

## Lesson Plan

### Comparing Concepts

**Book:** *Everyday Inventions Inspired by Nature*

**Series:** Technology Inspired by Nature

**Level:** Navigator

### Objective

To help students identify similarities and differences between two texts about the same invention and between two inventions based on similar concepts.

### Supplies

- *Everyday Inventions Inspired by Nature* book
- Keeping Cool Guided Reading Assignment (attached)
- Solar Panels and Scales Guided Reading Assignment (attached)
- Paper and pencils

### Before the Activity

Read *Everyday Inventions Inspired by Nature*, or assign it to students to read on their own. Print three copies of the Keeping Cool GRA and three copies of the Solar Panels and Scales GRA.

### Activity

To start, read the following excerpt from *Everyday Inventions Inspired by Nature* out loud:

- Some nature-inspired inventions improve other machines or products. These are called innovations. For example, many people no longer use incandescent light bulbs. Instead, they use LEDs, or light-emitting diodes. These light bulbs use less energy than older bulbs. They also last much longer. The first LED light bulbs did not give off enough light. Some of the light was trapped inside the bulbs. Scientists looked to fireflies for an answer. They studied the firefly's light organ. This part of the firefly's body gives off light. The scientists discovered that the light organ is covered in scales. They also found that the scales do not fit together. Instead, the scales look like shingles on a roof. The sharp edges of the scales cause light rays to scatter. This makes the light look brighter. In 2013, scientists added a similar surface to LED light bulbs. The new surface made the light bulbs 55 percent brighter. (*Everyday Inventions Inspired by Nature*, pp. 11–12)

LED light bulbs are also described in another book from the same series. Read the following excerpt from that book, *Energy Technology Inspired by Nature*, out loud as well:

- Fireflies produce a cold light. They waste little energy in the form of heat. To create the light, chemicals react inside the firefly's body. Scientists tried to copy this chemical reaction. But they could not make as much light as the firefly. They studied the firefly closer. They saw that it had small, overlapping scales. The scales help the firefly's light escape outward. This makes the light brighter. In 2013, scientists applied a similar pattern to light bulbs. They used LEDs, or light-emitting diodes. LEDs use less energy than typical bulbs. The pattern made the LEDs 55 percent brighter. The bulbs used less energy to light a room. (*Energy Technology Inspired by Nature*, p. 18)

Then ask the following questions:

- What are some similarities between these two descriptions? (Answers: Both explain the firefly's light organ; both say early LEDs could not produce as much light; both say the firefly-inspired surface made the bulbs 55 percent brighter.)
- What are some differences? (Answers: The first explains more details about how the scales fit together; the second gives more details about how the organ produces light.)

Several other ideas and inventions are described by both books. To take a closer look at these ideas and inventions, have students form six groups. Give three groups the Keeping Cool GRA. Give the Solar Panels and Scales GRA to the other three groups. Students in each group should write their answers on another piece of paper. Remind students to summarize each text in their own words instead of copying it directly from the GRA.

### **Evaluation**

Collect each group's GRA, and use the attached answer key to give each group up to 14 points.

### **Standards**

This lesson may be used to address the Common Core State Standards' reading standards for informational texts, grade 5 (RI 5.3, 5.2) and the National Science Education Standards' Content Standard E, grades 5–8.

## KEEPING COOL GRA

Read the following paragraphs:

“The Gherkin is a tower in London, England. It was completed in 2003. The Gherkin’s architects were inspired by the Venus flower basket. This tube-shaped sea sponge has a lattice-like structure. The mesh pattern makes the sponge very strong. The Gherkin’s outer walls use a similar pattern. This design helps make the building strong. It also creates a natural ventilation system. The tower’s curved walls allow more air to flow faster around it. Large vents at the bottom suck in the air and move it upward. This helps the building stay cool, requiring less air conditioning.” (*Everyday Inventions Inspired by Nature*, pp. 21–23)

“Termite mounds maintain a constant temperature. Their shape helps with this process. Cool air comes in at the base of the mound. It moves upward into the mound’s warmer areas. Scientists designed a similar system for the Eastgate Centre. This shopping center and office complex is in Harare, Zimbabwe. It uses only one-tenth of the energy needed to cool other buildings of the same size.” (*Everyday Inventions Inspired by Nature*, p. 22)

“Termites are skilled builders. They build large, complex mounds in deserts. Despite the hot sun, the mound stays cool. Scientists wondered how this was possible. They found cooler, muddy areas that the termites had built near the bottom of the mounds. Cool air enters the mound from these areas. Inside, warm air rises. It escapes through huge, chimney-like structures. Termite mounds inspired the design of the Eastgate Centre in Harare, Zimbabwe. The shopping center has shady areas at its base. Inside, hot air rises into large open areas. Then, it escapes through vents in the roof. This design was a success. The Eastgate Centre uses 10 percent of the energy needed to cool similar-sized buildings.” (*Energy Technology Inspired by Nature*, p. 22)

Answer the following questions on a separate sheet of paper:

1. How does the Gherkin’s shape keep the building cool?
2. How does the Eastgate Centre’s shape keep the building cool?
3. How are these two buildings similar?
4. How is the description of the Eastgate Centre in *Everyday Inventions Inspired by Nature* different from the description in *Energy Technology Inspired by Nature*?

## SOLAR PANELS AND SCALES GRA

Read the following paragraphs:

“One species, called the common rose butterfly, has black wings. Its wings have scales with tiny holes. The holes scatter the sunlight that hits them. That way, the wings can absorb more of the sun’s heat. The holes also make the wings lighter. In 2017, scientists used a similar method to help solar panels absorb more light. They created panels with tiny holes. Usually, solar panels must be pointed directly at the sun. But the tiny holes could catch light at an angle. This allowed the panels to absorb more light during daylight hours. As a result, they produced more power. The holes also made the panels lighter.” (*Everyday Inventions Inspired by Nature*, pp. 14–15)

“Scientists have improved solar panels by studying sunflowers. Sunflowers turn to face the sun during the day. This helps them gather as much energy as possible. Scientists used a similar method to create a solar power plant. They built clusters of mirrors around a central tower. The mirrors reflect the sun’s energy at the tower. Then, the tower turns the energy into electricity. Similar to sunflowers, the mirrors turn as the sun crosses the sky. But they do not face the sun directly. Instead, the mirrors find an angle that reflects the most energy at the tower.” (*Energy Technology Inspired by Nature*, pp. 6–8)

“One future technology may be inspired by butterflies. Scientists found that butterfly wings are covered in scales. When sunlight hits the wings, the scales reflect the light. This creates shimmering colors. The scales make the wings bright and colorful. Scientists hope to apply similar scales to computer screens. This would allow computers to have brighter screens while using less energy. They would not need a battery to create light.” (*Energy Technology Inspired by Nature*, pp. 26–27)

Answer the following questions on a separate sheet of paper:

1. How did studying the common rose butterfly help scientists improve solar power?
2. How did studying sunflowers help scientists improve solar power?
3. How are these two inventions similar?
4. How is the invention inspired by butterfly scales in *Energy Technology Inspired by Nature* similar to the invention described in *Everyday Inventions Inspired by Nature*?

## ANSWER KEY

### Keeping Cool GRA

1. How does the Gherkin's shape keep the building cool? (5 points)

The Gherkin is shaped like a sea sponge called a Venus flower basket. The sponge has a lattice-like structure. This shape helps with ventilation. The building's curved walls cause air to flow quickly around the building. And vents near the building's bottom suck air up to the top.

2. How does the Eastgate Centre's shape keep the building cool? (5 points)

The Eastgate Centre is shaped like a termite mound. A termite mound brings cool air in from the bottom. And it sends warm air out the top. Cool air enters the shopping center in a cool, shady area. Warm air rises out through open areas.

3. How are these two buildings similar? (2 points)

Both buildings have vents. Both are kept cool because of air that moves upward.

4. How is the description of the Eastgate Centre in *Everyday Inventions Inspired by Nature* different from the description in *Energy Technology Inspired by Nature*? (2 points)

*Energy Technology Inspired by Nature* gives more details about what the termite mound looks like. That book also gives more details about how the shopping center is similar to a termite mound.

### Solar Panels and Scales GRA

1. How did studying the common rose butterfly help scientists improve solar power? (5 points)

The butterfly's wings are filled with tiny holes. The holes help the wings absorb more light and heat from the sun. Scientists made solar panels with tiny holes. As a result, the panels could absorb more light. This made it possible for them to produce more power.

2. How did studying sunflowers help scientists improve solar power? (5 points)

Sunflowers turn to face the sun as it moves across the sky. Scientists built a solar power plant that used mirrors and a tower. The mirrors reflect energy from the sun toward the tower. The mirrors turn as the sun crosses the sky. They find the angle that reflects the most energy toward the tower.

3. How are these two inventions similar? (2 points)

Both are ways to help produce more power. Both use panels that do not directly face the sun.

4. How is the invention inspired by butterfly scales in *Energy Technology Inspired by Nature* similar to the invention described in *Everyday Inventions Inspired by Nature*? (2 points)

Both use scales to reflect light (to use for solar power or to use on screens). Both help make technology more efficient (to produce more power or to use less energy).