**Text-Dependent Questions and Writing Prompt for Complex Text**

**Article Title:** The Microbiome: When Good Bugs Go Bad

**Vocabulary Questions:**

1. Inflammation is a process by which the body’s white blood cells and their products protect our bodies from foreign invaders. Using information from paragraph six, describe the functions of one of their products.
2. In paragraph ten the author states, “The next step in Belkaid’s work aims to be *translational*. Using evidence from the text, what does *translational* refer to?

**Text Evidence/Content Questions:**

1. Many of the bacteria living in our microbiota are considered commensal and beneficial. How does having many different species of bacteria help protect us from pathogenic bacteria?
2. Thinking about scientific methods, why is it necessary that Dr. Belkaid used mice that are germ-free at the start of the experiment? Use text evidence to support your answer.
3. According to paragraph eight, “Psoriasis and Crohn’s disease occur primarily in the developed world.” Using evidence from the article, what changes might have occurred to encourage this change?

**Writing Prompt:**

Using evidence from both the article, “The Microbiome: When Good Bugs Go Bad” and the video, “The Gut Microbiome and its Impact on our Health,” explain the role of the microbiome in the human body, how and why it can be different from individual to individual, and the side effects that can result due to an unbalanced microbiome. Finally, briefly explain actions that individuals can take to create a healthier microbiome.

**Text-Dependent Questions and Writing Prompt for Complex Text**

**Sample Answer Key**

**Article Title:** The Microbiome: When Good Bugs Go Bad

**Vocabulary Questions:**

1. Inflammation is a process by which the body’s white blood cells and their products protect our bodies from foreign invaders. Using information from paragraph six, describe the functions of one of their products.

*The cells of the immune system produce cytokines, which help fight invading microbes. Cytokines can also cause inflammation. (In addition, paragraph 8 states that IL-17, a cytokine, is implicated in the development of psoriasis.)*

**Misconceptions/common errors**: *Students with only a basic biology background may not understand the role of cytokines. Emphasize to the students that cells often communicate with each other by proteins. When a protein is produced in one cell and then passed to another cell, that protein may cause a chemical reaction inside the second cell. This is how they communicate.*

1. In paragraph ten the author states, “The next step in Belkaid’s work aims to be *translational*. Using evidence from the text, what does *translational* refer to?

*Translational in this article refers to the medical field and human disease. In paragraph 10, the word translation refers to the idea that Dr. Belkaid’s research in the lab on animal models can be used to develop new types of treatments for human diseases. The text states, “The next step in Belkaid’s work aims to be translational. Can we alter the course of disease by actively modifying human microbiota?”*

**Text Evidence/Content Questions:**

1. Many of the bacteria living in our microbiota are considered commensal and beneficial. How does having many different species of bacteria help protect us from pathogenic bacteria?

*The author states in paragraph three that commensal means “to share the table.” The beneficial bacteria take up residence in or on our bodies. By taking up this space or habitat, it reduces space for the pathogenic bacteria to live. Dr. Belkaid states that “because we are ‘home’ for these microbes they protect us as much as we protect them.”*

**Misconceptions/common errors**: *The intense study of the microbiome is relatively new and there is still so much to learn. Students should realize that even though we know the bacteria are there, it is not a simple task to figure out which bacteria should stay and which are there due to an imbalance.*

1. Thinking about scientific methods, why is it necessary that Dr. Belkaid used mice that are germ-free at the start of the experiment? Use text evidence to support your answer.

*A valid scientific experiment should only have one experimental group. If Dr. Belkaid started with no bacteria, then as her team introduced different bacteria they would be able to accurately determine how the two interact and any effects produced. Dr. Belkaid states in paragraph five, “It’s like starting at point zero. Allowing us to selectively add back one, two, three, five, ten individual bacteria at a time-and then see what happens in terms of the immune response….”*

1. According to paragraph eight, “Psoriasis and Crohn’s disease occur primarily in the developed world.” Using evidence from the article, what changes might have occurred to encourage this change?

*The author states in paragraph nine that society has changed many things that might lead to autoimmune problems. “Overusing antibiotics and changing our diets” could alter the microbiota. Other changes such as destroying our relationship with parasitic worms may have also altered our microbiota. The author states, “We are today in a state of imbalance with regards to our microbiota, and our response to that dysregulation has contributed to increased incidence of diseases such as allergies, inflammatory or autoimmune responses.”*

**Misconceptions/common errors**: *Students may not truly understand the concept of an autoimmune disease. Be sure to help clarify that sometimes our immune system can get “confused” and be signaled to attack our own cells. It is important that students look at their bodies as ecosystems. If you removed one species, another can replace it. This is very similar to invasive species in the wild. For example, when an area in Florida becomes disturbed or cleared, it makes room for Brazilian pepper. The Brazilian pepper can quickly take over and forever change the local ecosystem.*

**Writing Prompt:**

Using evidence from both the article, “The Microbiome: When Good Bugs Go Bad”and the video, “The Gut Microbiome and its Impact on our Health,” explain the role of the microbiome in the human body, how and why it can be different from individual to individual, and the side effects that can result due to an unbalanced microbiome. Finally, briefly explain actions that individuals can take to create a healthier microbiome.

*The study of microbiota is one of the newest, most exciting fields currently in science. Microbiota, or the microbiome, is now considered to be an organ. The microbiome provides people with so many benefits, but if it is disrupted or off-balance, then it can lead to disease. Science is currently working on better understanding how the microbiome is linked to inflammation and autoimmune diseases like Crohn’s disease and Irritable Bowel Syndrome. It’s important that people understand the microbiome’s role in the body, how it can be changed, and the side effects that can result from those changes. Most importantly, people need to be aware of the ways they can take good care of their microbiome.*

*Understanding the role that the microbiome plays in the body is important. Microbiota consists of all the bacteria, viruses and fungi that live everywhere in and on the body. What may be most impressive is that “in terms of evolution, these microbes have always been with us,” says researcher Dr. Yasmine Belkaid. The benefits of the microbiome as discussed in the video “The Gut Microbiome and its Impact on our Health,” leads to a well-balanced immune system, aids in digestion, regulates the secretion of hormones and vitamins, and assists in energy extraction from food in the gut. The microbiome is a very important part of the human immune system, but not everyone’s microbiome is the same.*

*One might wonder, “What causes one person’s microbiome to be different from others?” Scientists have recently found that the microbiome’s development begins at birth. As discussed in the video, different types of birth will cause inoculations of different species of microbes. In addition, science shows that diet is very important in determining what bacteria live in the gut. Of course there are some factors that are not easy to control, like genetics and sometimes environment. The different things a person has been exposed to during their lifetime can change their microbiome. For example, Dr. Belkaid explains that the overuse of antibiotics can drastically change the microbiome. The video also adds that heavy use of antibiotics can cause irreversible effects on the microbiome.*

*When a person’s microbiome is changed, many possible side effects can occur.*

*As stated in the article “The Microbiome: When Good Bugs Go Bad,” “Beneficial bacteria compete for space on our body, thus stopping pathogenic microbes from setting up home. These same beneficial bacteria stimulate the cells of our immune system to produce cytokines that fight off invading microbes.” Once the “wrong” type of bacteria set up home in the gastrointestinal tract inflammation can occur. The inflammation that is found in Crohn’s disease and psoriasis is linked to an unbalanced microbiota. Belkain’s research group found that some members of “bad” bacteria are capable of producing a cytokine called IL-17, which has already been implicated in the pathogenesis of psoriasis. The video also states that “The damage caused by a large amount of antibiotic use throughout your lifetime may cause complete loss of certain species of beneficial microbiota and therefore possibly lead to disease.”*

*Considering the possible negative consequences from an unbalanced microbiome, it is important to know how to correct or help take good care of the microbiome. A healthy diet is key to helping maintain or increase the amount of good bacteria in the microbiome. A diet high in fruits and vegetables will help attract the most beneficial types of bacteria. Processed food and frequent use of antibiotics can make the microbiome susceptible to picking up the “wrong” type of bacteria. Doctors are also being encouraged to skip giving antibiotics to patients unless it is absolutely necessary.*

*In sum, the microbiome is an extremely important part of the body. It consists of many different microbes including bacteria, fungi, and viruses. The microbiome is inoculated at birth and its final composition depends on genetics, food, environmental exposure and type of birth. Benefits of a healthy microbiome include a balanced immune system, better digestion, and energy extraction. An unbalanced microbiome can lead to the “wrong” strains of bacteria colonizing the gastrointestinal tract. This could lead to inflammation or the development of disease. People can’t change how they were born or the genetics they inherited, but they can “feed” their microbiome the foods that attract the best bacterial strains in hopes of keeping this important organ in balance.*