



## Wizards of Wright

### Lesson: Biomimicry

<p><b>Background Info for Wizards:</b></p>	<p>Biomimicry is the science of imitating nature to better human life. Biomimicry is similar to the field of biotechnology. The difference is that with biomimicry, scientists are not looking to change nature, just imitate it.</p> <p>Some examples of biomimicry are: wind turbines modeled after humpback whale fins, absorbing shock like a woodpecker, and ventilation systems modeled after termite mounds.</p> <p>This lesson will encourage students to look at the ways nature has influenced science and engineering.</p>
<p><b>Materials:</b></p>	<p>10 pages - Nature's Carriers and Gliders (1 for each group) 1 airfoil sample 1 sample of camouflage fabric</p> <p>11 Biomimicry Example Bags (1 bag for each group and 1 for demonstration)</p> <ul style="list-style-type: none"><li>- Each bag includes Velcro, shock absorber, toy boat, and a roll of gecko tape</li></ul> <p>11 helicopter toys (1 per group and 1 for demonstration) 11 pages - Nature as Inspiration (1 for each group and 1 for demonstration)</p> <p>1 fan 10 small human replicas</p> <p>For the "Biomimicry Engineer" Activity: Student/Group Worksheets</p> <p>(Supplies will be on a communal table and will include around 10 of each type of building material.)</p> <ul style="list-style-type: none"><li>- Construction paper</li><li>- Digital scale</li><li>- Feathers</li><li>- Index cards</li><li>- Paper clips</li><li>- Pipe cleaners</li><li>- Saran Wrap</li></ul>



	<ul style="list-style-type: none"> <li>- Scissors</li> <li>- Stopwatches</li> <li>- Straws</li> <li>- Styrofoam</li> <li>- Tape</li> <li>- Tape measures</li> <li>- Wax Paper</li> </ul>
<p><b>Lesson Time:</b>  <b>60-70 minutes</b></p>	<p>Introduction: 5 minutes          Guided Lesson #1: 5 minutes          Student Activity #1: 10 minutes          Student Activity #2: 10 minutes          Guided Lesson #2: 5 minutes          Student Activity #3: 20-30 minutes          Conclusion: 5 minutes</p>
<p><b>Learning Targets:</b></p>	<p>Students will understand the concept of biomimicry.</p> <p>Students will study objects created through biomimicry.</p> <p>Students will create their own idea based on biomimicry.</p>
<p><b>Introduction for Students:</b>          5 minutes</p>	<p><b>Say to the students:</b> Who can tell me what Nature is? (Expect many different answers. Call on 3-5 students)          Nature is the living and non-living things on the earth.</p> <p><b>Ask the students:</b> What factors make something “living?” (Answers should include breathing, moving, able to have babies, etc....)</p> <p><b>Say to the students:</b> Today we are going to talk about Biomimicry. That’s probably a new word for you. Let’s break it down. Does anyone know what the word bio means? Like in biology? Or biome? Or biography? (Allow for a few answers.)</p> <ul style="list-style-type: none"> <li>- The word “bio” means life.</li> </ul> <p>How about mimic? Does anyone know what that means? (Allow for a few guesses.) The word “mimic” means to imitate. What does it mean to imitate something?</p> <ul style="list-style-type: none"> <li>- Right. Mimic means to act like something else.</li> </ul>
<p><b>Guided Lesson #1:</b>          5 minutes</p>	<p>So, let’s see what Biomimicry has to do with Nature.</p> <p>Biomimicry is the science of observing nature, then using that information to create something that helps humans. So, in</p>



	<p>biomimicry, scientists and engineers get great ideas from nature and imitate it to form a whole new creation.</p> <p>Some good examples of biomimicry would be: Airplane wings are shaped like bird wings (hold up an example of an airfoil). The shape of the wing of a plane is the same as the shape of a bird's wing. This shape creates lift, which is an important part for flight.</p> <p>Here's another great example. How many of you have seen camouflage clothing? (Hold up the sample of camouflage fabric).</p> <p>Did you know that the military was inspired by octopuses to create camouflage? No, not by the number of arms they have. An octopus can change the color and texture of its skin, depending on its surroundings. It can even make itself look like a rock.</p> <p>Why do you think an octopus would need camouflage? - (Answer should include – to hide from predators)</p> <p>Just like the octopus, sometimes soldiers need to be able to hide or blend in. It is a good thing the octopus gave us that idea.</p> <p>Today we will be looking closer at some biomimicry examples and creating our own biomimicry invention.</p>
<p><b>Student Activity #1:</b> 10 minutes</p>	<p><b>(Students will be working in small groups for this activity. Groups should be just 2-3 students. Ask the teacher if the groups have already been created. If not, wait while he or she does this.)</b></p> <p>Pass out 1 <i>Nature as Inspiration</i> photo page to each group.</p> <p><b>Explain to the students:</b> In a moment each group will receive a bag showing some examples of biomimicry. I want you to try to figure out what inspired the product, by using the photo sheet of things found in nature. Remember, we are looking for mimicry.</p> <p>All but 1 picture has a match. I will give you a few minutes to try to figure this out with your group. Once you find a connection, place the invention on top of the matching picture.</p> <p>Give each group 1 Biomimicry Example Bag.</p> <p><i>The items in each bag include: velcro (matches with the burrs picture),</i></p>



*shock absorber (matches to picture of the woodpecker),  
toy boat (matches with the fish picture),  
roll of gecko tape (matches with the picture of the gecko's feet), and*

*They will not yet have a match to the helicopter seed.*

***The helicopter toy will be handed out at the end of this activity.***

After a few minutes, you may begin discussing the choices and connections with the class. As you talk about each item, hold the corresponding object up from your personal demonstration bag.

**Say to the students:**

First, let us look at this item (**hold up the shock absorber**). Does anyone know what this object is called?

This is a shock absorber. As you were experimenting with it, what happened when you pushed on the top?

We use shock absorbers in cars, so that we can drive easily over bumps. They do this by cushioning and then rebounding the energy created by the push.

Which nature picture would you match to this shock absorber?  
(answer = woodpecker)

Woodpeckers have a spongy bone and fluid behind their beak. Together, these cushion the impact of the pressure caused by the woodpecker pecking a hole in the tree. It is no wonder that the woodpecker was the inspiration for the shock absorber.

**Say to the students:**

Let's look at the next item (**hold up the Velcro**). What is this item?  
Yep, this is Velcro.

What do we use Velcro for? (Wait for the answer - to close things)  
What nature item in the pictures do you think sparked the idea for Velcro? (answer = burrs)

In 1941, an engineer from Switzerland noticed that burrs were sticking to his dog when they took walks. Burrs are a plant's way of spreading seeds by using an animal's fur. He took a burr home and looked at it under a microscope (a tool that scientists use to see tiny objects up close). Under the microscope, the scientist saw that the end of the burrs had small hooks. He worked hard to mimic the small hooks to create the "fastener" called Velcro.



	<p><b>Say to the students:</b> The next item is the boat (<b>hold up the boat</b>). Boats have a very specific shape to them. Look at the bottom part of the boat, then see if you can match that shape to one of the nature pictures. Raise your hand if you think you have it. Let's all say our answer together. (Most should answer with fish)</p> <p>Boats have been around for over 8,000 years, and the shape of a fish is what inspired the shape of a boat. That shape is part of what keeps a boat afloat in the water.</p> <p><b>Say to the students:</b> Now, let's look at this item (<b>hold up the tape</b>). What is this? (Give the students a moment to say tape. Gecko tape doesn't look like ordinary tape) What do we use tape for? (Wait for the answer - holding things together)</p> <p>The tape you are holding is no ordinary tape. It is called Gecko tape and was invented in the year 2003. You may also have heard it called nano tape or alien tape. Gecko tape was inspired by the feet of geckos. Find the gecko feet on your photo page. You cannot see it (because you do not have a very powerful microscope), but geckos have teeny tiny hairs on the bottom of their feet called setae [see-tee]. They use these hairs to move up and down almost any kind of surface. It took 3 years, but the gecko setae were finally replicated (remade) by scientists, and a new kind of tape was made. Gecko tape is stronger and lasts longer than regular tape. Another unique thing about Gecko tape is that you can wash it and reuse it over and over.</p>
<p><b>Student Activity #2:</b> 10 minutes</p>	<p>We have 1 picture and 0 items left. Who can tell me what that last picture is? (Some students will call it a helicopter seed, and some will call it a whirlybird. Both answers are right)</p> <p>These seed carriers have a very specific shape to them. Do you see why some people say they look like helicopters?</p> <p>These types of seeds were the inspiration behind the invention of the helicopter. Raise your hand if you have ever thrown one of these helicopter seeds in the air to watch them twirl down?</p> <p>Helicopter seeds are designed by nature to travel. The shape allows them to travel and become a new tree far away from the tree that sprouted the seeds. Let's see how this works.</p>



	<p><b>Explain to the students:</b> You are going to hand out the helicopter toys and there will be 1 for each group to share.</p> <p>Show the class how it works. Put the stick in between the palms of your hands, move your hands in opposite directions and let go.</p> <p>Give the students the following safety instructions:</p> <ul style="list-style-type: none"><li>- point toy away from other students</li><li>- do not throw the toy</li></ul> <p>Remind the students that they need to take turns.</p> <ul style="list-style-type: none"><li>- Each student should have at least 2 turns to try the helicopter toy.</li><li>- Keep giving them reminders to pass it to someone else in their group.</li></ul> <p>Have students put the 4 original items back in the Mimicry Example Bags. Collect the bags and the helicopter toys.</p>
<p><b>Guided Lesson #2:</b> 5 minutes</p>	<p><i>On a communal table, have supplies for this activity already laid out for the groups to use.</i></p> <p><b>Say to the students:</b> I want you to think about small things in nature, like seeds.</p> <p><b>Ask the students:</b> What are some ways seeds get transferred to a new place to grow?</p> <ul style="list-style-type: none"><li>- Have a brief discussion about the wind blowing seeds and the importance of seeds being small and light.</li><li>- Ask the students what carriers in nature might look like.</li></ul>
<p><b>Student Activity #3:</b> 20-30 minutes</p>	<p><b>Students will work in the same group as before. Groups should be just 2-3 students.</b></p> <p>Pass out to each group: 1 Carrier and Glider picture page Explain that these are some examples of Carriers in nature.</p> <p>Explain to the students, that they will be Biomimicry Engineers today, and as a group, they will be using the carrier and glider example pictures to inspire their own invention. Briefly mention that before Orville and Wilbur Wright invented the airplane, they tested ideas and wing shapes by making and flying gliders. There are</p>





	<p>pictures of a few of their gliders on the back of the page you just passed out.</p> <p>Show the students where they can find supplies when it is time and explain what their options are. Make it clear to the students, that each group is only allowed to send 1 person to the supply table at a time, and they may only collect 4 items. (Ask the teacher to be in charge of the table.)</p> <p>Explain that they will be creating a carrier that will fly the tiny human replica from one side of a desk to the other. The carrier will travel by wind and not by another animal or have an engine. <i>A good hint would be that the carrier should be small, light, and make sure that it includes the tiny human replica.</i></p> <p>Turn on the fan to demonstrate the wind power that you will use to test the carriers.</p> <p><b>Say to the students:</b> Remember, it's a good idea that your carrier does not add a lot of weight to the "person" it's carrying. We want the wind to be able to pick it up.</p> <p><b>Say to the students:</b> When you are testing it, someone in your group should use a stopwatch to time how long it is in the air. We have those up here. We also have a scale up here, so you can weigh your invention. We also have tape measures, so you can measure the distance your "person" flies. There is a spot on this worksheet for you to fill in that information.</p> <p>Pass out a worksheet and 1 small human replica to each group. Explain that they will need to fill out the worksheet as they go, and to make sure they follow each step.</p> <p>As they are working, move from group to group to see that they are using all the steps. You can collect the Carrier picture sheet at this time too.</p> <p>Allow the students time to create and test their carriers. If there is time to redesign and retest for different results, allow them to do so.</p>
<p><b>Conclusion:</b> 5 minutes</p>	<p>Ensure understanding of the lesson by asking the following questions:</p> <p><b>Say to the students:</b> Who can tell me something that they learned today?</p>



Now let's see who can answer these questions for me.

**Where does the word biomimicry come from?** Life and imitate.

**What is biomimicry?** Biomimicry is a field of science that uses nature as its inspiration to create things that help us humans.

**What is an invention that was inspired by something in nature?** Velcro, shock absorber, boats, gecko tape, helicopters. Maybe they can think of others.

If there is time the groups can show their creations and share what in nature may have inspired it.

Information and graphics credited to: <https://biomimicry.org/four-engaging-ways-bring-biomimicry-classroom/>;  
<https://bigideas4littlescholars.com/biomimicry-for-kids-activities-and-resources-k-3/>; <https://www.digitaltrends.com/cool-tech/biomimicry-examples/>;  
<https://research.qut.edu.au/stemforschools/biomimicry-activity/>; <https://www.thoughtco.com/the-invention-of-velcro-4066111/>;  
<https://web.stanford.edu/group/mota/education/Physics%2087N%20Final%20Projects/Group%20Gamma/gecko.htm>;  
[https://www.dhgate.com/product/led-flashing-flying-dragonfly-toy-plastic/396769187.html?f=BM/Bing/PA/408012198/1191871212342546/74492046195914/pla-4578091589515710||US|396769187|c|&utm\\_source=Bing&utm\\_medium=cpc&utm\\_term=&utm\\_content=74492046195914&utm\\_campaign=US\\_Home%20%26%20Garden\\_PC&msslkid=cf423f7ca4c914ae42685dbbb48ad25a](https://www.dhgate.com/product/led-flashing-flying-dragonfly-toy-plastic/396769187.html?f=BM/Bing/PA/408012198/1191871212342546/74492046195914/pla-4578091589515710||US|396769187|c|&utm_source=Bing&utm_medium=cpc&utm_term=&utm_content=74492046195914&utm_campaign=US_Home%20%26%20Garden_PC&msslkid=cf423f7ca4c914ae42685dbbb48ad25a); [https://en.wikipedia.org/wiki/Wright\\_Glider](https://en.wikipedia.org/wiki/Wright_Glider)

Nature Photo Page: <https://bigideas4littlescholars.com/biomimicry-for-kids-activities-and-resources-k-3/>;  
<http://flickr.com/photos/calliope/2317881343/>;  
[https://www.kokomotribune.com/sports/martino-pileated-woodpeckers-make-presence-known/article\\_56af1d56-c4a2-11e6-9e8d-43c711826526.html](https://www.kokomotribune.com/sports/martino-pileated-woodpeckers-make-presence-known/article_56af1d56-c4a2-11e6-9e8d-43c711826526.html);  
<https://www.saltwaterfish.com/product-blueface-angel-18176>  
<https://www.woodlandtrust.org.uk/blog/2019/05/helicopter-seeds/>;

Carriers photo page: <https://www.woodlandtrust.org.uk/blog/2019/05/helicopter-seeds/>;  
<https://agriculturegoods.com/seed-dispersal/>; <https://courses.lumenlearning.com/boundless-biology/chapter/angiosperms/>;  
<https://ag.purdue.edu/stories/unexpected-plants-and-animals-of-indiana-southern-flying-squirrel/>;  
<https://owlcation.com/stem/butterfly-identification>;  
<https://nhsportpress.com/1793/opinion/port-press-face-off-are-flying-fish-an-affront-to-nature/>;