

Bug Biomimicry BOTM Lesson Plan



Time: 60 Minutes

Number of Students: Up to 30

Materials:

- Madagascar hissing cockroaches
- Laminated image of the CRAM robot
- Laminated images of water striders
- Large bin with water
- Boat building supplies separated into plastic bags, one for each team: plastic cups (1), Lego people (1), toothpicks (4), pipe cleaners (3), foam cubes (4), scissors (1)
- One or two rolls of masking tape
- Empty grocery store plastic bags
- The Observation Sheets that students completed during the pre-visit activity.

Observation Journals:

- Other than the Observation Sheet students used during the pre-visit activity there are no Observation Journals for this program.

Advance Preparation:

- Prepackage the boat building supplies into bags, one for each team.

Overview:

- Introduction: 5 minutes
- Holding and Observing Roaches: 10 minutes
- Roach Robot Example Discussion: 5 minutes
- Sharing Their Water Strider Observations: 10 minutes
- Engineering Challenge: Building a Water Strider Inspired Boat: 20 minutes
- Boat Building Debrief: 5 minutes
- Bonus Bug: Holding the Blue Death Feigning Beetles: 5 - 10 minutes

Learning Objectives:

Students will ...

- understand that human inventions can be inspired by a wide range of things, including careful observations of the natural world, insects included.
- observe and describe cockroaches and be able to discuss and hypothesize potential inventions inspired by their characteristics.
- apply their observations of the water striders to the design and construction of a model of a water strider inspired boat.



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Lesson Steps: Introduction and Getting Settled: 5 minutes

- Do not launch directly into a discussion of the term “biomimicry” at this time.
- Let students know that together we’ll be learning about bugs and how they can help us solve some of our human problems.
- Let students know that we’ll be observing a new (to them) Bug Ambassador, discussing the observations they already did about the water striders and ending with time for an engineering challenge.



Lesson Steps: Holding & Observing the Roaches: 10 minutes

- Gather students in a circle on the floor to hold, touch and observe the roaches.
- After everyone has held the roaches have students pair up and do a “Turn and Talk” thinking routine. Students will literally turn and talk to each other about what they noticed about the cockroaches. After one to two minutes of talking students will turn back around and share what they and their partner noticed about the roach.



Lesson Steps: Roach Robot Example: 5 minutes

- Have students consider all of the observations that were shared and help to synthesize and summarize their findings: the roaches were small, pokey, had a hard shell etc.
- Let the class know that a team of engineers in California has also studied the roaches - like they just did but for a longer period of time and with fancier scientific instruments. These engineers were working on a design for a new robot. They eventually said, “You know what, if we make our robot move like a cockroach it would be really good at _____.”
- Have the students do a second “Turn and Talk” activity. This time they are discussing the question “based on all of their own observations of the roaches, what job do you think that robot has?”
- After sharing their ideas of potential robot jobs, fill them in on the official role of the CRAM robot: search and rescue in tight spaces.
- Let students know that this process of getting ideas for human inventions from nature has a name, biomimicry. Biomimicry is going to be the focus of this program.

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Lesson Steps: Sharing their Water Strider Observations: 10 minutes

- Students can have their Observation Sheets from the pre-visit activity in front of them if it helps them to remember what they noticed about the striders.
- Ask students to share both what they noticed about the water striders as well as how they think water striders stay on top of the water.
- Guide students towards the “discussion take aways.”

Water Strider Discussion Take Aways

- Water striders have flat bodies that are low to the ground/water. This is a little like sitting in a canoe vs. standing up straight in a canoe.
- Water striders have six long legs that spread out in all different directions.
- Water striders have special hairs on their feet that push away water, just like the butterfly wings.
- Water striders are very light.

Finish the discussion by asking students what sort of biomimicry invention might have been inspired by water striders like the ones that they observed and guide them towards the concept of a boat, a life raft, inspired by water striders.

Lesson Steps: Engineering Challenge: 20 minutes

Students will use the materials at their team’s table to build a boat, a life raft, that is inspired by water striders. To test their designs they will put their boat in a bucket of water and the program leader will shake the bucket to create waves. If it stays afloat and the Lego man inside doesn’t get wet then they have successfully completed the challenge. For as long as time allows students will be encouraged to improve their prototype after each test. Introduce the challenge by explaining the concept of prototyping and laying out the ground rules for working together with their team to develop a water strider inspired boat prototype.



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Rules and guidelines for completing the Engineering Challenge

- Each team of 3 to 5 students is working together to create **one** prototype
- Teams that are the most successful are the teams that work together. Instead of saying, "Well that's a dumb idea, it'll never work," try "Hmm, I'm not sure about that but what if we try just this part of your idea and this part of my idea?" Teams that use the best ideas from everyone in their team are often the most successful.
- Teams can use all of the materials at their table EXCEPT for the plastic bag that they came in. They do not need to use every material if they don't want/need to.
- Observation Sheets can be left on the floor/turned in as they won't be needed during the challenge.

Sponge Activity:

If a team finishes their challenge early they can either continue to make and test new design ideas or start brainstorming ideas for other inventions inspired by arthropods.

Lesson Steps: Boat Building Debrief: 5 minutes

- Ask students what worked well and what didn't work well for them.
- Ask students what they learned about working together as a team.
- Ask students if they think that there are other invention ideas out there that haven't been thought up yet, that maybe they could invent.



Boat Building Debrief Take Aways:

- The closer the design mimicked the water strider, the better it did.
- Changing things up and trying again helped them to be successful.
- Just because a design didn't work the first time around doesn't mean that it can't be improved or that everything is a total loss.

Lesson Steps: Bonus Bug - Holding the Blues: 5 minutes

Many students will want the chance to hold another bug before the program ends but after boat building challenge wraps up there is not a lot of time left. The solution is to introduce the blue beetles and have their teachers bring the experience full circle after the BOTM program is over.

- Remind the group that there are lots of bugs that have inspired cool inventions around the world, not just the hissing and the water striders.
- Explain that the "bonus bug" they're about to meet is related to a beetle that lives in the Namib desert in Africa that has inspired an invention. Their job right now is to hold the bug and imagine inventions that it might inspire. Let students know that you'll be sending their teacher a video about that invention so they can learn what professional engineers have developed by using biomimicry and studying the beetle.
- Give students a chance to hold the blue death feigning beetles.
- Don't forget to send the video links after the program.