



# TEACHER'S GUIDE

PATHFINDER AND ADVENTURER | VOL. 20 NO. 1

## IN THIS GUIDE:

About the Learning Framework.....	2
Language Arts Lesson and Lesson Frame.....	3-5, 8-9
Think Sheet (English and Spanish).....	6-7
<b>Rethinking Spinosaurus</b> Science Lesson.....	10
Science Master (English and Spanish).....	11-12
<b>The Transformer</b> Science Lesson.....	13
Science Master (English and Spanish).....	14-15
<b>Turning Trash into Treasure</b> Science Lesson.....	16
Science Master (English and Spanish).....	17-18
Article Tests (English and Spanish).....	19-24
Answer Key (English and Spanish).....	25-26

## LEXILE® FRAMEWORK LEVELS

### PATHFINDER

Rethinking Spinosaurus.....	700L
The Transformer.....	640L
Turning Trash into Treasure.....	680L

### ADVENTURER

Rethinking Spinosaurus.....	750L
The Transformer.....	790L
Turning Trash into Treasure.....	870L

## STANDARDS SUPPORTED

- Common Core State Standards (CCSS)
  - Next Generation Science Standards (NGSS)
  - C3 Framework for Social Studies State Standards (C3)
- See each lesson for the specific standard covered.

Educational consultant **Stephanie Harvey** has helped shape the instructional vision for this Teacher's Guide. Her goal is to ensure you have the tools you need to enhance student understanding and engagement with nonfiction text.



Visit [EXPLORERMAG.ORG](http://EXPLORERMAG.ORG) to access digital issues of Explorer magazine in **English** and **Spanish**. Engage students with digital read-alouds, videos, and interactive activities.

# NATIONAL GEOGRAPHIC LEARNING FRAMEWORK

## INTRODUCTION

### BACKGROUND

Since 1888, the National Geographic Society has funded scientists and explorers and shared their findings with the world. To support educators who use our resources, we have created a Learning Framework, which lays out what we believe students should learn from their experiences with the Society.

### PURPOSE

The Learning Framework was designed to convey the Society's core beliefs and values. It is built around a set of attitudes, skills, and knowledge that embody the explorer mindset.

To determine the learning outcomes within the Learning Framework, we dug deep into national standards in key subject areas. We also sought advice from subject matter and child development experts, along with the combined expertise of NG instructional designers, researchers, and content developers. To learn more, go to: <https://www.nationalgeographic.org/education/learningframework/>.

### IMPLEMENTATION

Each article in this magazine has a knowledge-based link to the Learning Framework.

## MINDSET OF AN EXPLORER: KEY FOCUS AREAS

### ATTITUDES



**CURIOSITY** An explorer remains curious about how the world works throughout his or her life. An explorer is adventurous, seeking out new and challenging experiences.

**RESPONSIBILITY** An explorer has concern for the welfare of other people, cultural resources, and the natural world. An explorer is respectful, considers multiple perspectives, and honors others regardless of differences.

**EMPOWERMENT** An explorer acts on curiosity, respect, responsibility, and adventurousness and persists in the face of challenges.

### SKILLS



**OBSERVATION** An explorer notices and documents the world around her or him and is able to make sense of those observations.

**COMMUNICATION** An explorer is a storyteller, communicating experiences and ideas effectively through language and media. An explorer has literacy skills, interpreting and creating new understanding from spoken language, writing, and a wide variety of visual and audio media.

**COLLABORATION** An explorer works effectively with others to achieve goals.

**PROBLEM SOLVING** An explorer is able to generate, evaluate, and implement solutions to problems. An explorer is a capable decision maker—able to identify alternatives and weigh trade-offs to make a well-reasoned decision.

### KNOWLEDGE



**THE HUMAN JOURNEY** An explorer understands where we came from, how we live today, and where we may find ourselves tomorrow.

**OUR CHANGING PLANET** An explorer understands the amazing, intricate, and interconnected systems of the changing planet we live on.

**WILDLIFE AND WILD PLACES** An explorer reveals, celebrates, and helps to protect the amazing and diverse creatures we share our world with.

# LANGUAGE ARTS

## Notice and Use Nonfiction Features to Guide Learning

### Standard Supported

- **CCSS Reading Informational Text:** Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears. (4-7)

### CONNECT & ENGAGE (5 minutes)

*Kids are in a group with you in front of them.*

**Say:** This article, “Turning Trash into Treasure,” is nonfiction. Do you know what nonfiction is? Turn and talk with a partner about what you know about nonfiction.

*Kids turn and talk and share what they know about nonfiction. Make sure kids know that nonfiction is text that gives us true or real information. It includes facts. It is not fiction. It is not made up or make believe.*

**Say:** Let’s browse through this article before we start reading. For this lesson, we are going to focus on some of the features of nonfiction. As you look through the article, what are a few things you notice that are different from fiction, a story that is made up? Turn and talk about what you notice.

*Kids turn and talk about the features of the article and then share out with the class. They should mention things such as chunks of text under different headings, bold type in the text, photos with captions, diagrams.*

### MODEL (10 minutes)

*Kids continue to sit in a group with you in front of them.*

**TEACHER TIP:** This segment of the lesson is about the teacher modeling for students. This should not only be instructive but also interactive.

**Say:** As we talked about, this article is nonfiction, and a lot of nonfiction includes features that can guide our learning. We saw

### What You Will Need

- “Turning Trash into Treasure”
- Think Sheet (Teacher’s Guide, pages 6–7)
- Clipboards
- Pencils

some nonfiction features while browsing through this article. Features like headings, bold text, photos, captions, and diagrams can help us better understand what we are reading.

**Say:** I am going to read through a bit of this article and show you my thinking. I’m also going to write down my thinking on this two-column chart. Let’s look at the first pages of the story. I’m going to read and view what’s on the pages.

*Read aloud the title and text on the first page and refer to the photo.*

**Say:** A title is a feature that we find in both fiction and nonfiction. In nonfiction, a title often gives us a clue about what we will be reading. When I read the title “Turning Trash into Treasure,” I get some good information. The title is letting me know that the article is about trash and turning it into some kind of treasure. By reading and thinking about the title, I have a lot of questions that I can consider as I read on. As I continue to read, the text and photo introduce me to Arthur Huang. I also find out from the text that the trash is plastic, and Arthur Huang has some bold plans for Earth’s mounting piles of plastic trash. However, I still don’t know what the treasure is, so I’m curious about that.

**Say:** Now, I’m going to write on my chart. I’ll put “title” in the “FEATURE” column and “tells about the article” in the “PURPOSE” column. Under “FEATURE,” I’m also going to add “photo.” What is the purpose of the photo? Turn and talk about that.

*Kids turn and talk.*

**Say:** That’s it! The photo lets us see the person the article is about. I’m going to write this in the “PURPOSE” column.

## LANGUAGE ARTS

### Notice and Use Nonfiction Features to Guide Learning

#### GUIDE (10 minutes)

Hand out Think Sheets and have kids attach them to their clipboards. Kids remain in a group with you in front of them.

**Say:** We had a good start with finding nonfiction features, and there are more in this article. As you read and notice a nonfiction feature, write down on your Think Sheet what the feature is and its purpose.

Turn to the next pages.

**Say:** First, let's turn and talk about a feature on the next pages that we already saw and talked about on the previous page.

*Kids should notice the photos.*

**Say:** Did you notice any new features? Turn and talk about that.

*Kids turn and talk and then share what they think are new features.*

**Say:** Did you notice the headings—the bold text in a different color at the top of each column of text? A heading gives you an idea about what the text that follows it will tell you. It's kind of like a title for a section of text.

**Say:** And what about the bold words that appear in the text. What do you think their purpose is? Turn and talk about that.

*Kids turn and talk. They should mention that bold words are important terms. They may also note that bold terms are often defined in a glossary.*

**Say:** Before we continue, write these features and their purpose on your Think Sheet.

Allow time for kids to write.

**Say:** Did you notice the sentences near each of the photos? These are called captions. Captions are a new feature in this article. What is their purpose? Turn and talk about that.

*Kids turn and talk and should note that a caption tells what is in the photo or something about the photo.*

**Say:** Be sure to write about captions and their purpose on your Think Sheet.

*Allow time for kids to read and then turn and talk about what they read and how the nonfiction features helped them understand more about Arthur Huang's EcoArk.*

### COLLABORATE (25 minutes)

**Say:** Now it's time for you to work with a partner. Read through the pages and note all of the nonfiction features you find that we've already talked about and written down on our Think Sheets. If you run across something new, try to figure out what to call the feature and what its purpose is. Jot down anything new you find on your Think Sheet.

*Partners work together. Move around the room, conferring with partners. Kids should notice headings and bold terms as well as the new features.*

- *"Wordwise" is a new feature. It is a glossary that gives definitions of the bold words in the article.*
- *"Trashpresso" and "Circular Economy" are two different types of diagrams that visually show or represent different processes. The illustrated trashpresso diagram shows and explains Huang's invention and how it works. The Circular Economy diagram shows how waste can be used and reused in a continuous cycle.*

*Allow time for kids to read and then talk about the features on these pages. Encourage them to discuss how the features helped them understand what they were reading about Arthur Huang's work—his motivations and goals, his inventions, the materials he uses, and the products he creates from them. You might want to discuss the two diagrams on the pages to make sure kids understand them and their connection to the article*

### SHARE THE LEARNING (10 minutes)

*Kids join a sharing circle with you and share out, using respectful language.*

**Say:** Okay, flip through the article and consult your Think Sheet and choose a feature and purpose you would like to share. I am going to invite [student name] to share new learning. We are going to share using respectful language. So when I ask: "[student name] would you like to share your new learning?" You need to say: "Yes, thank you." Then you can share your learning. After you share, ask if anyone has any comments or questions. Then you can invite someone else to share. To do that, you need to call on the person by name and use the same language we just practiced. When we use polite, respectful sharing language, everyone pays closer attention to the important information being shared. Also, everyone likes to be listened to when they share out, so remember to pay attention to the person who is sharing.

*Kids share out and invite others to share, always using the respectful sharing language that was modeled. There should be time for about 3 or 4 kids to share out with the whole group. Once they are finished, have everyone turn and share with the person next to them, so that all have a chance to be heard.*

**Say:** You learned so much today about nonfiction features. Turn and talk about how they can help us when we read nonfiction.

*Several kids share out.*

**Say:** Awesome job, everyone! Don't be surprised if you start seeing these features in all of the nonfiction you read. As you read more nonfiction, you'll start to find that these features will guide you in learning and understanding.

**THINK SHEET**

As you read, write each feature you see.  
Then write its purpose.

FEATURE	PURPOSE

**HOJA DE PENSAR**

A medida que lees, anota las características que encuentres.  
Luego, escribe cuál es su función.

CARACTERÍSTICA	FUNCIÓN

# LESSON FRAME

## Notice and Use Nonfiction Features to Guide Learning

This frame is a template of the language arts lesson. It has the instructional moves and language of the lesson, but the specific content has been removed. This way you can use the Lesson Frame for the other articles in the issue or for any nonfiction text you might be teaching.

### What You Will Need

- Nonfiction text
- Think Sheet template
- Clipboards
- Pencils

### CONNECT & ENGAGE (5 minutes)

*Kids are in a group with you in front of them. Hold up the article.*

**Say:** This article \_\_\_\_\_ is nonfiction. Do you know what nonfiction is? Turn and talk with a partner about what you know about nonfiction.

*Kids turn and talk and share what they know about nonfiction. Make sure kids know that nonfiction is text that gives us true or real information. It includes facts. It is not made up or make believe.*

**Say:** Let's browse through this article before we start reading. For this lesson, we are going to focus on some of the features of nonfiction. As you look through the article, what are a few things you notice that are different from a story that is made up? Turn and talk about what you notice.

*Kids turn and talk about the features of the article and then share out with the class. They may mention things such as chunks of text under different headings, bold type in the text, photos with captions, and diagrams.*

### MODEL (10 minutes)

*Kids continue to sit in a group with you in front of them.*

**Say:** As we talked about, this article is nonfiction, and a lot of nonfiction includes features that can guide our learning. We saw some nonfiction features while browsing through this article. Features like headings, bold text, photos, captions, and diagrams can help us better understand what we are reading.

**Say:** I am going to read through a bit of this article and show you my thinking. I'm also going to write down my thinking on this two-column chart. Let's look at page(s) \_\_\_\_\_. I'm going to read and view what's on the pages.

*Read aloud the title and text on page(s) \_\_\_\_\_ and refer to any photos.*

**Say:** Well, I'm starting to get some information from the title, text, and photo(s) on these pages. The title is letting me know that the article has something to do with \_\_\_\_\_. Since the photo(s) are showing \_\_\_\_\_, that is giving me a clue that this article is about \_\_\_\_\_. I'm going to write this down on my chart. I'll put "title" in the "FEATURE" column and "tells about the article" in the "PURPOSE" column. Under "FEATURE" I'm also going to add "photos." What is the purpose of photos? Turn and talk about that.

**Say:** That's it! The photos give us information we can see. I'm going to write this information in the "PURPOSE" column.

## LESSON FRAME

### Notice and Use Nonfiction Features to Guide Learning

#### GUIDE (10 minutes)

Hand out *Think Sheets* and have kids attach them to their clipboards. Kids remain in a group with you in front of them.

**Say:** We had a good start with finding nonfiction features, and there are more in this article. As you read and notice a nonfiction feature, write down on your *Think Sheet* what the feature is and its purpose.

Turn to page(s) \_\_\_\_\_.

**Say:** First, see if there are any features here that we've already seen and talked about on previous pages. Turn and talk about that.

*Kids turn and talk with a partner.*

**Say:** What new features did you notice?

*Kids share out.*

**Say:** Now be sure to record these features and purposes on your *Think Sheet*.

#### COLLABORATE (25 Minutes)

**Say:** Now it's time for you to work with a partner. Read through pages \_\_\_\_ and note all of the nonfiction features you find that we've already talked about and written down on our *Think Sheets*. If you run across something new, try to figure out what to call the feature and what its purpose is. Jot down anything new you find on your *Think Sheet*.

*Partners work together. Move around the room, conferring with partners.*

*Allow time for kids to talk about the features on these pages and how they help them better understand what they are reading.*

#### SHARE THE LEARNING (10 minutes)

*Kids join a sharing circle with you and share out using respectful language.*

**Say:** Okay, flip through the article and consult your *Think Sheet* and choose a feature and purpose you would like to share. I am going to invite [student name] to share new learning. We are going to share using respectful language. So, when I ask: "[student name] would you like to share your new learning?" You need to say: "Yes, thank you." Then you can share your learning. After you share, ask if anyone has any comments or questions. Then you can invite someone else to share. To do that, you need to call on the person by name and use the same language we just practiced. When we use polite, respectful sharing language, everyone pays closer attention to the important information being shared. Also, everyone likes to be listened to when they share out, so remember to pay attention to the person who is sharing.

*Kids share out and invite others to share, always using the respectful sharing language that was modeled. There should be time for about 3 or 4 kids to share out with the whole group. Once they are finished, have everyone turn and share with the person next to them, so that all have a chance to be heard.*

**Say:** You learned so much today about nonfiction features. Turn and talk about how they can help us when we read nonfiction.

*Several kids share out.*

**Say:** Awesome job, everyone! Don't be surprised if you start seeing these features in all of the nonfiction you read. As you read more nonfiction, you'll start to find that these features will guide you in learning and understanding.

# RETHINKING SPINOSAURUS

## SCIENCE

### Standards Supported

- **NGSS Science and Engineering Practices:**

- **Engaging in Argument from Evidence:**

Construct an argument with evidence, data, and/or a model. (4-LS1-1)

- **NGSS Science and Engineering Practices:**

- **Engaging in Argument from Evidence:**

Support an argument with evidence, data, or a model. (5-LS1-1)

### What You Will Need

- Interactive digital magazine
- Content Assessment Master (pages 11-12)
- Article Test (pages 19-20)

### SCIENCE BACKGROUND

*Spinosaurus aegyptiacus* lived around 97 million years ago. Stretching more than 15 meters (50 feet) long, it was the biggest and baddest of all meat-eating dinosaurs. It was also a dinosaur that could swim.

*Spinosaurus* floated like a crocodile as it stalked prey in North Africa's rivers. It enjoyed a steady feast of lungfish, sharks, crocodylian creatures, and other dinosaurs. It used its backward-slanted, spike-shaped teeth to catch prey. Its long, powerful arms had hooked claws that snagged anything that tried to get away.

German paleontologist Ernst Freiherr Strommer von Reichenbach discovered the first *Spinosaurus* fossils in 1912. All of the fossils he found were destroyed during World War II. In 2008, National Geographic Explorer Nizar Ibrahim led a team that discovered new fossils. Ibrahim tracked down Stromer's notes and studied the dinosaur further. His work continues to reveal new details about this ancient aquatic predator.

### ENGAGE

Encourage students to flip through the article and turn and talk with a partner to discuss what they see. Invite students to ask questions or share what they already know about *Spinosaurus*.

### EXPLORE

Display the “**Rethinking Spinosaurus**” article from the interactive digital magazine. As a class, brainstorm ideas about why a scientist might “rethink” what he or she knew about a dinosaur.

### EXPLAIN

After reading, have students review the Wordwise feature at the end of the article.

**Ask:** *How are all of these words connected?*

(They identify key parts of the scientific method.) *How do they summarize the way Nizar Ibrahim studied Spinosaurus?* (He observed a bone and other evidence to develop a *hypothesis*. He developed a *method* to conduct *experiments* that tested that hypothesis. Then he formed a *conclusion* based upon the results.) Have students turn and talk as they identify new evidence Ibrahim found and how it affected his conclusion. (He found more fossils of tail bones and studied how they connected to each other. He created digital and real life-size models to test his ideas. The results strengthened his conclusion that *Spinosaurus* spent most of its time in the water.) Encourage students to share what they learned about *Spinosaurus* and the process of scientific discovery.

### ELABORATE

Have students examine photo of the life-size model and the illustration of *Spinosaurus's* tail in the article. Challenge students to identify reasons why the new shape is a good fit for a dinosaur that spent most of its time in the water.

### EVALUATE

Have students complete the **Content**

**Assessment** for this lesson. Encourage them to share and compare the results in small groups.



Click here for the Kahoot! quiz:  
<https://play.kahoot.it/#/k/1658b19c-248c-47ae-b263-ebb2004d2b03>

## CONTENT ASSESSMENT: RETHINKING SPINOSAURUS

Use the organizer to record information about the article.

What are two questions Nizar Ibrahim had to answer before he could form a hypothesis about the strange dinosaur fossil he bought in 2008?

What experiments did he plan and carry out to find the answers?

What conclusion did he reach? What evidence led him to reach this conclusion?

What new evidence did he find? How did it affect his conclusion?

**EVALUACION DE CONTENIDO: REPENSAR EL ESPINOSAURIO**

Utiliza el organizador para anotar información sobre el artículo.

¿Qué dos preguntas debe responder Ibrahim antes de formular una hipótesis sobre el extraño fósil de dinosaurio que compró en 2008?

¿Qué experimentos planificó y llevó a cabo para hallar las respuestas?

¿A qué conclusión llegó? ¿Qué pruebas le llevaron a esa conclusión?

¿Qué nuevas pruebas encontró? ¿Qué efecto tuvieron en su conclusión?

# THE TRANSFORMER

## SCIENCE

### Standards Supported

- **NGSS LS1.A: Structure and Function:** Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1)
- **NGSS LS2.A: Interdependent Relationships in Ecosystems:** Organisms can survive only in environments in which their particular needs are met. (5-LS2-1)

### What You Will Need

- Interactive digital magazine
- Content Assessment Master (pages 14–15)
- Article Test (pages 21–22)

### SCIENCE BACKGROUND

Dragonflies are predatory insects found on every continent but Antarctica. There are about 7,000 different species.

Like many insects, dragonflies undergo incomplete metamorphosis. Females lay eggs in the water. After seven to eight days, the eggs hatch and wingless nymphs emerge. Nymphs may stay in the water for years, hunting aquatic insects, mosquito larvae, and small fish. They molt, or shed their skin, many times as they grow.

After a nymph goes through its final molt, a fully formed adult emerges. The adult has four horizontal wings. Dragonflies are exceptional fliers. They can fly backward, hover like helicopter, and reach speeds up to 56 kilometers (35 miles) an hour as they chase prey. That speed, paired with superior eyesight, means they usually nab what they're after. Adults may only live a few months, so their other priority is finding a mate.

### ENGAGE

Encourage students to flip through the article and turn and talk with a partner to discuss what they see. Invite students to ask questions or share what they already know about dragonflies.

### EXPLORE

Display the **article “The Transformer”** from the interactive digital magazine. As a class discuss what it means to transform.

### EXPLAIN

After reading, invite students to share what they learned about the life cycle of a dragonfly. **Ask:** *How does coloring help nymphs survive in water and dragonflies survive on land?* (Nymphs are brown and green. These colors make it hard for predators to see them in the water. Adults have bright colors that help them attract a mate.) *Why do nymphs and adults eat different foods and how do they catch their prey?* (They eat different foods because nymphs live in water and adults live on land. They have very different body parts, too. To catch prey, nymphs shoot out their lower lip and stab it with sharp spines. They cut the prey into pieces with their strong jaws and sharp teeth. Adults are fast fliers with sharp eyesight. They catch and devour other flying insects in the air. They grab prey with their long legs, bite off its wings so it can't fly away, and then eat the rest of the insect's body.)

### ELABORATE

Invite students to conduct research to identify more insects that undergo metamorphosis. Have them sort the insects they find into two groups: complete and incomplete metamorphosis. Challenge them to create an educational display that highlights key differences between these two types of insects.

### EVALUATE

Have students complete the **Content Assessment** for this lesson. Encourage them to share and compare the results in small groups.



Click here for the Kahoot! quiz:  
<https://play.kahoot.it/#/k/a142392f-c93d-4b62-bebc-ec7e6667dbee>

## CONTENT ASSESSMENT: THE TRANSFORMER

Draw a dragonfly nymph and adult. Then use information from the article to answer each question.

	Nymph	Adult
Draw		
What does it look like?		
Where does it live?		
What does it do?		

What do dragonflies nymphs and adults eat? How do they catch their prey?

---



---



---



---

## EVALUACION DE CONTENIDO: LA GRAN TRANSFORMADORA

Dibuja una ninfa y un adulto de libélula. Luego responde las preguntas a partir de información del artículo.

	Ninfa	Adulto
Dibuja		
¿Qué parece?		
¿Dónde vive?		
¿Qué hace?		

¿De qué se alimentan una ninfa y un adulto de libélula?

¿Cómo cazan a sus presas?

---



---



---

# TURNING TRASH INTO TREASURE

## SCIENCE

### Standards Supported

- **NGSS ETS1.A: Defining and Delimiting Engineering Problems:** Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5-ETS1-1)
- **NGSS ESS3.C: Human Impacts on Earth Systems:** Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. (5-ESS3-1)

### What You Will Need

- Interactive digital magazine
- Content Assessment Master (pages 17-18)
- Article Test (pages 23-24)

### SCIENCE BACKGROUND

Plastic pollution is a growing problem around the world, and National Geographic Explorer Arthur Huang and his team have found an impressive solution. They built the EcoArk, a nine-story building in Taiwan that is constructed out of 1.5 million recycled plastic bottles.

Powered by solar energy and strong enough to withstand fires and earthquakes, EcoArk has been hailed as the future of green buildings. Huang and his team also invented the Trashpresso, an assembly line of machines that transforms plastic trash into six-sided tiles that can be used to build walls, floors, or ceilings.



Click here for the Kahoot! quiz:  
<https://play.kahoot.it/#/k/c029d6fa-c675-4e17-a54c-69e14bab2ba7>

### ENGAGE

Encourage students to flip through the article and turn and talk with a partner to discuss what they see. Invite students to ask questions or share what they already know about recycling plastic.

### EXPLORE

Display the “Turning Trash Into Treasure” from the interactive digital magazine. Invite students to examine the article's photos. Challenge them to identify the type of “trash” this article is about and the type of “treasure” it is being turned into.

### EXPLAIN

After reading, have students share what they learned about upcycling. **Ask:** *How did Arthur Huang build a nine-story building out of plastic?* (He and his team invented a way to reshape and strengthen melted plastic into a new type of building blocks called Polli-Bricks. They assembled the blocks into panels, applied a coating to protect against fire and weather, and used the panels to build the building.) *What is Trashpresso?* (Trashpresso is an assembly line of machines that can shred, wash, dry, and mold plastic into things people can use.) *Why is Huang's work an example of upcycling?* (He recycles materials to create something more valuable than the original.) As a class, brainstorm ideas for other materials and products that could be made from upcycled trash.

### ELABORATE

Point out to students that people are used to building with traditional materials like wood, steel, and cement. As a class, brainstorm ideas about how Arthur Huang could market his product to convince more developers to construct buildings out of recycled plastic.

### EVALUATE

Have students complete the **Content Assessment** for this lesson. Encourage them to share and compare the results in small groups.

## CONTENT ASSESSMENT: TURNING TRASH INTO TREASURE

Summarize how Arthur Huang is turning trash into treasure.

--

Brainstorm ideas for a way you could turn trash into treasure. Draw your invention. Describe how it works. Explain why it is an eco-friendly idea.

Draw	Explain
Describe	

## EVALUACION DE CONTENIDO: DE BASURA A TESORO

Resume cómo convierte Arthur Huang la basura en un tesoro.

--

Haz una lluvia de ideas de cómo convertirías basura en algo valioso. Dibuja tu invento. Describe cómo funciona. Explica por qué es una idea ecológica.

Dibuja	Explica
Describe	

## ARTICLE TEST: RETHINKING SPINOSAURUS

Read each question. Fill in the circle next to the correct answer and then write your response on the lines.

1. Where were the *Spinosaurus* fossils found?

- Ⓐ in Antarctica
- Ⓑ in the Sahara
- Ⓒ in the ocean

2. What did Nizar Ibrahim do to form a hypothesis about the fossils?

- Ⓐ He conducted experiments.
- Ⓑ He came to a conclusion.
- Ⓒ He asked questions.

3. Which experiment did he conduct?

- Ⓐ He observed a live *Spinosaurus*.
- Ⓑ He searched for more fossils.
- Ⓒ He created a digital model on a computer.

4. What did newly discovered fossils reveal about *Spinosaurus*?

- Ⓐ Its jaws were cone-shaped instead of round.
- Ⓑ Its tail was broad instead of narrow and pointed.
- Ⓒ Its feet were webbed instead of hoofed.

5. How did new tests strengthen Ibrahim's ideas about *Spinosaurus*?

---

---

---

---

## PRUEBA DEL ARTICULO: REPENSAR EL ESPINOSAURIO

Lee cada pregunta. Llena el círculo de cada respuesta correcta y escribe la última respuesta en los espacios en blanco.

1. ¿Dónde se encontraron los fósiles de espinosaurio?

- Ⓐ en la Antártida
- Ⓑ en el Sahara
- Ⓒ en el océano

2. ¿Qué hizo Nizar Ibrahim para formular su hipótesis sobre los fósiles?

- Ⓐ Hizo experimentos.
- Ⓑ Llegó a una conclusión.
- Ⓒ Hizo preguntas.

3. ¿Qué experimento realizó?

- Ⓐ Observó un espinosaurio vivo.
- Ⓑ Buscó más fósiles.
- Ⓒ Creó un modelo digital en una computadora.

4. ¿Qué revelaron los fósiles recién descubiertos sobre el espinosaurio?

- Ⓐ Sus mandíbulas eran cónicas en vez de redondas.
- Ⓑ Su cola era ancha en lugar de estrecha y puntiaguda.
- Ⓒ En vez de tener pezuñas en las patas, estas eran palmeadas.

5. ¿Como reforzaron las pruebas que hizo Ibrahim sus ideas sobre el espinosaurio?

---

---

---

---

## ARTICLE TEST: THE TRANSFORMER

Read each question. Fill in the circle next to the correct answer and then write your response on the lines.

1. What are the stages of incomplete metamorphosis?

- Ⓐ egg, larva, pupa, adult
- Ⓑ larva, nymph, adult
- Ⓒ egg, nymph, adult

2. Where do dragonfly nymphs live?

- Ⓐ in the water
- Ⓑ on land
- Ⓒ in the air

3. Which body part do dragonfly nymphs use to catch prey?

- Ⓐ wings
- Ⓑ legs
- Ⓒ lower lip

4. What must dragonfly nymphs do many times before becoming adults?

- Ⓐ molt
- Ⓑ fly
- Ⓒ mate

5. What are three ways dragonfly nymphs look different from the adults?

---

---

---

---

## PRUEBA DEL ARTICULO: LA GRAN TRANSFORMADORA

Lee cada pregunta. Llena el círculo de cada respuesta correcta y escribe la última respuesta en los espacios en blanco.

1. ¿Cuáles son las fases de la metamorfosis incompleta?

- Ⓐ huevo, larva, pupa, adulto
- Ⓑ larva, ninfa, adulto
- Ⓒ huevo, ninfa, adulto

2. ¿Dónde viven las ninfas de libélula?

- Ⓐ en el agua
- Ⓑ en tierra
- Ⓒ en el aire

3. ¿Con qué parte de su cuerpo atrapan las ninfas de libélula a sus presas?

- Ⓐ con las alas
- Ⓑ con las patas
- Ⓒ con el labio inferior

4. ¿Qué deben hacer varias veces las ninfas de libélula antes de llegar a adultas?

- Ⓐ mudar
- Ⓑ volar
- Ⓒ aparearse

5. ¿Cuáles son tres diferencias clave entre las ninfas y las libélulas adultas?

---

---

---

---

## ARTICLE TEST: TURNING TRASH INTO TREASURE

Read each question. Fill in the circle next to the correct answer and then write your response on the lines.

1. What is the EcoArk?

- Ⓐ a boat
- Ⓑ a building
- Ⓒ a bottle

2. What is it made out of?

- Ⓐ glass panels
- Ⓑ concrete and steel
- Ⓒ recycled plastic

3. How does the EcoArk have a zero carbon footprint?

- Ⓐ It burns lots of fossil fuels.
- Ⓑ It gets all of its power from renewable resources.
- Ⓒ It stores all of its waste in carbon containers.

4. What happens during upcycling?

- Ⓐ A product is used and then thrown away, producing waste and pollution.
- Ⓑ A product is used more than once in a variety of different ways.
- Ⓒ A product is recycled to make something more valuable than the original.

5. How does the Trashpresso help create a circular economy?

---

---

---

---

## PRUEBA DEL ARTICULO: DE BASURA A TESORO

Lee cada pregunta. Llena el círculo de cada respuesta correcta y escribe la última respuesta en los espacios en blanco.

### 1. ¿Qué es el EcoArk?

- Ⓐ un barco
- Ⓑ un edificio
- Ⓒ una botella

### 2. ¿De qué está hecho?

- Ⓐ de paneles de vidrio
- Ⓑ de hormigón y acero
- Ⓒ de plástico reciclado

### 3. ¿Cómo consigue EcoArk no dejar ninguna huella de carbono?

- Ⓐ Quema muchos combustibles fósiles.
- Ⓑ Obtiene la electricidad a partir de recursos renovables.
- Ⓒ Almacena todos sus desechos en depósitos de carbono.

### 4. ¿En qué consiste el suprarreciclaje?

- Ⓐ El producto se usa y se tira, lo cual genera basura y contaminación.
- Ⓑ Un producto se usa más de una vez de varias formas diferentes.
- Ⓒ El producto se recicla generando otro nuevo de más valor que el original.

### 5. ¿Cómo contribuye el Trashpresso a crear una economía circular?

---

---

---

---

# PATHFINDER AND ADVENTURER

## ANSWER KEY

### RETHINKING SPINOSAURUS

**Content: pages 11-12**

**Question 1:** Possible responses include: Where were the fossils found? What part of the animal did they come from?

**Question 2:** He used the fossils he'd gathered to create a digital model on a computer. He even made skin for his model. Later on, he built a life-size model.

**Question 3:** He concluded that *Spinosaurus* spent most of its time in the water. Key evidence that brought him to this conclusion included the long tail, webbed feet, and high nostrils.

**Question 4:** He found more *Spinosaurus* tail bones. The bones showed that *Spinosaurus* had a broad tail with bumps on the end. The shape and bumps would have helped the dinosaur swim. This strengthened his conclusion that *Spinosaurus* spent most of its time in the water.

**Article Test: pages 19-20**

1B, 2C, 3C, 4B, 5: Ibrahim created a real model with the new tail shape and tested it in the water. He found that the tail delivers more than eight times the forward thrust in water than the tails of other dinosaurs on land. This made him more certain than ever that *Spinosaurus* spent most of its time in the water.

### THE TRANSFORMER

**Content: pages 14-15**

**Draw:** Students should draw pictures of a dragonfly nymph and adult that resemble those shown on the opening pages of the article.

**Question 1:** Nymph: three body segments, six legs, no wings, eyes far apart, not colorful; Adult: three body segments, two pairs of wings, huge complex eyes that are so close together they touch, colorful body

**Question 2:** Nymph: in the water; Adult: on land

**Question 3:** Nymph: molt, grow, eat, squirt water out of its back end to propel itself through water; Adult: eat, fly, mate

**Question 4:** Nymphs eat insects, small tadpoles, and fish. They shoot out their lower lip and stab prey with sharp spines. Adults eat other flying

insects. They grab prey with their legs, bite off its wings, and then eat the rest of its body.

**Article Test: pages 21-22**

1C, 2A, 3C, 4A, 5: Possible responses: Nymphs don't have wings, adults do; A nymph's eyes are set far apart, but the adult's eyes are close together; Nymphs have brown and green bodies, but adult bodies are brightly colored.

### TURNING TRASH INTO TREASURE

**Content: pages 17-18**

**Summary:** Arthur Huang has found eco-friendly ways to get rid of plastic pollution. He invented a way to turn recycled plastic bottles into strong building blocks. He used the blocks to build the EcoArk, a sleek, modern building in Taiwan. He also created the Trashpresso, an assembly line of machines that change plastic trash into products people can use.

**Invention:** Answers will vary. Students should draw a picture of an invention, describe how it works, and explain why it is an eco-friendly product.

**Article Test: pages 23-24**

1B, 2C, 3B, 4C, 5: In a circular economy, waste is used as a resource to make a product again or to make another product. That is what the Trashpresso does. It changes plastic garbage into useful materials or products, eliminating all waste.

# PATHFINDER Y ADVENTURER

## CLAVE DE RESPUESTAS

### REPENSAR EL ESPINOSAURIO

**Contenido:** páginas 11-12

**Pregunta 1:** Posibles respuestas: ¿Dónde se encontraron los fósiles? ¿De qué parte del animal procedían?

**Pregunta 2:** Utilizó los fósiles que había juntado para recrear un modelo digital en una computadora. Incluso creó una piel para su modelo. Más adelante construyó un modelo a tamaño natural.

**Pregunta 3:** Concluyó que el espinosaurio pasaba casi todo el tiempo en el agua. Las evidencias clave que le condujeron a esa conclusión fueron la larga cola del dinosaurio, sus patas palmeadas y las fosas nasales altas.

**Pregunta 4:** Encontró más huesos de la cola del espinosaurio. Los huesos evidenciaron que el espinosaurio tenía una cola ancha con bultos en la punta. Esa forma y esos bultos le ayudaban a nadar. Esto reforzó su conclusión de que el espinosaurio pasaba casi todo el tiempo en el agua.

**Prueba del artículo:** páginas 19-20

1B, 2C, 3C, 4B, 5: Ibrahim creó un modelo real con la nueva forma de la cola y lo puso a prueba en el agua. Descubrió que la cola del espinosaurio generaba en el agua una propulsión ocho veces mayor que las colas de otros dinosaurios en tierra firme. Esto le convenció más que nunca de que el espinosaurio estaba casi siempre en el agua.

### LA GRAN TRANSFORMADORA

**Contenido:** páginas 14-15

**Dibuja:** Los dibujos de los estudiantes deben ser similares a los de la ninfa y el adulto de libélula que aparecen en las primeras páginas del artículo.

**Pregunta 1:** Ninfa: cuerpo dividido en tres segmentos; seis patas; no tiene alas; ojos separados; colores apagados. Adulto: cuerpo dividido en tres segmentos; dos pares de alas, enormes ojos compuestos que prácticamente se tocan; cuerpo de vivos colores

**Pregunta 2:** Ninfa: en el agua; adulto: en tierra

**Pregunta 3:** Ninfa: muda, crece, come, expulsa agua hacia atrás para propulsarse por el agua. Adulto: come, vuela, se aparea

**Pregunta 4:** La ninfa come pequeños insectos, renacuajos y pececillos. Dispara el labio inferior y atraviesa a sus presas con sus púas afiladas. Los adultos se alimentan de otros insectos voladores. Agarran a sus presas con las patas; les arrancan las alas y luego se comen el resto de su cuerpo.

**Prueba del artículo:** páginas 21-22

1C, 2A, 3C, 4A, 5: Posibles respuestas: Las ninfas no tienen alas, los adultos sí; los ojos de la ninfa están separados, pero los de la libélula adulta están muy juntos; las ninfas tienen el cuerpo marrón y verde; los cuerpos de las libélulas adultas, sin embargo, son de vivos colores.

### DE BASURA A TESORO

**Contenido:** páginas 17-18

**Resumen:** Arthur Huang ha encontrado formas de deshacerse de la basura plástica que respetan el medio ambiente. Inventó una forma de convertir botellas de plástico recicladas en resistentes ladrillos de construcción. Usó esos bloques para construir EcoArk, un elegante y moderno edificio de Taiwán. También inventó el Trashpresso, una línea de ensamblaje de máquinas que transforman la basura plástica en productos que las personas pueden usar.

**Invento:** Las respuestas variarán. Los estudiantes deben dibujar el invento, describir cómo funciona y explicar por qué es un producto ecológico.

**Prueba del artículo:** páginas 23-24

1B, 2C, 3B, 4C, 5: En las economías circulares, los desechos se convierten en el recurso necesario para volver a hacer el mismo producto u otro nuevo. Eso es lo que hace Trashpresso. Transforma la basura plástica en materiales o productos útiles, eliminando todos los desechos.