



**NATURE'S BLUEPRINT!**  
**A Biomimicry Exploration**



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# NATURE'S BLUEPRINT

## A Biomimicry Exploration

Dive into the fascinating world of biomimicry and discover how nature's designs inspire innovation in science and technology. Unlock the secrets of nature's blueprint through these engaging activities.

### Objectives:

1. Examine how engineers mimic nature's designs to solve problems.
2. Apply critical thinking, creativity and problem-solving skills to create biomimicry inspired designs.

### Inspired By:

- **Dirt Camp, 2nd Edition:** Day 6 Soil Engineers
- **Cubelets BOT Builder:** Day 11 Rodeo-Bot

### Materials:

- Books: See a list of recommended books at the end of this guide (optional)
- Paper and pencils for sketches and diagrams
- Craft supplies and recyclables (cardboard, string, glue, scissors, etc.)
- Clay or model magic
- Scissors
- Tape/Glue
- Popsicle sticks (optional)
- Magnifying glass (optional)

### Key Terms:

**Biomimicry:** When people solve problems by getting ideas from nature. It is the design and production of materials, structures and systems that are modeled on living things and processes.

**Function:** What something does.  
Nature: Natural things in our world such as animals, plants, mountains and rivers.

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**Problem:** Something that needs to be solved.

**Prototype:** An original model on which something is patterned.

**Solution:** A way to solve a problem.  
**Structure:** A part of something, such as an animal or plant part.

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### STEAM Connections

- **Science:** Ecosystem Dynamics, Animal Architects, Nature's First Engineers
- **Technology:** Adaptation of nature to high-tech solutions
- **Engineering:** Design Thinking to Develop Possible Solutions
- **Art:** Use a variety of materials to design biomimicry prototypes

### Aligned Standards

#### Common Core State Standards (CCSS):

- Participate in collaborative conversations with diverse partners about topics and texts with peers and adults in small and larger groups.

#### Next Generation Science Standards (NGSS):

- Engineering Design
- Structure and Function
- Analyzing Properties of Matter
- Ecosystem Dynamics
- Biodiversity



#### International Society for Technology in Education (ISTE) Standards for Students:

- Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.

#### National Core Arts Standards (NCAS):

- Apply knowledge of available resources, tools, and technologies to investigate personal ideas through the art-making process.

#### 21st Century Skills:

- Communication and Collaboration
- Creativity and Innovation
- Critical Thinking and Problem Solving
- Flexibility and Adaptability
- Initiative and Self-Direction
- Leadership and Responsibility

#### Habits of Mind:

- Applying Past Knowledge to New Situations
- Creating, Imagining, and Innovating
- Persisting

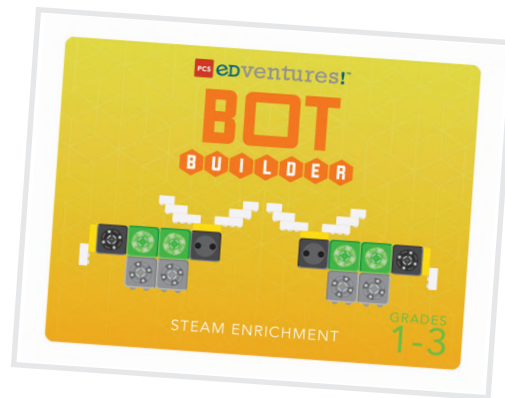


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### Background Information

Dive into the world of biomimicry with these hands-on, STEAM activities designed to inspire critical thinking and curiosity. Inspired by PCS Edventures *Dirt Camp* and *Cubelets BOT Builder*, these engaging challenges invite learners to explore how nature's designs drive innovation in science and technology.



### Why You'll Love It:

- **Quick and Easy Setup:** Minimal materials needed so that you can focus on the fun.
- **Perfect for Grades 1-3:** Tailored to fit the needs of elementary students, but adaptable for any grade level.
- **Interactive and Fun:** Collaborative activities that connect the natural world to engineering.

### Lessons Include:

- **Nature's Inspiration Station:** Explore how natural designs inspire technology.
- **Earthworm Engineers:** Discover how earthworms can inspire solutions.
- **My Biomimicry Creation:** Collaborate and discover how nature's strategies can solve real-world problems.

Each lesson is filled with fun and collaborative STEAM activities that challenge your learners to see nature through the eyes of an engineer. You'll be amazed by learners' creativity when inspired by the genius of nature's design!

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### Lesson 1: Nature's Inspiration Station!

Directions for educators are in black. Discussion questions and examples are in blue for quick and simple implementation.

**Estimated Runtime:** 35 - 45 minutes

#### Prep:

- Be prepared to display images of a diver's flippers and duck's webbed feet. Examples are included in this Educator Guide, but any version of the pictures will do!

### Activity 1: What Is Biomimicry?

**Whole Group Activity:** 10-15 minutes

Breaking down the word "biomimicry" into its roots is a great way to introduce learners to the concept. It helps them understand the term more deeply and connects the idea to its literal meaning.

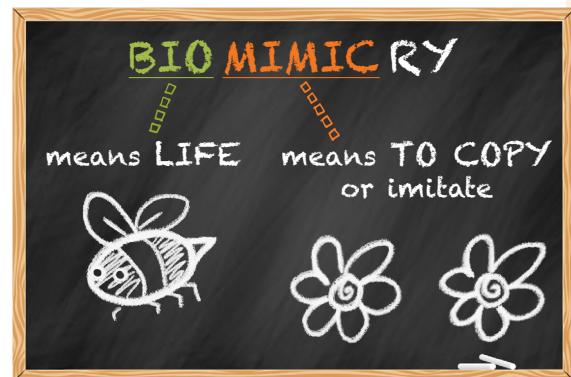
Nature can teach us so many amazing things! Just as we learn by watching our teachers, parents and friends, engineers can learn a lot by watching, or observing, nature. This process has a special name. It's a big word, but we can understand it better by breaking it down.

- Write the word "BIOMIMICRY" on a black or whiteboard where all learners can see it.
- Underline the word "bio." Leave space beneath to include rough sketches.

Bio means life. Can you think of some examples of living things? Let's share a few ideas and I'll draw some pictures to help us remember.

Examples:

- Animals:** dogs, cats, birds or fish
- Plants:** trees, flowers or grass
- Insects:** bees, butterflies or ants



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### Activity 1: What Is Biomimicry? (continued)

3. Next, underline the word “mimic.” Ask learners if they know its meaning (to copy or imitate). Create a sketch, then copy it, to represent its meaning.

When engineers use biomimicry, they look at how living things solve problems. They often use the behaviors and structures they observe to design new technologies and solutions.

### Activity 2: BIO Says

**Whole Group Activity:** 10 minutes

Invite learners to play a game of BIO Says (a twist on the classic Simon Says). Include a mix of animal, plant and insect actions.

#### How to Play:

1. **Follow the Leader:** The leader’s job is to say “BIO Says” followed by an action that a living thing might do.
2. **Act it Out:** Everyone should mimic the action that the leader describes and acts out.
3. **BIO Says:** Only copy the leader if they say, “BIO Says.” Wrong moves mean sitting down. The last player(s) standing win(s)!

Watch and listen carefully. I’ll act as a **living thing**, and you’ll **mimic** my actions!

- **BIO Says,** “Crawl like a caterpillar.”
- Stretch like a tree reaching for the sun.
- **BIO Says,** “Sway like grass in the wind.”
- **BIO Says,** “Hop like a frog.”
- Walk like a crab.
- Stretch like a giraffe.
- **BIO Says,** “Float like a jellyfish.”
- **BIO Says,** “Swim like a shark.”
- Stand like a cactus.
- **BIO Says,** “Waddle like a penguin.”
- Hover like a hummingbird.

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**Independent/Partner Activity:** 15-20 minutes

### Materials:

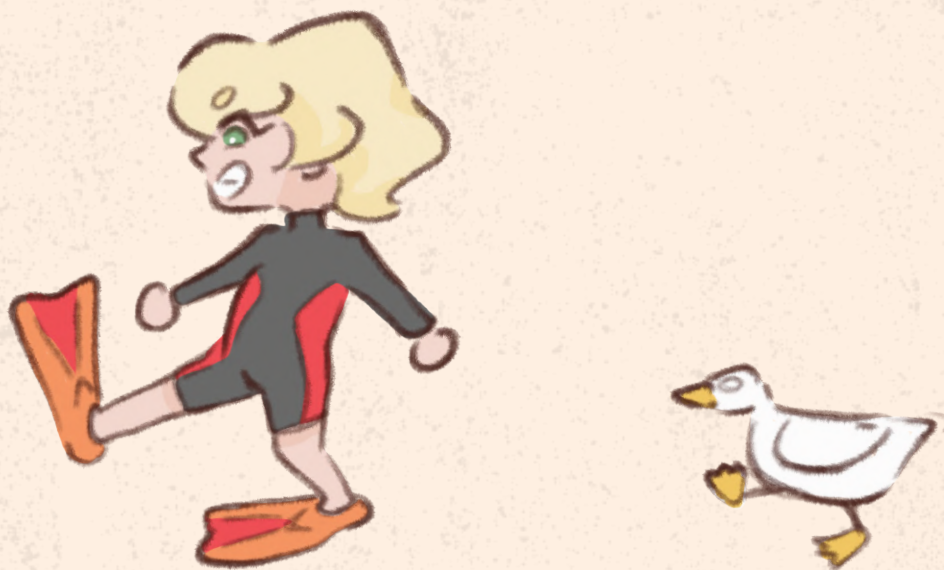
- Student Activity Booklet
- Copies of Nature's Inspiration (Page 12) for each student
- Scissors
- Tape/Glue

### Activity 3: Biomimicry Matching Game

We've explored so many different behaviors of living things today! Now let's think like engineers to see how they inspired some inventions you might know.

For example, look at these flippers that divers use to swim underwater. Do they remind you of something you've seen on an animal? (See Page 9)

If learners do not draw conclusions on their own, guide them toward the answer: a duck's webbed feet. Point out the similarities and discuss how engineers observed the webbing and determined it made swimming easier. If it's effective for ducks, why not let people give it a try?!





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### Activity 3: Biomimicry Matching Game

#### Print, Cut and Paste:

Make copies of the cut-and-paste activity on page 12 of this Educator Guide, one for each learner. Distribute the sheets and guide learners to cut out the squares and match “nature’s inspiration” to “human invention” in their student activity books. Remind them not to glue until after a class review of the answers.

#### Discussion Question:

How do engineers use ideas from nature to fix problems?

Engineers are problem-solvers who design and build things. They often get their ideas from nature because living things have unique, useful behaviors and beneficial features.

#### Extensions:

**Science and Engineering:** Build background knowledge by watching one or more of the following videos:

1. Biomimicry 101 - Examples Of How We Copied Nature  
<https://youtu.be/V2GvQXvjhLA>
2. 27 Inventions Inspired by Nature  
<https://youtu.be/2nrYaty-X1A>
3. Learning from Nature – Biomimicry  
<https://youtu.be/xDQGBr79W1g>

## Cut-Outs: NATURE'S INSPIRATIONS



Fins of a  
Humpback Whale



Cat Eyes



Shark Skin



Gecko Feet



Kingfisher's Beak



Burr or  
Burdock Plant



Bird Wings



Ant Trails

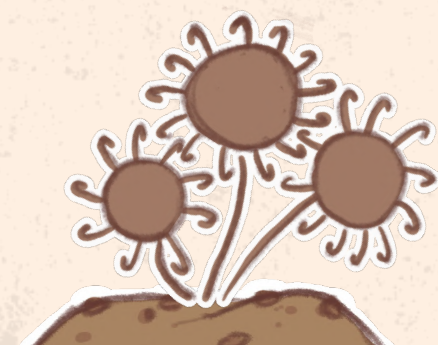
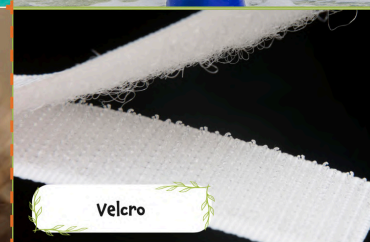
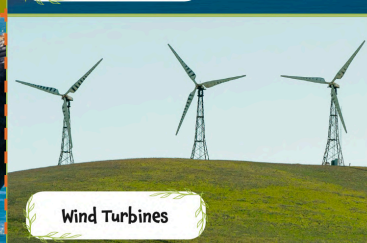


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### Activity 3: Biomimicry Matching Game

#### Answer Key



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### Lesson 2: Earthworm Engineers

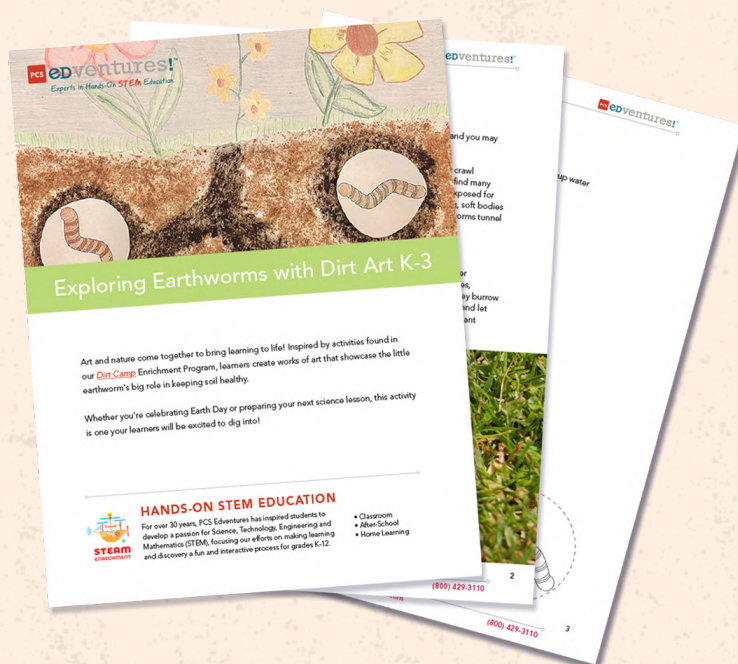
Estimated Runtime: 45-60 minutes

#### Prep:

Read the background information from the PCS Edventures freebie, *Exploring Earthworms with Dirt Art*. This freebie is inspired by *Dirt Camp* where learners in grades 1–3 explore the roles of soil engineers and more through hands-on activities.

#### Materials:

- *Exploring Earthworms with Dirt Art* (<https://edventures.com/blogs/stem-freebies/exploring-earthworms-with-dirt-art>), Background Knowledge
- Student Activity Booklet
- Any type of clay or model magic
- Pencils
- Popsicle sticks (optional)
- Magnifying glass (optional)





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### Activity 1: Observing Earthworms

**Whole Group Activity:** 25-30 minutes

*Have you ever seen an earthworm? Where was it? What did it look like?* Allow time for learners to share what they know.

*Earthworms are super helpful! They help plants grow big and strong thanks to their work underground. Today, we'll learn all about their special features and how they live. We'll even think of some fun and creative ideas inspired by what we learn. Are you ready? Let's dig in and start our earthworm adventure!*

### Procedure:

1. Take a moment to allow students to observe the image of an earthworm in their Student Activity Booklet. Together, create a list of all the unique features they notice.
2. Give each learner a small amount of playdough or modeling clay. Show them how to roll the clay into long, thin shapes, resembling earthworms. Pinch one end to mimic the earthworm's head and use a pencil (or popsicle sticks) to press ridges down the length of the body lightly.
3. Encourage learners to create their own clay earthworms, paying attention to the segments. Provide magnifying glasses for them to examine their earthworms closely.
4. Build on the discussion with details that help learners identify earthworms' structure, function and behavior, such as aerating the soil and breaking down organic matter. This information can be found in the *Exploring Earthworms with Dirt Art* freebie.

### Discussion Questions:

*Do earthworms have legs? How do you think they get around?* No, they do not have legs. Encourage learners to act out how an earthworm might move.

*Do you think earthworms have eyes? Why or why not?* Earthworms do not have eyes. They have light receptors that can sense if there is light. Earthworms live underground where it's very dark.

*What do you notice about the shape and flexibility of your clay earthworms? How might it help them move underground?* Earthworms don't have bones. Their flexible bodies allow them to move through tightly packed soil, creating air pockets that help water flow into the ground and allow plant roots to spread out and grow.

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### Activity 2: Problems Earthworms Could Help You Solve

**Independent/Partner Activity:** 20-25 minutes

#### Brainstorm Strategy 1-2-4

Remind learners that biomimicry is when engineers get ideas from nature to solve problems or create new things. Discuss how earthworms' movement, unique bodies and skills can inspire inventions. Then follow the 1-2-4 brainstorming strategy outlined here:

*Now that you know a bit about how earthworms move and what they can do, let's think like earthworm engineers! What earthworm-like invention would you create? A machine that digs tunnels? A new type of toy? A device that solves a problem?*

*Use your imagination to sketch your invention in your Student Activity Booklet.*

**1 - Individual:** In their Student Activity Booklets, draw an invention inspired by earthworms (structure, function, habits).

**2 - Pair:** Learners share with a partner their ideas, and listen to their partner's ideas. They can add to their drawing or think of something new to draw.

Remind learners that engineers are always building on one another's ideas. Drawing inspiration from others is how we arrive at the best ideas, just like biomimicry!

**4 - Group:** In groups of 4 share ideas, listen to each person's ideas and continue to add to/revise drawings in Student Activity Booklets.

#### Extensions:

##### Science: Go on a Nature Walk

Head outdoors to look for earthworms. Bring magnifying glasses to get a closer look at their structures and observe their behavior.

##### Art: Create Art with Dirt!

Keep the earthworm fun going! Channel learners' inner artists and discover the magic beneath our feet by completing the activity outlined in the *Exploring Earthworms with Dirt Art* freebie.



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### Lesson 3: My Biomimicry Creation

**Estimated Runtime:** Minimum of two 40-60 minute sessions

#### Materials:

- Student Activity Booklets
- Animal Cards for Grouping Students (Page 20)
- Pencils
- Magnifying glasses (optional)

#### Prep:

- Animal Cards for Grouping Students
  - Cut out an animal card for each student
  - Laminate for repeated use (optional)

### Activity 1: Brainstorming Biomimicry Inventions

*Your earthworm-inspired ideas were fantastic! Let's challenge ourselves even further. This time, we'll create designs inspired by some of our favorite living things.*

Learners will work in groups of 3-5 for this activity.

1. Distribute the animal cards provided.

- Animal images include:
  - Elephant
  - Kangaroo
  - Dolphin
  - Mouse
  - Bird
  - Snake (Consider assigning this creature to struggling learners. They can build on their thinking from the Earthworm Engineers lesson.)

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### Activity 1: Brainstorming Biomimicry Inventions (continued)

2. Have learners spread out around the room. Have learners make their animal's sound and act out any of its distinguishing behaviors.
3. Tell learners to find peers mimicking the same behaviors as they are and stick together and continue searching for other group members. Once everyone is found, learners should sit with their group.

*Differentiation:* Feel free to change the groups' assigned animals. Challenge learners to choose a plant or insect. Alternatively, assign one animal for the entire class and discuss observations with the whole group before moving on to the next step.

4. As a group, ask learners to discuss their living being's functions, structures and behaviors. Remind them to refer to the picture cards to make observations, just as they did during their earthworm exploration. Learners can record what they know about their living beings along with anything they notice in the Student Activity Booklets.

Circulate around the room to clarify misconceptions and offer additional items to notice. Consider posting the prompts below somewhere visible to all groups.

Prompts to Guide Discussions:

- *What does your group's living being look like?*
  - *What is special about its shape or color?*
  - *How do its features help it live or grow?*
  - *Sketch/label its functions, structures or habits that might help solve a problem.*
5. Ask learners to brainstorm inventions based on their living being's structures and behaviors. Consider posting the prompts below somewhere visible to all groups.

Prompts to Inspire Innovation:

- *How could we make something that moves like your group's living being?*
- *How would your invention help people or make things easier?*

*Differentiation:* If learners have trouble generating ideas talk about robots and machines that mimic animals, like those featured in *Cubelets BOT Builder* (e.g: animatronic dinosaurs, a robo-gecko that can climb walls or mechanical bulls).

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### Activity 1: Brainstorming Biomimicry Inventions (continued)

Try the following prompts with respective groups:

**Elephant:** Think about how elephants can pick up things with their long trunks.

**Kangaroo:** What problem could be solved with a device that bounced like a kangaroo or had a convenient pouch?

**Dolphin:** How might a smooth, rubbery surface like dolphin skin help solve a problem? What about an invention with structures like dolphins' fins or tails?

**Mouse:** Consider how small and flexible mice are, especially when scurrying in and out of tight spaces.

**Bird:** How might feathers, beaks or wings be useful?

**Snake:** Think back to our discussion of earthworms! Snakes have much larger bodies, but they move similarly. They can also unhinge their jaws to fit big food items in their mouths. Wow!

- Let learners know that they'll soon be building a model of their biomimicry inspired invention. Before bringing the lesson to a close, ask groups to choose the idea their group would like to design.

NOTE: Educators should record each group's ideas for future reference, especially for young learners who cannot write their choices clearly in their Student Activity Booklets.

### Extensions:

#### Science and ELA: Digging Deeper into Biomimicry

Encourage groups to learn more about their living being. Share age-appropriate websites and books, like those in the Recommended Book List at the end of this guide. The more learners discover, the more inspired they'll be!

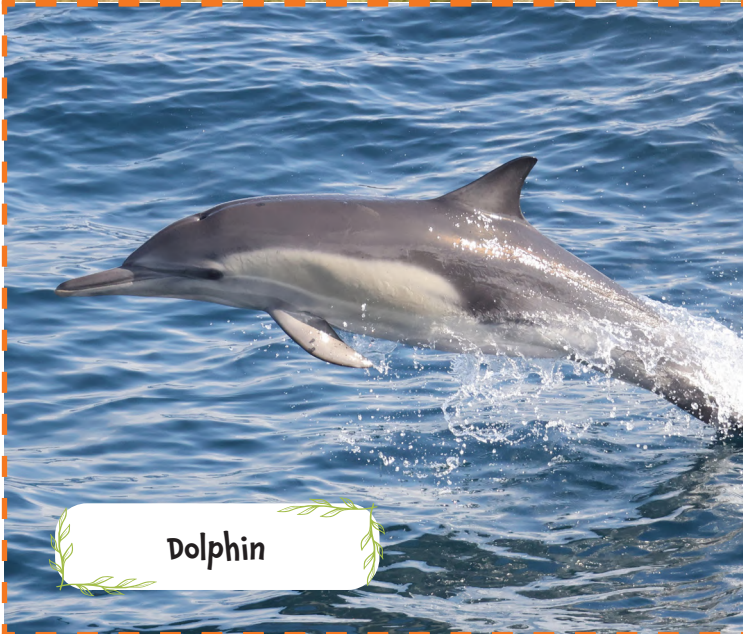




Elephant



Kangaroo



Dolphin



Mouse



Bird



Snake



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### Lesson 3: My Biomimicry Creation

#### Materials:

- Cardstock (at least one per group)
- Various classroom supplies and recyclables as building material

### Activity 2: Bringing Biomimicry Inspired Ideas to Life!

#### Procedure:

Today you'll put together the first build of your biomimicry inventions! Engineers call this process building a prototype. When you draw a new picture, sometimes you take a step back and think: "This could use more color" or "I should change this shape a bit." You make all the changes to your drawing before hanging it up for all to see, right? Nothing is perfect on the first try. That's why engineers always start with a prototype!

1. Discuss in more detail why engineers might make a prototype before fully building their invention. *Prototypes help engineers work out the kinks in their design, visualize its scale and shape and keep costs low in development.*
2. It's build day! Before distributing any materials, ask groups to discuss the following questions with their groups as a reminder of what they worked on during the previous session.
  - *What features did you use as inspiration for your invention?*
  - *What is the problem you wanted to solve?*
  - *How does the invention solve the problem?*
3. Distribute materials and cardstock. Now that groups know what materials are available to them, allow time for them to sketch a preliminary plan for their design on the sheet of cardstock (groups should work collaboratively on one drawing).

NOTE: Remind learners that engineers continually make changes to their prototypes as they meet new challenges. Something that does not work as planned is not a failure. It's an opportunity for engineers to improve their designs.

4. Time to get building! Use classroom supplies and recyclables to create a prototype of each group's biomimicry inspired invention.

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### Activity 2: Bringing Biomimicry Inspired Ideas to Life! (continued)

#### Discussion Questions:

- Did your prototype change as your group worked on it? If so, what changes did you make and why?
- What challenges did you face while building your prototype? How did your group overcome them?

#### Extensions:

##### Engineering: Biomimicry Invention Showcase!

Share prototypes, explaining how each invention solves a problem using an animal, plant or insect as inspiration. Groups can hold a demonstration or participate in an invention gallery walk.





# RECOMMENDED BOOK LIST

## Check out these titles for more fun with biomimicry!

### Biomimicry

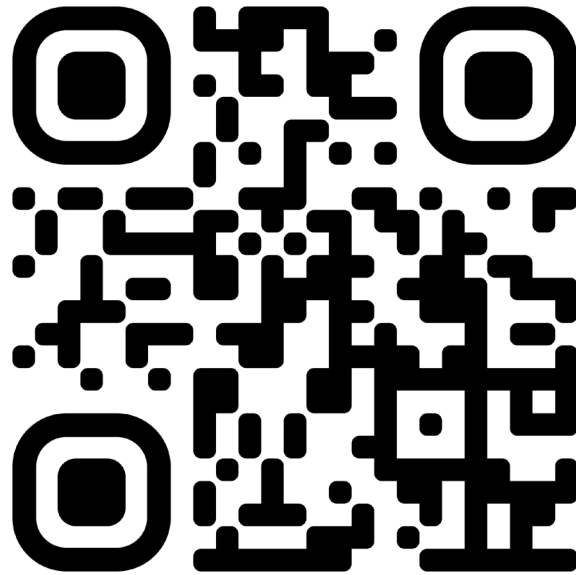
- **Wild Ideas: Let Nature Inspire Your Thinking** by Elin Kelsey (ages 4-6)
- **Nature Did It First** by Karen Ansberry and Jennifer DiRubbio (ages 5-11)
- **Mimic Makers: Biomimicry Inventors Inspired by Nature** by Kristen Nordstrom (ages 7-11)
- **Beastly Bionics: Rad Robots, Brilliant Biomimicry, and Incredible Inventions Inspired by Nature** by Jennifer Swanson (ages 8-12)
- **Invented by Animals: Meet the creatures who inspired our everyday technology (Designed by Nature)** by Christiane Dorion and Gosia Herba (ages 7-12)
- **Inventions Inspired by Flying Animals** by Tessa Miller (ages 8-12)
- **Inventions Inspired by Oceanic Animals** by Tessa Miller (ages 8-12)
- **Inventions Inspired by Mammals** by Tessa Miller (ages 8-12)
- **Inventions Inspired by Reptiles and Invertebrates** by Tessa Miller (ages 8-12)

### Animal Architects

- **Animal Architects: Amazing Animals Who Build Their Homes** by Julio Antonio Blasco (ages 7-11)
- **Animal Architects** by Amy Cherrix (ages 3-8)
- **Trapdoor Spiders** by Claire Archer (ages 4-8)
- **Mighty Ants: Exploring an Ant Colony** by Wiley Blevins (ages 7-10)
- **The Ant Energetic Worker** by Luc Gomel (ages 4-8)
- **Bees Build Beehives** by Elizabeth Raum (ages 5-8)

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