Immunotherapy: How Antibodies Can Be Used to Treat Diseases

Name: _____

Date: _____

Student Quiz—*Answer key*

1. Match the following terms with the right description. Write the letter representing the right description for each term in the table below.

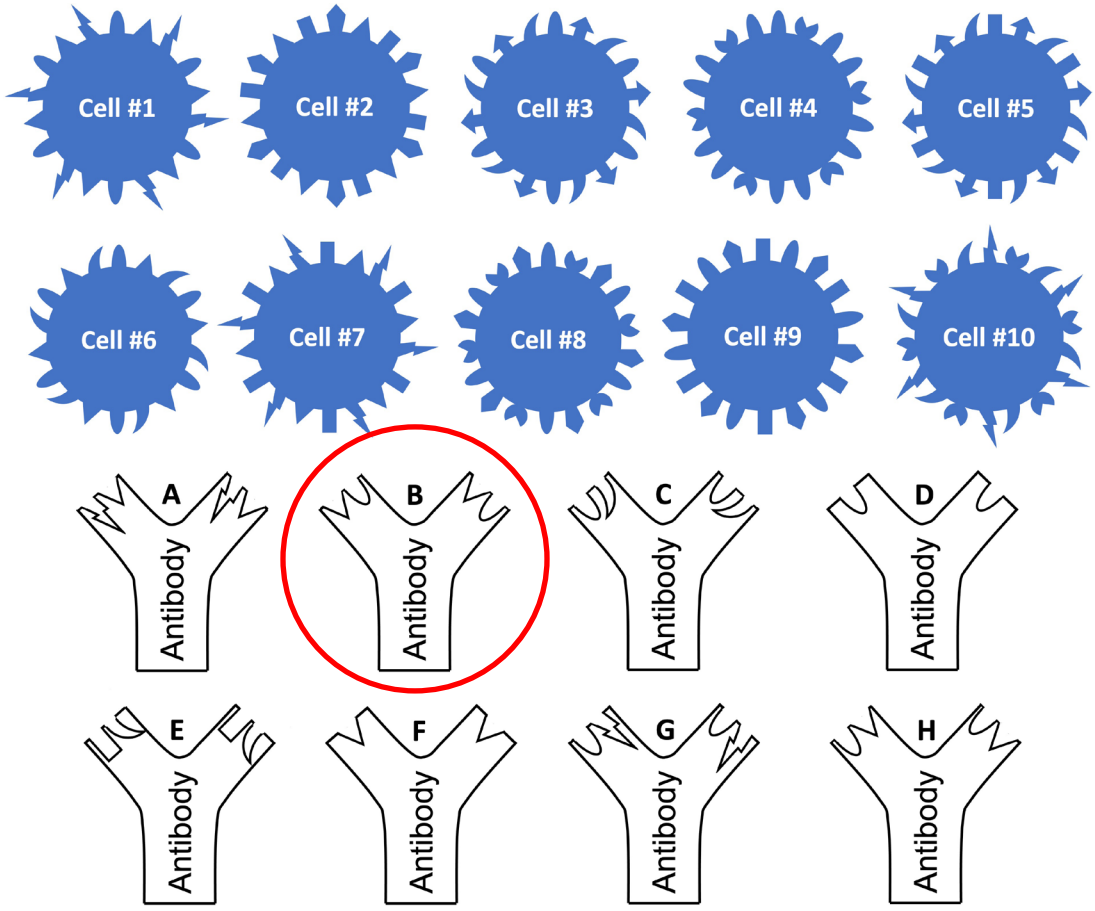
Term	Description #
Antibody	***F***
Antigen	***J***
Monoclonal antibody	***A***
Target antigen	***G***
Bispecific antibody	***B***
Antigen-binding site	***L***
Immunotherapy	***K***

Description	#
Identical antibody molecules produced in the laboratory from a single clone of cells. They all bind to the same antigen.	A
An antibody produced in the laboratory that contains two different antigen-binding sites and can thus bind to two different types of antigens.	B
A y-shaped protein produced by B cells. Consists of a constant region and a variable region that includes specific antigen-binding sites.	F
An antigen linked to the onset, progression, or prevention of disease. It can be targeted by a monoclonal antibody.	G
Any foreign substance or molecular structure that triggers an immune response. Example: specific features or molecular structures on a cancer cell surface.	J
Prevention or treatment of disease with substances like therapeutic antibodies that use the immune system to fight diseases like cancer.	K
Specific region on an antibody that binds to an antigen.	L

Name: _____

2. Which of the following statements is true?
   a. Monoclonal antibodies can treat cancer by blocking molecules that cancer cells need to grow.
   b. Monoclonal antibodies can treat cancer by flagging immune cells for destruction.
   c. Monoclonal antibodies can treat cancer by delivering growth-stimulating hormones to cancer cells.

3. Which of the antibodies below can bind to cell #1 AND cell #6 but no other cells?



Antibody B

Name: _____

4. Monoclonal antibody drugs can also be used to treat infectious diseases. During the COVID-19 pandemic caused by the SARS-CoV-2 virus, several monoclonal antibody treatments were developed to treat the original virus strains. With the emergence of new SARS-CoV-2 variants, such as Omicron, the effectiveness of these monoclonal antibody drugs decreased significantly, which resulted in the FDA gradually revoking all their authorizations. Given what you know about how antibodies work, can you explain why the monoclonal antibody drugs treating COVID became less effective with the emergence of new virus variants?

   Antibodies are highly specific. Their antigen-binding site can only bind to one single target antigen. The monoclonal antibodies for the treatment of COVID were designed to bind to one specific target antigen on the SARS-CoV-2 virus surface. However, the SARS-CoV-2 virus evolved over time, and new virus variants, such as the Omicron variant, emerged that differ from the original virus. When the virus changes over time, the target antigen for the monoclonal antibody can change, too. If this is the case, the monoclonal antibody cannot bind to its target anymore. The monoclonal antibody treatment becomes ineffective. This is what happened during the COVID pandemic. New virus variants, such as the Omicron variant, rendered the monoclonal antibody drugs useless. In cases like this, the high target specificity of the monoclonal antibody drug can become a huge disadvantage.

5. What is usually the first step of the antibody drug development process?
   a. Preclinical research: developing and testing monoclonal antibodies that bind to an identified target antigen.
   b. Clinical trials: testing the efficacy and safety of a promising monoclonal antibody candidate in humans.
   c. Target discovery: identifying a disease-causing antigen that can be targeted by the monoclonal antibody drug.
   d. Manufacturing: producing large quantities of the monoclonal antibody drug.

Name: _____

6. In your own words, describe the difference between monoclonal antibodies and bispecific antibodies.

   Monoclonal antibodies and bispecific antibodies are both bioengineered antibodies produced in the lab from a single clone of cells. The monoclonal antibody has one antigen-binding site that can bind to one single target antigen. The bispecific antibody, on the other hand, has two different antigen-binding sites (a different one on each y-arm). This means it can bind to two different antigens simultaneously.