Lesson 5.5
End-of-Unit Assessment Part 2
Students’ Explanations

In this lesson, in which students write their final scientific explanations for the people of East Ferris, serves as the End-of-Unit Assessment. Students reflect on and communicate what they have learned about chemical reactions and wastewater treatment through group discussion and independent writing. They begin by reading about wastewater treatment in *Water Encyclopedia* to contextualize how chemical reactions are used in wastewater treatment plants. They then engage in the Word Relationships routine to discuss ideas they have learned using vocabulary related to chemical reactions and wastewater treatment. Finally, students write an explanation about how East Ferris can turn wastewater into freshwater, the second of a two-part End-of-Unit Assessment. The purpose of this lesson is for students to make the connection between chemical reactions and wastewater treatment and demonstrate what they have learned.

**Anchor Phenomenon:** A wastewater treatment plant turns wastewater into clean freshwater.

**Students learn:**

- Wastewater treatment plants use chemical reactions to help them clean wastewater.
Students read about the process of wastewater treatment, which includes chemical reactions, in Water Encyclopedia.

Instructional Guide

1. **Review the Chapter 5 Question.** Remind students they are working to investigate wastewater treatment for Mayor McKnight. Read the chapter question aloud.

   - Remember that Mayor McKnight asked us to learn more about wastewater treatment as a possible solution to East Ferris’s water shortage problem.

   - We need to answer the question *How can East Ferris turn wastewater into clean freshwater?*

2. **Project Wastewater Treatment Plant Diagram.** Have students reflect on the diagram and chemical reactions. If necessary, refer students to the key concepts from Chapter 5.

![Wastewater Treatment Plant Diagram](image-url)
Based on what we have learned through our investigations, what do you think happens during wastewater treatment?

[Engineers add substances to wastewater and a chemical reaction happens.]

3. **Set a purpose for reading.** Hold up a copy of *Water Encyclopedia.*

We have an idea of how wastewater treatment works. Let’s read part of *Water Encyclopedia* to see if we can find additional evidence that supports our idea that a chemical reaction happens during wastewater treatment.

4. **Assign partners and distribute books.** Direct students to use the table of contents to find the “Treating Water for Human Use” section (pages 38–39). Provide time for students to read and discuss.

5. **Discuss the text.** Ask for a few students to share evidence from the text.

What evidence did you find in *Water Encyclopedia* to support our idea that a chemical reaction happens during wastewater treatment?

[We read that during wastewater treatment, objects and particles are removed, and then engineers use chemical reactions to make the remaining particles easier to remove from the water.]

**Teacher Support**

**Instructional Suggestion**

**Providing More Experience: Today’s Daily Written Reflection**

*Why do you think scientists and engineers investigate chemical reactions?* This prompt (on page 108 in the Investigation Notebook) allows students to reflect on the importance of chemical reactions in science and engineering.

**Background**

**Science Note: Wastewater Treatment**

Wastewater treatment is very complex and involves a series of different processes. Even the complicated diagram in *Water Encyclopedia* presents a simplified version of the process. In more detail, this process includes:

- **Screening:** Wastewater flows through a screen, which catches large items like wood and rocks.
- **Sedimentation:** Small particles, such as sand and coffee grounds, settle to the bottom and get pumped out of the tanks. Simultaneously, “scum” (oils, plastics, and other lighter materials) float to the top of the water and get skimmed off the surface.
- **Aeration:** Air is pumped into wastewater to stimulate bacterial growth. Bacteria eat organic material (material that was once alive, such as dead plants or animals) in the water. Sludge—the material left after decomposition by bacteria—settles to the bottom and gets pumped out for further processing.
- **Disinfection:** Wastewater is disinfected by chemicals such as chlorine, which kill harmful bacteria.
Chemical reactions happen throughout this process, but they principally aid in sedimentation. Chemical reactions form solid particles from dissolved metals and cause tiny particles to coagulate into larger aggregations, which can settle to the bottom of the water column.

**Rationale**

**Pedagogical Goals: Reading about Wastewater Treatment**

The purpose of having students read about the process of wastewater treatment is not for them to memorize all of the steps involved, or to fully understand the details of each step such as how bacteria break down organic material in the wastewater. Rather, the book contextualizes and provides evidence for what students have been learning about chemical reactions and allows them to see how chemical reactions are part of a bigger system through which our wastewater gets treated.

**Background**

**Science Note: Sludge**

One aspect of wastewater treatment that this unit does not address is the production of many byproducts. The substances removed from wastewater are often treated further. These substances, known as *sludge*, are then used as fertilizer for farms. You could discuss this with students to introduce another benefit of wastewater treatment.

**Background**

**Science Note: Clean Freshwater, Not Pure Water**

Students may come away from this chapter thinking that the clean freshwater that flows out of wastewater treatment plants is pure water. In reality, wastewater treatment does not remove all substances from the water. It must meet certain standards of quality depending on what it will be used for. Regardless, there are always some substances left in the water. For example, chlorine is often used to disinfect the water because it can eliminate many pathogens in the water, but some chlorine remains in the water that flows out of the treatment plant. For the purposes of understanding the content of this unit, students need not understand this nuance.
Chemical Reactions in Wastewater Treatment

Students read about the process of wastewater treatment, which includes chemical reactions, in *Water Encyclopedia*.

Instructional Guide

1. Review the Chapter 5 Question. Remind students they are working to investigate wastewater treatment for Mayor McKnight. Read the chapter question aloud.

   Recuerden que la alcaldesa McKnight nos pidió que aprendiéramos más acerca del tratamiento de aguas residuales como una posible solución al problema de escasez de agua de Ferris del Este.

   Necesitamos responder la pregunta ¿Cómo puede Ferris del Este convertir las aguas residuales en agua dulce limpia?
2. **Project Wastewater Treatment Plant Diagram.** Have students reflect on the diagram and chemical reactions. If necessary, refer students to the key concepts from Chapter 5.

![Wastewater Treatment Plant Diagram](image)

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Basándose en lo que han aprendido a través de nuestras investigaciones, ¿qué piensan que sucede durante el tratamiento de aguas residuales?

[Los ingenieros agregan sustancias a las aguas residuales y ocurre una reacción química].

Tenemos una idea de cómo funciona el tratamiento de aguas residuales. Leamos parte de la *Enciclopedia del agua* para ver si podemos encontrar evidencia adicional que resalte nuestra idea de que ocurre una reacción química durante el tratamiento de aguas residuales.

¿Qué evidencia encontraron en la *Enciclopedia del agua* para respaldar nuestra idea de que ocurre una reacción química durante el tratamiento de aguas residuales?

[Leímos que durante el tratamiento de aguas residuales, se eliminan objetos y partículas, y luego los ingenieros usan reacciones químicas para hacer que las partículas restantes sean más fáciles de eliminar del agua].
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