

Article-Based Observations

Directions: Read the article "[Cancer's sweet cloak](#)" and pay close attention to the diagram titled "Surface tension." Then answer these questions:

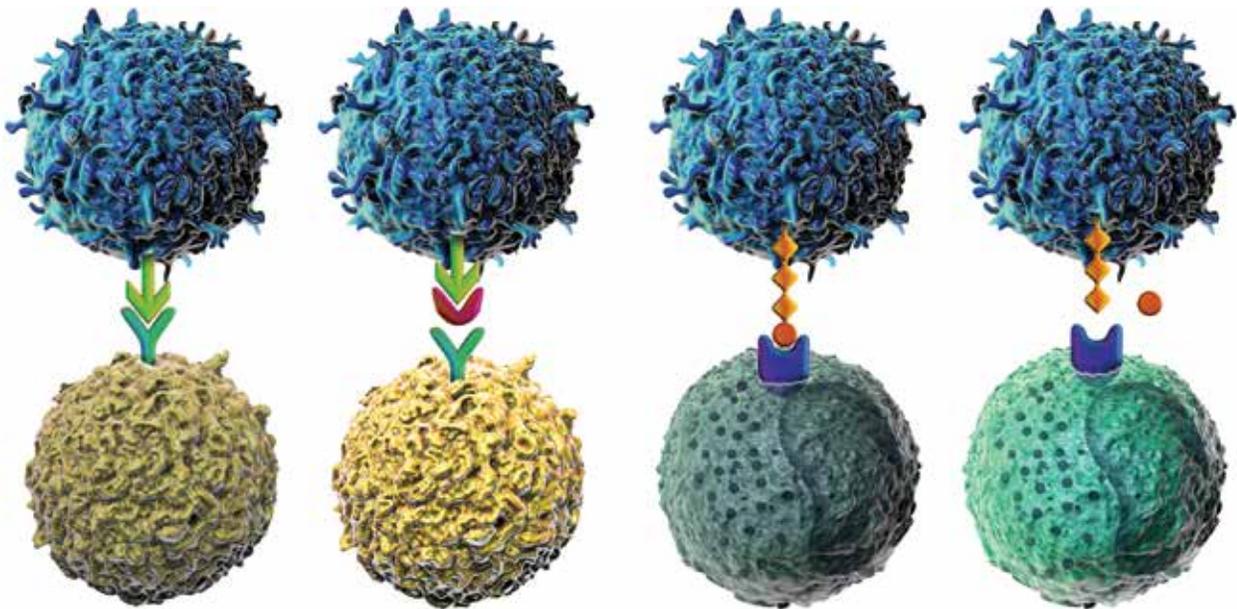
1. How does the author describe a cell's surface in the opening paragraphs? What is a role of cell-surface sugars and proteins as discussed in the article?
2. In terms of immune response, why are cell-surface molecules important? Why are some tumor cells not detected by the immune system?
3. How do protein-based immune therapies work? Why are other types of therapies being explored?
4. Chemist Carolyn Bertozzi of Stanford University studies cell-surface sugars. Why is it difficult to study sugars?
5. How does Carolyn Bertozzi hope to apply her surface-sugar research?
6. What is a macrophage? What have biologist Paul Crocker and his team discovered about macrophages?

7. Explain how sialic acids might serve as a cloak. How did scientists determine that tumors have this cloak?

8. What is Herceptin? How did Carolyn Bertozzi and her coworkers use it as part of an immune therapy plan?

9. Imagine that you are writing a newspaper headline for a story about the research described in this article. Your space is limited and you need to catch readers' attention. Write a short headline that summarizes the article.

10. Using the article as a reference, fully label the diagram below and summarize the immune therapies described by the diagram. Which therapies are already used and which are potential treatments?



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Responses to Article-Based Observation:

- 1. How does the author describe a cell's surface in the opening paragraphs? What is a role of cell-surface sugars and proteins as discussed in the article?** Possible student response: The author likens the cellular surface to Earth's terrain. Sugar molecules extend from cell-surface proteins like the "large fronds" of "palm trees." The cell-surface sugar molecules help cells communicate.
- 2. In terms of immune response, why are cell-surface molecules important? Why are some tumor cells not detected by the immune system?** Possible student response: Cell-surface molecules interact with immune system cells to either trigger or silence an immune response. To avoid detection by immune cells, tumor cells have adopted molecular modifications to their cell-surface molecules.
- 3. How do protein-based immune therapies work? Why are other types of therapies being explored?** Possible student response: Current protein therapies block interactions that suppress the immune system. For example, the PD-L1 protein on a tumor cell is blocked and thus cannot interact with the PD-1 protein to silence T cell response. Current protein-based immune therapies do not work for all types of cancer or for all patients.
- 4. Chemist Carolyn Bertozzi of Stanford University studies cell-surface sugars. Why is it difficult to study sugars?** Possible student response: Even though sugars are prolific on the surface of cells, they are hard drug targets. The author describes sugars as having "unpredictable diversity." The type and location of nucleotides in a protein's DNA sequence helps determine its three-dimensional structure. But sugars are the product of many possible enzymatic reactions, which result in many possible conformations.
- 5. How does Carolyn Bertozzi hope to apply her surface-sugar research?** Possible student response: Bertozzi and her team have found that manipulating sugars on the surface of tumor cells has the potential to expand an exciting new class of cancer drugs. Similar to surface proteins, Bertozzi describes cell-surface sugars as molecular fingerprints, telling a roving immune cell, "This one's OK. Move along." Since these sugars can conceal a tumor cell from the body's immune system, interrupting the intercellular communication by trimming off the sugar may lead to potential new cancer therapies.

- 6. What is a macrophage? What have biologist Paul Crocker and his team discovered about macrophages?** Possible student response: The word macrophage is Greek for “big eater.” A macrophage is part of the innate immune response — it finds and devours pathogens and dying cells. In 1986, Crocker’s team discovered a protein that makes macrophages sticky and later named it sialoadhesin. Checking for signature sequences in the gene that codes for sialoadhesin, researchers were excited to discover that the protein was part of a group of proteins, later named “Siglecs,” that bind to cell-surface sialic acids.
- 7. Explain how sialic acids might serve as a cloak. How did scientists determine that tumors have this cloak?** Possible student response: Cell-surface sugars act like a cloak to disguise tumor cells from immune cells. When sialic acid on a tumor cell binds with Siglec proteins on a natural killer cell, the immune system ignores the tumor. If the Siglec protein is not blocked, the natural killer cell attacks the tumor. Certain pathogens, such as the bacteria that cause gonorrhea or streptococcal infections, coat themselves with sialic acids to hide from the immune system. Several years ago, scientists wondered if cancer cells use a similar trick. That suspicion had roots in a strange but widespread observation — huge amounts of sialic acids clustered on the surfaces of tumor cells. In the late 1990s while starting up her lab at the University of California, Carolyn Bertozzi saw sialic acids as a potential marker for cancer. Bertozzi’s group determined a method of adjusting sialic acid levels on cells to show that sialic acid amount does in fact affect immune response.
- 8. What is Herceptin? How did Carolyn Bertozzi and her coworkers use it as part of an immune therapy plan?** Possible student response: Herceptin is a cancer drug that recognizes a protein called HER2 on the surface of many breast tumors. As an antibody, Herceptin binds to HER2 and marks the tumor cell for destruction by innate immune cells. Bertozzi and her team fused a sialidase enzyme with Herceptin to deliver sialidase to tumor cells.
- 9. Imagine that you are writing a newspaper headline for a story about the research described in this article. Your space is limited and you need to catch readers’ attention. Write a short headline that summarizes the article.** Possible student response: Trimming sugar could lead to new cancer therapy.
- 10. Using the article as a reference, fully label the diagram below ([Page 2 of Blackline Master 1](#)) and summarize the immune therapies described by the diagram. Which therapies are already used and which are potential treatments?** Possible student response: Current immune therapies interfere with protein interactions between cancer and T cells. Potential treatments could target interactions between sialic acids on tumors and sugar-binding Siglec proteins on natural killer cells.