivated/killed vaccines made?

(4 marks)

*The pathogen is killed (1) using heat (0.5) or chemicals (0.5) so that it can no longer cause disease (1), but the antigenic sites remain (0.5) so it can cause an immune response (0.5).*

4: What are toxoid vaccines?

(2 marks)

*Toxoid vaccines provoke an immune response against a toxin (0.5) produced by the pathogen (0.5). The toxin is inactivated (0.5) by heat or chemicals (0.5), without destroying the antigenic sites, so immunity can develop after vaccination.*

5: How are subunit vaccines made?

(3 marks)

*These vaccines only use part of the pathogen (1), for example the part that has the antigenic site (0.5). This provokes immunity (0.5) without causing disease (0.5) as only part of the pathogen is present (0.5).*

6: How do mRNA vaccines work?

(3 marks)

*mRNA vaccines work by isolating the part of the viral RNA that produces the antigenic protein (0.5), then using this in a vaccine (0.5). The mRNA enters the cytoplasm of the body cells (0.5) and codes for production of the antigenic protein (0.5). The produced antigen (0.5) then provokes the body’s immune response. (0.5)*

7: Which provides longer lasting immunity – live attenuated, or inactivated vaccine?

(1 mark)

*Live attenuated vaccines provide longer lasting immunity.*

8: What is a risk with live attenuated vaccines that is not present with other vaccine types?

(1 mark)

*Live attenuated vaccines can (rarely) revert to their original form and cause disease.*

9: List one disease currently prevented by each vaccine type:

(5 marks)

|  |  |
| --- | --- |
| **Vaccine Type** | **One Disease Prevented** |
| Live Attenuated | *Any one of measles, mumps, rubella, rotavirus, oral polio vaccine, tuberculosis (1)* |
| Inactivated/Killed | *Any one of influenza, pertussis, inactivated (acellular) pertussis, rabies (1)* |
| Toxoid | *Any one of diphtheria or tetanus (1)* |
| Subunit | *Any one of HPV, Hepatitis B, some influenza and some whooping cough (pertussis) vaccines (1)* |
| mRNA | *Covid-19 (1)* |

10: List three ways vaccines can be administered.

(3 marks)

*By injection into skin/muscle (1), orally (1) and via nasal spray (1)*

11: Describe in detail what happens from when the vaccine is injected, until antibody for the specific disease is produced.

(7 marks)

*1: Vaccine is injected/delivered. (0.5)*

*2: Vaccine active ingredient (0.5) ingested by APC (0.5), which presents antigen on its surface (0.5).*

*3: APC presents antigen (0.5) to B-lymphocyte (0.5) with a matching receptor (0.5).*

*4: B-lymphocyte sensitises (0.5), enlarges (0.5) and divides (0.5), producing many more sensitised*

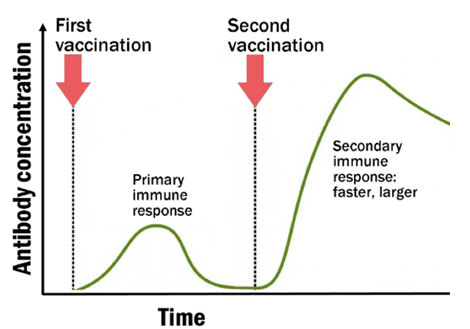
*B-cells (0.5)*

*5: Most sensitised B-cells become plasma cells (0.5). These produce antibody (0.5) that has*

*receptors for the antigen (0.5).*

12: Draw a graph to show the antibody response after the first and second vaccine doses are given.

(3 marks)



*Axes correctly labelled (0.5)*

*Point of first vaccination correctly labelled (0.5)*

*Point of second vaccination correctly labelled (0.5)*

*Primary immune response peak smaller (0.5)*

*Secondary immune response peak much larger (0.5)*

*Secondary immune response peak tails off slowly (0.5)*

13: Explain why the antibody concentration rises so quickly after the second vaccination.

(4 marks)

*After the first vaccination, anti-body mediated immunity develops (0.5) in response to the antigen in the vaccine (0.5). During this process B-memory cells (0.5) are created. These are sensitised (0.5) B-lymphocytes (0.5) that remain in the circulation (0.5) so that when the antigen is encountered in the second vaccination (0.5), the response is quicker (0.5) and much more antibody is produced (0.5).*

14: List and describe three benefits of vaccination:

(3 marks)

*1: They are cheap (0.5): It is cheaper for individuals and communities to vaccinate than to treat the*

*disease (0.5).*

*2: They are safe (0.5): Side effects are extremely rare (0.5).*

*3: They are effective (0.5): They produce immunity without people getting the disease (0.5).*

15: List two common side-effects some people may experience after vaccination.

(1 mark)

*Allergic reaction; local redness and pain*

16: What is herd immunity and who does it protect?

(3 marks)

*Herd Immunity is when enough people (0.5) in the community are immune (0.5) so that the disease can no longer spread (0.5) to people who are not immune (0.5). It protects people who are allergic to the vaccine (0.5), people who are immunocompromised (0.5), and people too young or old to be vaccinated (0.5).*

17: List and Describe the layers of the meninges.

(4 marks)

*Dura mater (0.5) fibrous layer (0.5) adheres closely to inside surface of skull (0.5)*

*Arachnoid mater (0.5) weblike layer (0.5) through which CSF can flow (0.5)*

*Pia mater (0.5) delicate layer (0.5) adheres closely to brain surface (0.5)*