**Supplemental Materials**

**Study Text on “Volcanoes” (adapted from Griffin et al., 2019)**

**VOLCANOES**

The Earth’s outer shell is broken into a dozen plates that can converge or diverge. There are three types of converging plate boundaries: oceanic–continental, oceanic–oceanic, and continental–continental. When an oceanic–continental convergence occurs, a denser oceanic plate subducts beneath a continental plate. As the oceanic crust is forced deep into the Earth’s interior, it encounters high temperatures and pressures. The melting of the crust forms magma that rises toward the Earth’s surface, and volcanoes usually form above a subduction zone.

An oceanic–oceanic convergence often results in the formation of an island arc system. As one plate subducts, it melts within the mantle, and the magma rises to the surface of the ocean floor to form volcanoes. If the activity continues, the volcano may grow tall enough to create an island. A continental–continental convergence generally does not involve subduction, but the two plates squeeze and deform each other to form mountains.

Scientists have defined two types of volcanoes: shield volcanoes and stratovolcanoes. Shield volcanoes, such as those in Hawaii, are gently sloping with non-explosive eruptions. In contrast, stratovolcanoes are typically located near convergent plate boundaries where subduction occurs. These volcanoes tend to grow in a cone shape with steep slopes, and erupt violently.

The different abundances of silica in magma influence the explosiveness of an eruption. Magmas that are low in silica tend to be very fluid. Basalt rocks in Hawaii have a low abundance of silica, and high abundances of iron and magnesium. In contrast, most volcanic rocks along continental margins are andesite. Andesite has a high abundance of silica, and low abundances of iron and magnesium. Because basalt magma is fluid, gas in the magma can escape before the eruption, whereas gas is trapped inside andesitic magmas. When andesitic magma nears the vent, the gas bubbles exert outward pressure and lava is ejected violently.

**Supplemental Materials**

**Study Text on “Food Allergies” (adapted from Griffin et al., 2019)**

**FOOD ALLERGIES**

Antibiotics are drugs used to kill bacteria. Since their discovery in the 1930s, antibiotics have cured many diseases. Diseases like pneumonia, tuberculosis, and meningitis are caused by bacteria. Yet, some bacteria that naturally exist in our body help protect us from diseases. For example, bacteria in our digestive tract manufacture B-vitamins and folic acid. They also provide the enzyme lactase for food digestion.

One of the most important functions of bacteria in our digestive tract is to keep in check the growth of parasites, fungi, and yeasts. In a healthy situation, the small intestine epithelium maintains tight cell junctions. This contributes to the physical barrier in intestinal absorption.

The situation changes when people take antibiotics, and consequently, there are not enough bacteria to control the growth of yeasts such as Candida. Candida produces aldehyde secretions that make small intestine epithelial cells shrink, and the cell junctions loosen. This allows intestinal toxins to infiltrate through the epithelium and pass into the blood.

When the intestinal barrier has been compromised by antibiotic use, intestinal toxins are not the only pathogens to be absorbed. The barrier, in a healthy state, selectively allows nutrients to enter the small intestine only once they are fully digested. However, when the barrier is compromised, nutrients can be absorbed before they are fully digested. Just like when intestinal toxins cross the barrier, this prompts an immune response. The body’s immune system will use specific antigen-antibody markers to tag these foods as foreign irritants. Once these foods are tagged as irritants, an immune response will be mounted every time in the future that the particular food touches the epithelia. What started as a Candida irritation with shrinking of the epithelial cells has now been complicated with active inflammation every time a particular food is eaten. The allergic reaction to food particles can be manifested in skin rashes and inflammations.

**Supplemental Materials**

**News Article on “Volcanoes”**

**Mount St. Helens Volcano Erupts In Worst Blast Yet**

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*Causes Under Investigation*

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[Photo masked due to copyright reasons]

Mount St. Helens volcano exploded at 8:39 A.M. today with a thud felt 100 miles away and with a drifting column of steam and ash that turned day into night. The explosion is estimated to have had the power of 500 atomic bombs, and is one of the largest of its kind recorded in history. Flood waters, fires, and mudslides hit shortly after the volcano’s eruption.

Joe Sullivan, 32, and his family witnessed the eruption: “We watched it blow, and there was this massive black cloud. We’re lucky we got out alive.”

Scientists are continuing to monitor the situation. They will be investigating the formation history of Mount St. Helens volcano and the causes of its major eruption.

**Supplemental Materials**

**News Article on “Food Allergies”**

**Boy Suffers Life-Threatening Allergic Reaction**

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*Causes of Boy’s Condition Not Yet Known*

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[Photo masked due to copyright reasons]

At 8:20 P.M. last Friday, a mother rushed into Dr. Lai Yirong’s clinic asking for help. Striding out to the reception area, Dr. Lai saw four-year-old Braxton Ong in distress. Braxton had eaten buckwheat noodles and oranges for dinner with his mother at a nearby eatery. Shortly after, his lips and eyes turned reddish, while his stomach began to bloat.

Dr. Lai said: “He looked like he was struggling to breathe and I realized he had a life-threatening allergic reaction that required immediate treatment.” Dr. Lai administered anti-allergy medication to the child.

Braxton’s condition has now stabilized, and he was discharged yesterday. Tests to determine his medical history and causes of his serious allergic reaction will be done.

**Supplemental Materials**

**Application Test on “Volcanoes”**

Analyze the event reported in the news article: Applying what you have learnt from the prose passage that you studied earlier, (a) What might be the formation history of Mount St. Helens volcano, and (b) the causes of its major eruption? Please answer in as much detail as possible.

**Supplemental Materials**

**Application Test on “Food Allergies”**

Analyze the event reported in the news article: Applying what you have learnt from the prose passage that you studied earlier, (a) What might be the medical history of Braxton Ong, and (b) the causes of his serious allergic reaction? Please answer in as much detail as possible.