AMAZING MIGHTY MICRO MONSTERS

GRADES K-8 EDUCATOR GUIDE

ABOUT

COLOSSUS PRODUCTIONS

Colossus Productions is the 3D-specialist production company formed by Atlantic Productions (see more below) with Sky in 2011. The joint venture was created to develop and produce high-end 3D films for UK and international audiences. Emerging from Atlantic Production's record in producing award winning content, Colossus has already released in IMAX and Giant Screen such diverse educational and entertaining films as *Flying Monsters 3D*, *Penguins 3D* and *Galapagos 3D: Nature's Wonderland* into cinemas worldwide. Colossus' most recent IMAX/Giant Screen films are *Museum Alive* and *Amazing Mighty Micro Monsters* which were released in late 2016 and the newest Colossus production, *Conquest of the Skies* will be released in IMAX and Giant Screen later in 2016.

ATLANTIC PRODUCTIONS

Atlantic Productions is one of the world's leading factual production companies whose multi BAFTA and Emmy award-winning films and content are regularly seen in over 100 countries around the world. Founded in 1992, Atlantic has built a reputation for world-class story-telling, enhanced by the latest techniques and technologies including the building of pioneering cross-platform and digital experiences. Atlantic Productions leads a group of companies which make television programmes, theatrical and IMAX films, apps (Atlantic Digital), visual effects (Zoo VFX) and now, immersive virtual reality experiences (Alchemy VR).

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This guide was developed as a companion to the Colossus Productions film, *Amazing Mighty Micro Monsters.*

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WELCOME LETTER

SUPERPOWERS ARE ALL AROUND US . . . AND IT´S ALL THANKS TO BUGS

Dear Educator,

Welcome to a world where truth is infinitely stranger than fiction. *Amazing Mighty Micro Monsters* is a thrilling exploration of a realm that's close to ours yet rarely noticed, often puzzling, and sometimes disturbing to our human sensibilities—the strange, the weird, the wonderful world of arthropods.

Arthropods consist of insects, arachnids, and crustaceans. Over 10 million trillion insects are alive on Earth at any one time, and there are a staggering 1 million species (compared to 50,000 known vertebrate species). Students' innate curiosity about these mini marvels make them an excellent gateway to STEM subjects like ecology, biology, technology, engineering, and mathematics, and provide numerous opportunities for cross-curricular connections from geography to literacy.

Filmed from a unique perspective, using technology developed specifically for this film, students will be captivated by these organisms with real-life superhero powers. This guide includes standards-based activities designed for use with upper elementary students, with adaptations for both younger and older students. Worksheets and handouts are included, and educators will also find additional activity ideas, as well as a list of standards addressed by each activity.

These activities will capture your students' interest and offer excellent opportunities for STEM learning. Enjoy meeting the amazing insects, spiders, and scorpions we share the planet with.

Sincerely,

Colossus Productions
& the Amazing Mighty Micro Monsters team

Education Standards and Skills Addressed

The activities in this guide are designed to target the following national standards and key skills:

National Standards

- National Science Education Standards
- Next Generation Science Standards
- Common Core State Standards for Mathematics
- Common Core State Standards for English Language Arts
- National Geography Standards

Key Skills

- 21st Century Student Outcomes
- 21st Century Themes
- Critical Thinking Skills
- Science and Engineering Practices
- Geographic Skills

A NOTE ABOUT HOW TO USE THIS GUIDE

This guide is intended for use by both museum and classroom educators.

Formal classroom educators will find activities to deepen learning around the film by introducing students to the content before they view the film and expanding on what they learned afterward. Museum educators can make these activities available to classroom educators via their organization's website.

Museum educators will also find suggestions on how to share information about the *Amazing Mighty Micro Monsters* film with educators in their area as well as additional activity ideas to engage students on-site, before and after viewing the film. Although the material is copyrighted, educators may reproduce instructional assets within this guide for non-commercial purposes in order to share with fellow educators.

SPREAD THE WORD ABOUT THE FILM

NEWSLETTER TEXT

Include the following text in your organization's newsletter to raise awareness about *Amazing Mighty Micro Monsters:*

Guess what? An ogre-faced spider's eyes are 2,000 times more sensitive to light than human eyes! Learn more with *Amazing Mighty Micro Monsters*! **23 WORDS**

Amazing Mighty Micro Monsters is a thrilling exploration of a realm that's close to ours yet rarely noticed, often puzzling, and sometimes disturbing to our human sensibilities—the surprising, weird, and wonderful world of the arthropods. This film invites audiences to meet fascinating organisms through an engaging STEM lens. **49 WORDS**

Welcome to a world where truth is stranger than fiction. *Amazing Mighty Micro Monsters* takes students on a journey to a bustling world beneath their feet—the world of the arthropods. Students' innate curiosity about these organisms make arthropods an excellent gateway to STEM subjects like ecology, biology, technology, engineering, and mathematics, and provide numerous opportunities for cross-curricular connections with subjects from geography to literacy. Filmed using technology developed specifically for this movie, these organisms with real-life superhero powers will captivate students. **82 WORDS**

BACKGROUND INFORMATION

FILM SYNOPSIS

EXPLORE THE HIDDEN WORLD OF THE SUPER-POWERED BUGS!

Amazing Mighty Micro Monsters takes you on a tour of the bustling world beneath your feet to meet the true rulers of planet Earth. From the Kenyan savannah to the tropical rainforests of northeast Australia, via specialized technology utilized in studios in the U.K., the superpowers of these mighty micro monsters are revealed. In a playful nod to classic superhero movies, we will come face to face with some of the natural world's most incredible creatures. We'll meet a beetle that can fire boiling chemicals at its attackers, a deadly spider with super strength, and many more miniature superheroes.

The film features the following organisms:

aphid
assassin bug
bombardier beetle
caterpillar/butterfly
centipede
goliath beetle
green ant
ogre-faced spider
Portia spider
praying mantis
redback spider
red claw scorpion
trapdoor spider
whirligig beetle

DID YOU KNOW? • FUN FACTS ABOUT ARTHROPODS

Nearly 2 billion people around the world, particularly in parts of Central Africa, Southeast, Asia and Latin America, eat insects regularly. The most popular critters? Beetles, caterpillars, bees, wasps, and ants.

Bugs can be an indicator of water quality. Some insects are more sensitive to pollution than others, meaning that some insects can live in waters that are more polluted. Scientists can assess how polluted a body of water is by looking at what macroinverterbrates live there.

To survive cold winter temperatures, some insects use a strategy called diapause. An agent in their blood acts like an antifreeze, allowing them to be semi frozen until they thaw in the spring. Some insects freeze all the way through and are still able to survive!

Ancient dragonflies had wingspans up to 0.6 meters (2 feet) wide.

That's just slightly larger than the wingspan of a modern parakeet.

The black cutworm has been recorded flying at speeds between 97 and 112 kilometers (60-70 miles) per hour.

That's about as fast a car traveling down a highway.

The extinct giant millipede *Arthropleura* is believed to have been the largest land dwelling "bug" of all time. It could grow to be more than 0.45 meters (1.5 feet) wide and more than 1.8 meters (6 feet) long. The longest modern insect is the *Pharnacia serratipes*, found on the Malay Peninsula. It can grow to be almost 56 centimeters (22 inches) long with its legs outstretched.

Goliath beetles are among the largest insects on Earth, if measured in terms of size, bulk, and weight.

Some grasshoppers are pink, instead of their usual brown and green, due to a genetic mutation.

Locusts eat their own weight in food every day.

Cicadas can burrow and live underground for up to 17 years.

ACTIVITIES TO BUILD CONTENT KNOWLEDGE

BEFORE VIEWING THE FILM

ACTIVITY 1: What Is an Arthropod?

ACTIVITY DESCRIPTION

Students act as entomologists to discover the difference between invertebrates and vertebrates, identify five key distinguishing features of insects, and apply what they learn to other arthropod groups.

CONNECTION TO FILM

The film focuses on arthropods, and assumes background knowledge about these organisms. All students will benefit from an introduction or review of what arthropods are and their defining characteristics. Engaging students in this activity is also an opportunity to discuss classifications, as well as make cross-curricular connections to geography—in particular why things from different places look different.

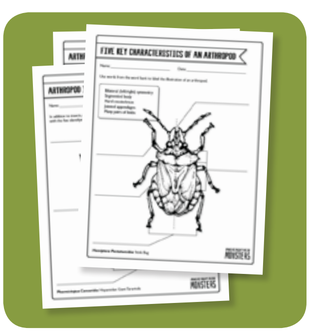
LEARNING GOALS

- distinguish between invertebrates and vertebrates
- define the anatomical characteristics of arthropods
- apply knowledge to classify various arthropods

PREPARATION

No special preparation is needed for this activity.

MATERIALS LIST



- Dry-erase markers
- Whiteboard
- Five Key Characteristics of an Arthropod worksheet
- Arthropod Illustration worksheet

Note: all worksheets are available in the Worksheets and Handouts section of this guide.

TIME NEEDED

45 minutes

VOCABULARY

- arachnid
- arthropod
- characteristic
- classify
- crustacean
- entomologist
- exoskeleton
- insect
- invertebrate
- organism
- segments
- species
- symmetry
- taxonomy
- vertebrate

DIRECTIONS

1. **Discuss the difference between invertebrates and vertebrates by having students compare and contrast invertebrates and humans.**
Ask: *What body systems do humans have?* Elicit examples, such as skeletal, circulatory, and nervous systems. Ask students to describe what the skeletal system includes (bones) and does (supports the body and its organs). Explain the definition of a vertebrate and have students record it in their notebooks. A **vertebrate** refers to an organism with a backbone or spine. Humans are vertebrates because we have backbones. **Invertebrates** do not have an internal skeleton or backbone. Ask students to name invertebrates they have heard of or have seen in the real world, and write these on the board.

2. **Explain that there are different types of invertebrates and define the term *species*.**
Explain to students that invertebrates make up about 95% of all known animals. Some of these invertebrates are called **arthropods**. Arthropods include **insects**, **arachnids** (spiders and scorpions), and **crustaceans**. Return to the list of invertebrates students generated. Ask students to identify which, if any, of the animals they listed are arthropods. Not all invertebrates are arthropods; for example, worms and slugs. Give students the opportunity to add to the list additional arthropods with which they are familiar.

   Tell students that scientists make observations about the **characteristics** of **organisms** in order to group, or **classify**, them into species. For example, insects are divided into two groups: species with wings and species without wings. A **species** is a group of similar organisms that can mate with one another and produce fertile offspring. Ask students to recall physical characteristics of arthropods on their list. Do any have wings? What are their bodies shaped like?

3. **Invite students to act as entomologists to identify the key characteristics of arthropods.**
Remind students that arthropods include insects, arachnids, and crustaceans. Explain that arthropods, like humans, have key distinguishing features, but theirs are different. Tell students they will role play **entomologists**, or scientists that study insects, in order to classify them.

4. **Review the five key characteristics of arthropods with students.**
Distribute the Five Key Characteristics of an Arthropod worksheet. Label it with students, using the terms from the word bank. As you label each term, review it with students.
   - ✓ Bilateral (left/right) symmetry—discuss a symmetry test, or how you can check by "folding" the organism in half.
   - ✓ Segmented body—review the term segments.
   - ✓ Hard exoskeleton—remind students that arthropods are invertebrates, and ask them to recall the definition of invertebrate. Remind them that arthropods need an external skeleton in order to support organs.
   - ✓ Jointed appendages
   - ✓ Many pairs of limbs

5. Have students apply what they've learned to other arthropod groups.
Ask students to name other animals that share these characteristics (spiders, crabs, etc). Remind students that in addition to insects, arthropods also include arachnids and crustaceans. Distribute the Arthropod Illustration worksheet, and have students label both organisms with the five identifying features of arthropods.

6. Have a wrap-up discussion during which students classify a new, undiscovered species.
Continue having students role play entomologists to apply what they've learned. Explain that the class has just returned from an expedition in the field. While there, they were fortunate enough to discover some new species and now they need to classify the organisms. Read the following statements to students:

Species #1:
One of your teammates made an astonishing discovery one morning. When turning her boot over, out popped a species with many, jointed legs. Upon further investigation, she decides this species has a hard, segmented body that is bilaterally symmetrical. Is this species an arthropod? (Yes.)

Species #2:
You have discovered a remarkably beautiful species. It has two, bright blue wings and at least one pair of limbs. Could this species be classified as an arthropod? (Knowing a species has wings might be enough information to assume a species is symmetrical, but it is not enough information to classify this species as an arthropod. For example, this species might be a bird. Students need to ask if the species is an invertebrate or vertebrate, if its limbs are jointed, and if it has a segmented body.)

Species #3:
While working in the water, your team has discovered what you believe is a new species of jellyfish. Prove that a jellyfish is not an arthropod. (Jellyfish are cnidarians, not arthropods. While they are invertebrates, they do not have an exoskeleton. Additionally, they are not bilaterally symmetric. Jellyfish are radially symmetric.)

Have a whole-class discussion on the types of questions students need to ask in order to answer each species question. Record and post students' responses and questions on the board. (Students' questions should reflect whether or not the five key characteristics are present, as well as if the new species is an invertebrate or vertebrate.)

ADAPTING THE ACTIVITY FOR YOUNGER STUDENTS

For the youngest students, practice classifying objects. Provide students with a set of materials and ask them to sort the objects based on their similarities and differences. Vary objects based on student ages. For example, give youngest students objects that are different in shape and color. Ask students to explain why they placed the objects in different groups. Then, ask students to count how many of each object are in each group.

EXTENDING THE ACTIVITY FOR OLDER STUDENTS

Dig further into classification with older students. Continue the activity by having students classify species from other taxonomic groups. Explain that taxonomy is the study of the way organisms are classified. Review the following taxonomic groups, in order, with students: kingdom, phylum, order, class, family, genus, and species. As a group, develop a mnemonic (using K, P, O, C, F, G, S) to help students remember the order. Explain that scientists must classify an organism to a very detailed level in order to determine what species it is. Classifying an organism is useful because grouping an organism with others that are similar can help scientists make inferences about the organism.

Divide students into groups of four or five. Assign each group a class from Kingdom Animalia: amphibians; sharks, rays, and their relatives; mammals; clams, oysters, and scallops; or birds. Tell students that they are going to prepare scientific reports about the key features of their assigned class. They will need to identify key characteristics of the class and identify these features on a sample organism, similar to the exercise they just went through with arthropods. Have them prepare a presentation with visuals for their peers.

CROSS-CURRICULAR CONNECTION

Geography Have a class discussion about habitats, using the Arthropod Illustration worksheet. Ask: *What habitats do each of these animals live in?* Tarantulas live in the rainforest and lobsters live in the ocean. Ask students to describe these physical environments. Ask: *How is each of these animals able to live in those environments? How do an animal's physical characteristics help it in its environment? What physical characteristics do these organisms have to help them survive? How are they similar and different?*

KEY SKILLS

21st Century Themes

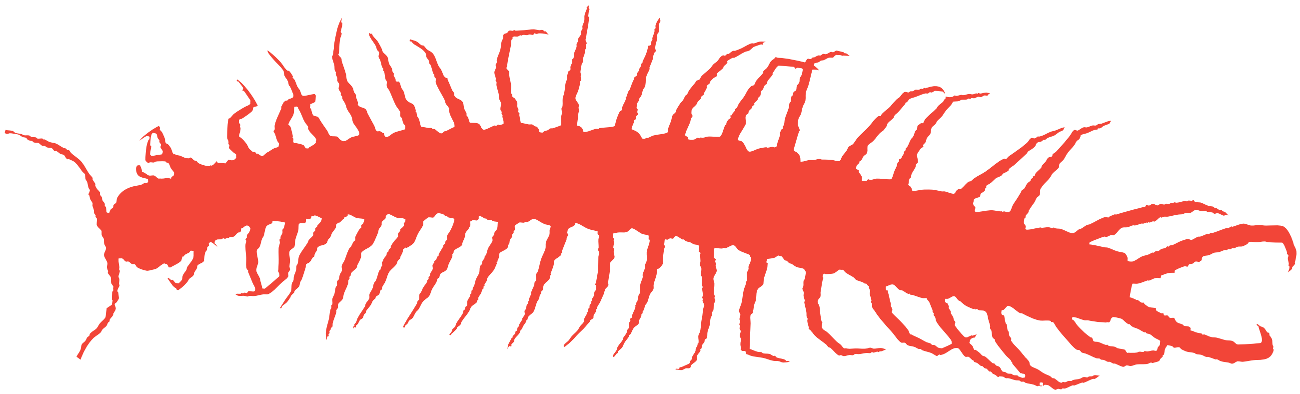
- ✓ Environmental Literacy

Critical Thinking Skills

- ✓ Remembering
- ✓ Understanding
- ✓ Applying

Science and Engineering Practices

- ✓ Analyzing and Interpreting Data



CONNECTIONS TO STANDARDS

National Science Education Standards

(K-4) C-1: The Characteristics of Organisms
(K-4) C-3: Organism and Environments
(K-4) G-1: Science as a Human Endeavor

(5-8) A-1: Abilities necessary to do scientific inquiry
(5-8) A-2: Understandings about scientific inquiry
(5-8) C-4: Structure and Function in Living Systems
(5-8) D-5: Diversity and Adaptations of Organisms
(5-8) G-1: Science as a Human Endeavor

Next Generation Science Standards

2-LS4-1. Make observations of plants and animals to compare the diversity of life in different habitats.

4.LS1.A. Structure and Function. Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.

Common Core State Standards for Mathematics

CCSS.MATH.CONTENT.K.MD.B.3: Classify objects into given categories; count the number of objects in each category and sort the categories by count.

Common Core State Standards for English Language Arts

CCSS.ELA-Literacy.L.2.4: Use glossaries and beginning dictionaries, both print and digital, to determine or clarify the meaning of words and phrases.

ACTIVITY 2: Ecosystem

ACTIVITY DESCRIPTION

Students play a collaborative game to model predator-prey relationships. Afterward, students discuss why some organisms were more successful in the game than others, and develop their own "ecosystem" game models.

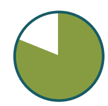
CONNECTION TO FILM

The film explores arthropods primarily through numerous examples of predators and prey. All students will benefit from a deeper understanding or review of predator-prey relationships. Use this game to introduce or review this key concept with students.

LEARNING GOALS

- ✔ model an ecosystem by competing with other organisms in a fun game
- ✔ analyze a model to apply knowledge about predator-prey relationships
- ✔ develop an ecosystem model based on ecological rules

TIME NEEDED



45-60 minutes

VOCABULARY

- ✔ ecosystem
- ✔ organism
- ✔ predator
- ✔ prey
- ✔ species

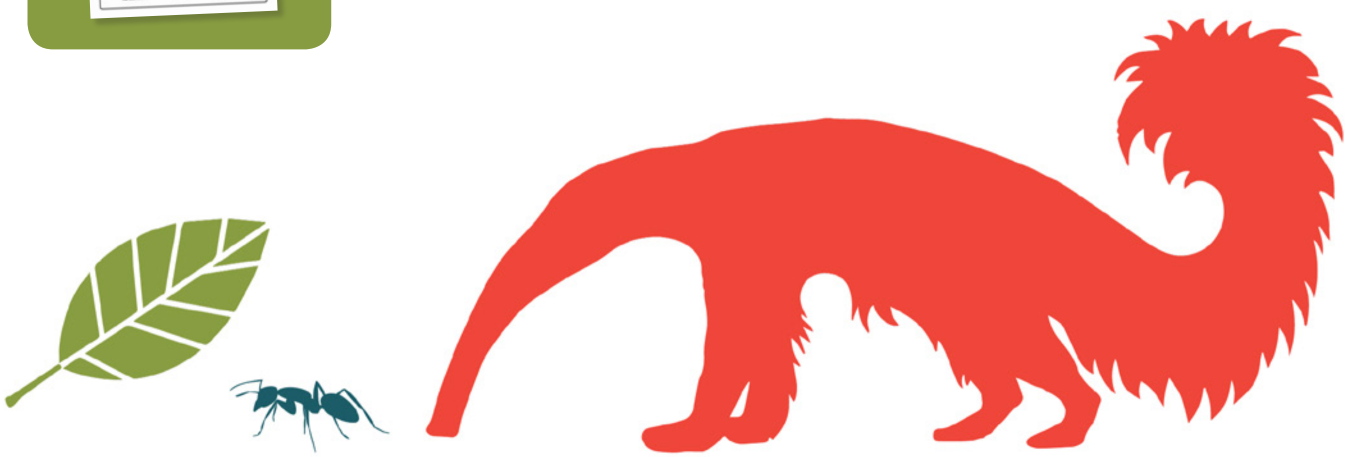
PREPARATION

Clear or reserve an open space that students can move around in.

MATERIALS LIST

- ✔ Index cards
- ✔ How to Play "Leaf-Ant-Anteater" handout

Note: all worksheets are available in the Worksheets and Handouts section of this guide.



DIRECTIONS

1. Activate prior knowledge by asking students what they know about predators and prey.

Divide students into pairs and give each pair an index card. Ask each pair to write definitions of the terms **predators** and **prey** in their own words, to give examples of each, and then to describe how they relate to one another in an **ecosystem** on their card. Ask partners to share what they wrote with the class.

2. Explain and model the game of "Leaf-Ant-Anteater."

Leaf beats Anteater.

Ant beats Leaf.

Anteater beats Ant.

Explain that students are going to play a group game called Leaf-Ant-Anteater, an extreme version of Rock-Paper-Scissors that simulates an ecosystem. Distribute copies of the How to Play "Leaf-Ant-Anteater" handout to students, and review the rules of the game.

Review the hand symbols with students on the How to Play "Leaf-Ant-Anteater" handout. Leaf beats Anteater (because giant anteaters don't eat leaves). Ant beats Leaf (because leaf-cutter ants cut the leaves to grow fungus and eat food). Anteater beats Ant (because giant anteaters eat leaf-cutter ants). Students will act as **organisms** (leaves, leaf-cutter ants, or giant anteaters) and engage each other in competition (rounds of Leaf-Ant-Anteater). They will move around and challenge other members of their species while they play. Students are divided into pairs to start but will play multiple rounds in order to become different organisms as they play. All players start as a Leaf. The goal of the game is to turn into an Anteater by winning multiple rounds to turn from a Leaf into an Ant, then an Ant into an Anteater.

Model how the game works using six students. Have the three pairs compete at Leaf-Ant-Anteater. Clarify that though all students are starting as leaves, they can play any hand symbol in Leaf-Ant-Anteater. Each partner that wins their game becomes an "Ant." The partner that lost that game continues to be a Leaf. Students now need to move around in order to find a new partner to compete against in a game of Leaf-Ant-Anteater. Leaves play against Leaves, Ants against Ants. Students can identify members of their own "species" based on how they move around the area. Leaves should sway their arms as they walk. Ants should crawl. In Ant versus Ant rounds, the partner that loses becomes a Leaf again, and the partner that wins becomes an Anteater. Students continue to move and play Leaf-Ant-Anteater games against their same species. Anteaters should put their arm up to their nose and walk as if they have a trunk. In Anteater versus Anteater rounds, the partner that loses becomes an Ant again. Students' goal is to try and remain Anteaters once they become them.

3. Play a practice round of Leaf-Ant-Anteater.
Divide students into pairs and have them play a practice round of Leaf-Ant-Anteater against their partner.

4. Have students play the game.
As a large group, begin a game of Leaf-Ant-Anteater. The game can be ended anytime, though it's best to end when you notice there are fewer anteaters compared to the number of ants and leaves.

5. Have a discussion about the game's outcome.
At the end of the game, have students count how many Leaves, Ants, and Anteaters there are. Ask: *How does this reflect the number of plants, predators, and prey within a real ecosystem?* Explain that in a healthy ecosystem, there are fewer predators than prey.

6. Students design their own version of Leaf-Ant-Anteater using different predator-prey relationships in an ecosystem.
Have students demonstrate their understanding of predator-prey relationships by designing their own Leaf-Ant-Anteater-style game with rounds that include three organisms. These Leaf-Ant-Anteater-style rounds should demonstrate proper ecological relationships and can include hand movements if students desire. For example, a predator should beat a prey organism. If time allows, have the group play one or more games that the students develop.

ADAPTING THE ACTIVITY FOR YOUNGER STUDENTS

For younger students, spend extra time introducing the concepts of predator and prey in Directions Step 1. Explain that organisms relate to one another in different ways. Define predator as an animal that lives by killing and eating other animals. Define prey as an animal that is hunted or killed by another animal for food. Spend extra time defining vocabulary and discuss definitions of herbivore, carnivore, and omnivore. An ecosystem is a system formed by the interactions of living and nonliving things in a given area. Ask students to name some examples of predator-prey pairings. Ask: *How are the physical characteristics of those organisms similar and different?*

ADAPTING THE ACTIVITY FOR OLDER STUDENTS

For older students, after conducting the activity, discuss the transfer of energy through the Leaf-Ant-Anteater game. Ask: *How did ants get energy? How did anteaters get energy? What happens to energy in an ecosystem?* Have a discussion about energy, prompting students to list what needs to be added to the Leaf-Ant-Anteater model in order to complete the energy cycle in this ecosystem (sun, decomposer). Have students work in groups to update the Leaf-Ant-Anteater game so that it includes these missing factors. Have groups teach their models/games to the class and share their reasoning.

CROSS-CURRICULAR CONNECTION

Geography Divide students into groups and assign them each a different ecosystem, from a different part of the world. These ecosystems could be a North American desert, an African savanna, the Great Barrier Reef, and so on. Have students research their ecosystem and design a version of Rock-Paper-Scissors using at least three organisms from their assigned ecosystem. Have groups teach their Rock-Paper-Scissors-style games to other students. Then have a discussion on the similarities and differences between the games. Ask: *Were any species both predator and prey? What commonalities exist between these ecosystems and their organisms?*

KEY SKILLS

21st Century Student Outcomes

Learning and Innovation Skills

- ✓ Critical Thinking and Problem Solving
- ✓ Communication and Collaboration

Critical Thinking Skills

- ✓ Remembering
- ✓ Applying
- ✓ Analyzing
- ✓ Evaluating
- ✓ Creating

Science and Engineering Practices

- ✓ Developing and Using Models
- ✓ Analyzing and Interpreting Data

CONNECTIONS TO STANDARDS

National Science Education Standards

(K-4) C-1: The Characteristics of Organisms
(K-4) C-3: Organisms and Environments
(5-8) B-3: Transfer of Energy
(5-8) C-4: Population and Ecosystems
(5-8) C-5: Diversity and Adaptation of Organisms

Next Generation Science Standards

3-LS4-3. Construct an argument that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.
5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

AFTER VIEWING THE FILM

ACTIVITY 3: Mighty Micro Monster Math

ACTIVITY DESCRIPTION

Students calculate and graph the physical feats they would be able to perform if they were some of the insects featured in the film.

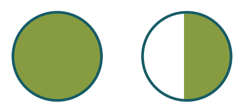
CONNECTION TO FILM

In the film, students hear comparisons between insects and humans. For example, the film states that if the red claw scorpion were the size of a grown man, it could crush a seven ton-truck in its pincers. Comparisons like these help students to better understand the uniqueness and power of the insects featured in the film and provide a jumping off point for a fun math activity.

LEARNING GOALS

- practice taking measurements
- perform calculations using collected data
- discuss the importance of units
- create and model visual representations of their calculations

TIME NEEDED



90 minutes

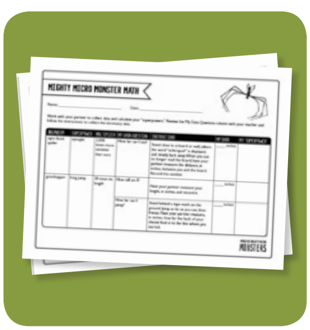
PREPARATION

Set up as many data stations as materials and space allow for students to rotate through to collect their data. See Directions Step 3 and the "My Data Question" and "Instructions" columns of the Mighty Micro Monster Math worksheet for guidance.

VOCABULARY

- bar graph
- data
- measurement
- multiplier
- organism
- unit

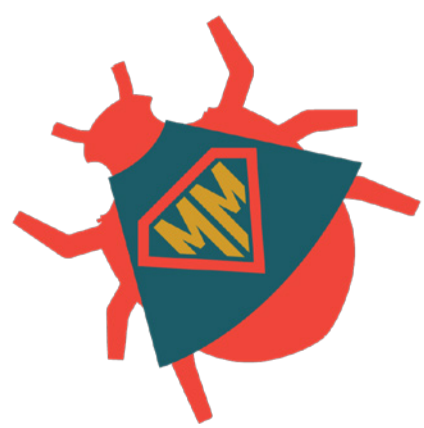
MATERIALS LIST



MIGHTY MICRO MONSTER MATH

- Measuring tapes (5-10)
- Stopwatches (5-10)
- Masking tape
- Mighty Micro Monster Math worksheet

Note: all worksheets are available in the Worksheets and Handouts section of this guide.



DIRECTIONS

1. **Ask students what they know about arthropods.**
Discuss how arthropods are capable of incredible physical feats in order to defend themselves from predators and catch prey. The film *Amazing Mighty Micro Monsters* calls these adaptations "superpowers." Explain that students are going to calculate what their own "superpowers" would be if they had the same physical capabilities as the arthropods featured in the film and other arthropods with "superpowers."

2. **Review the "micro monsters" students saw in the film.**
Ask students to recall which arthropods they saw in the film, and discuss what adaptation made each **organism** unique. Record student responses on the board.

3. **Have students work in pairs to collect data and calculate their "superpowers."**
Distribute the Mighty Micro Monsters Math worksheet to students. Explain to students that they will collect their own **data** to complete the "My Data" and "My Superpower" columns of the worksheet. First, review the Multiplier column with students.

   Divide students into pairs. Tell them they will work with partners to collect data for the "My Data" column. Student pairs can rotate through stations independently, or the class can work through the data collection together. Review the "My Data" Question and Instructions for each station with students so they know what is expected of them. In some cases, students will need to answer multiple questions.

   A note about the ogre-faced spider:

   Clarify for students that eye sensitivity does not equate to distance. In actuality, ogre-faced spiders are able to see more clearly in lower levels of light than humans are. So, if students were to stand next to an ogre-faced spider at night with a full moon, the spider would be able to see as well as you could during a cloudy day. This activity uses distance as a substitution for light levels in order to have students practice measuring.

   After all pairs have completed all the stations, regroup as a class to have everyone do their calculations. Ask: *How will we calculate our arthropod-inspired abilities, or "superpowers"*? Have students calculate their arthropod "superpowers" by multiplying their data with the **multiplier**. Note: For grasshoppers, first discuss which multiplier to use, as students recorded two data values. (Students should use their height, as the multiplier is based on the grasshopper's length.)

4. **Students visualize the data.**
Have students choose either the grasshopper or Australian tiger beetle "superpower" to visualize on a bar graph. The **bar graph** will compare their abilities as a human to a superpower bug-human. As a model, draw a blank graph on the board with the x-axis ("Regular Human vs. Superpower Bug-Human") and y-axis ("My Data") labels. In the case of the grasshopper, students will need to decide which figure to graph. (In this instance, they will want to use the distance they were able to jump rather than their height.) Discuss the importance of **units** when visualizing data. For example, the ogre-faced spider and leaf-cutter ant are very hard to graph because of scale.

Close the activity by having students calculate the difference in their abilities, using the information they plotted on their bar graphs. Ask: *What is the difference between your abilities as a normal human and with arthropod "superpower" abilities?* Have students hand in their answers.

ADAPTING THE ACTIVITY FOR YOUNGER STUDENTS

Have students only focus on grasshoppers. This will keep the activity to 45 minutes. Have students measure each other's height and long jumps and round to the nearest whole value. Record class data on the board. Convert the student values to "grasshopper" values for students and record these numbers on the board. Have students visualize this data. In a hallway or other large space, have a student mark his or her long jump distance with a strip of masking tape. Next, measure out the distance for the student's corresponding superpower long jump (this should be around 100 feet).

ADAPTING THE ACTIVITY FOR OLDER STUDENTS

Do not provide the worksheet to students in Directions Step 3. Rather, write the first three columns (Organism, Superpower, Multiplier) on the board with the complete data and have students record the table in their notebooks. Ask students to determine an equivalent of the "My Data Question" column (what data they need to measure in order to calculate their "superpowers"). Pay special attention to the grasshopper, as students will need to create two "My Data" questions. After students have determined their questions, have them then measure the data. Have students round their measurements to the nearest whole unit.

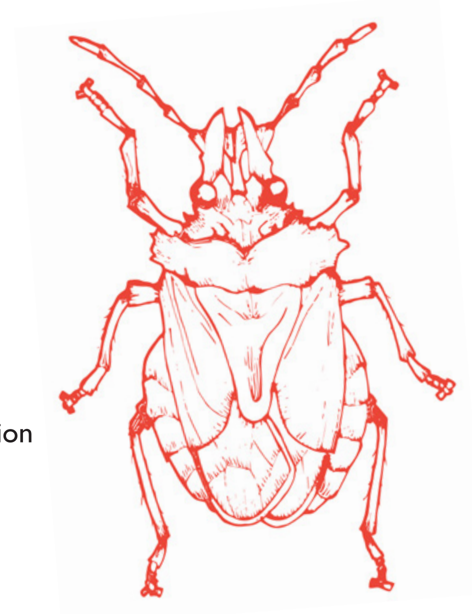
Additionally, have older students complete their measurements in one unit of measurement, and convert them to another. For example, if they recorded everything in inches have them convert their data and the multiplier values to centimeters.

Have older students create graphs to compare their human abilities to their superpower abilities. Students will need to decide what type of graph will be most appropriate for each category or if it is possible to graph based on scale (e.g., the ogre-faced spider and leaf-cutter ant are hard to graph due to issues of scale). Students will also need to calculate an appropriate scale for the axes.

CROSS-CURRICULAR CONNECTION

Literacy Have students choose one organism they worked with in this activity: ogre-faced spider, grasshopper, leaf-cutter ant, or Australian tiger beetle. Have them work in small groups to develop, write, and illustrate a narrative about a student who suddenly develops that arthropod's "superpower." Set clear expectations for elements that should be included in students' stories, such as effective technique, descriptive details, and clear event sequences. For example, their story should be well-written and concise. It should have a clear beginning (what was this student like before they had a superpower?), middle (how did they develop this superpower?), and end (what did they do with their superpower once they discovered it?). Additionally, groups should include a labeled illustration or diagram with their story.

KEY SKILLS



21st Century Student Outcomes

Learning and Innovation Skills

- ✔ Communication and Collaboration

Critical Thinking Skills

- ✔ Applying
- ✔ Analyzing

Science and Engineering Practices

- ✔ Analyzing and Interpreting Data
- ✔ Using mathematics and computational thinking
- ✔ Obtaining, evaluating, and communicating information

CONNECTIONS TO STANDARDS

National Science Education Standards

(K-4) A-1 Abilities necessary to do scientific inquiry
(K-4) C-1: The Characteristics of Organisms
(5-8) A-1: Abilities necessary to do scientific inquiry
(5-8) A-2.3: Understandings about scientific inquiry. Mathematics is important in all aspects of scientific inquiry.
(5-8) C-5: Diversity and Adaptations of Organisms

Next Generation Science Standards

LS4.C. For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.

Common Core State Standards for Mathematics

CCSS.MATH.CONTENT.2.MD.A.3
Estimate lengths using units of inches, feet, centimeters, and meters.

CCSS.MATH.CONTENT.3.OA.A.4
Determine the unknown whole number in a multiplication or division equation relating three whole numbers.

CCSS.MATH.CONTENT.3.MD.B.3
Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more: and "how many less" problems using information presented in scaled bar graphs.

CCSS.MATH.CONTENT.3.MD.B.4
Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters.

CCSS.MATH.CONTENT.4.OA.A.1
Interpret a multiplication equation as a comparison, e.g., interpret 35 = 5 x7 as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations.

CCSS.MATH.CONTENT.4.MD.B.4
Make a line plot to display a data set of measurement in fractions of a unit. Solve problems involving addition and subtraction of fractions using information presented in line plots.

CCSS.MATH.CONTENT.5.MD.A.1.
Convert among different-sized standard measurement units within a given measurement system, and use these conversions in solving multi-step, real world problems.

CCSS.MATH.CONTENT.5.MD.B.2
Make a line plot to display a data set of measurement in fractions of a unit. Solve problems involving addition and subtraction of fractions using information presented in line plots.

Common Core State Standards for English Language Arts
CCSS.ELA-Literacy.W.3.3, CCSS.ELA-Literacy.W.4.3, CCSS.ELA-Literacy.W.5.3
Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences.

ACTIVITY 4: Insect Inventory

ACTIVITY DESCRIPTION

Students conduct a species inventory, using the scientific skills of observation and recording data, to identify arthropods that live in their local environment and draw a map of the study area. They also make and confirm predictions about biodiversity in their community.

CONNECTION TO FILM

In the film, students learn that "there are more bugs in a single square mile of forest than human beings on Earth." This fact can be both surprising and difficult for students to fully comprehend. Helping students make connections to their own lives by conducting a local species inventory will bring this concept to life while also enabling them to practice important scientific skills.

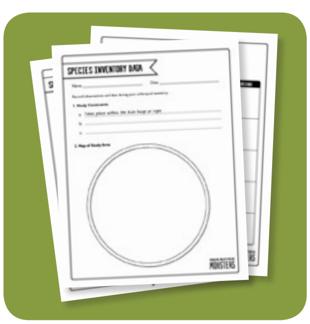
LEARNING GOALS

- ✓ Participate in a scientific practice
- ✓ Practice skills used by scientists in the field, including observation and recording data
- ✓ Gather and analyze data
- ✓ Make and confirm predictions about biodiversity in their community

PREPARATION

Reserve or locate an outdoor space for students to use (e.g., on school grounds or in a local park). Be prepared to begin the activity in the classroom setting, to visit the outdoor study area in the middle of the activity, and to end the activity in the classroom setting.

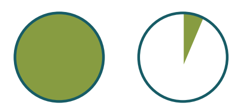
MATERIALS LIST



- ✓ Hula Hoop or 1 meter (approximately 3.28 feet) of rope
- ✓ Species Inventory Data worksheet

Note: all worksheets are available in the Worksheets and Handouts section of this guide.

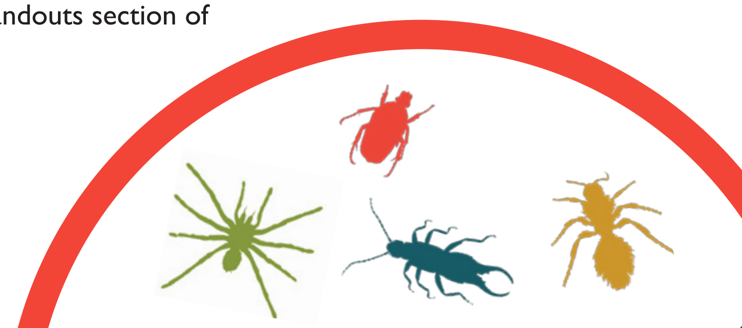
TIME NEEDED



25 minutes in the classroom
25 minutes, or as long as time allows, in the outdoor study area
15 minutes in the classroom

VOCABULARY

- ✓ arthropod
- ✓ biodiversity
- ✓ constraints
- ✓ data
- ✓ ecosystem
- ✓ observation
- ✓ organism
- ✓ species
- ✓ species inventory



DIRECTIONS

In the Classroom:

1. **Activate prior knowledge about biodiversity.**
   Draw a simple T-chart on the board. Invite students to share examples of the insects they have observed outdoors locally. List examples in the left column as you hear them. Define **biodiversity** as the variety of living organisms within an area. It's usually indicated by the number of different types of plants and animals in an area. Remind students that in the film, *Amazing Mighty Micro Monsters*, the narrator states that "there are more bugs in a single square mile of forest than human beings on Earth." Ask: *What do you think such an abundance of insects tells us?* Elicit from students that this is an indicator of **ecosystem** health, or the health of an environment.

2. **Introduce the practices of observation and recording data and have students make predictions.**
   Ask: *How do we know the specific biodiversity of an area?* Discuss the importance of **observation**, **data** gathering and recording, and the role of scientists. Remind students that they were relying on the skill of observation to generate their original list of insects. Ask: *What do you predict is the quality of biodiversity in our community based on your past observations of insects?*

3. **Introduce the practice of a species inventory.**
   Explain that scientists will often perform **species** inventories to measure the biodiversity of an area. A **species inventory** is a study researchers undertake to identify all **organisms** living in a particular place. Some inventories focus on a particular type of organism or period of time, for example, a season. Essentially, scientists study an area and count the number of species in it. First, they set constraints. A **constraint** is a limit or restriction. In the case of a species inventory, a constraint would be the area of study (e.g., 1 square mile) or the amount of time (e.g., 1 hour).

4. **Set constraints for students' species inventory.**
   Tell students that they will be working in groups as scientists to perform their own species inventories outside. They will be doing **arthropod** inventories!

   Ask students to share what they know about arthropods. Then modify the left-hand side of the list on the board to include arthropods students think they might see during their inventory.

   Divide students into small groups and distribute the Species Inventory Data worksheet. Review the worksheet with students and explain that each group will get a hula hoop or rope to form their study area. It's up to the group to decide where to put their circle of study. Their job as a group of scientists is to observe and record what they see in their study area. Explain that, as a scientist, it's also important to record environmental data, like weather.

In the Outdoor Study Area:

5. Go outside and have students prepare their study areas.
Go outside to the observation site and explain that students need to determine, as a group, three constraints for their study. Provide the first one: their study needs to take place within the group's circle. Direct groups to select two more constraints and to place their hula hoop or rope. Encourage them to focus on a particular type of arthropod or habitat.

6. Assist students as they conduct a species inventory.
Direct students to collect data to analyze and report on once they return to the classroom. Ask them to focus on taking notes while they are outside, including drawing a picture or map of their study area.

In the Classroom:

7. Have students analyze their data and predictions.
Once students have completed their inventories, return to the classroom. Ask groups to list the organisms they saw. Record the list in the right column on the board, next to the original list of organisms students expected to see. Discuss students' findings as a class. Did groups see the same things? What was the same? What was different? Ask: *How does our post-inventory list compare to our pre-inventory list? What role did constraints play?* Finally, have students confirm or modify the predictions they made in Directions Step 2 about the quality of biodiversity in your community based on their observations.

ADAPTING THE ACTIVITY FOR YOUNGER STUDENTS

Have younger students practice making observations in the classroom ahead of time. In the outdoor study area, provide them with all three constraints: within the hula hoop or rope, within a certain amount of time, and identifying arthropods based on their key characteristics. Use the "What Is an Arthropod?" activity from this guide to develop students' content knowledge about arthropods.

ADAPTING THE ACTIVITY FOR OLDER STUDENTS

Provide students with additional copies of the Species Inventory Data worksheet. Have them repeat the inventory on multiple days, compare and contrast what they see on different days, and make inferences about why they see particular similarities and differences.

CROSS-CURRICULAR CONNECTION

Literacy First, have students revisit this quote from the film and analyze it following their species inventory: "There are more bugs in a single square mile of forest than human beings on Earth."

Then provide students with the following writing prompt and instructions: Do you think this quote is true for our community? Why or why not? Write an opinion essay supporting your point of view, using reasoning and well-organized data. After students finish writing, invite volunteers to share their ideas and reasoning.

If students need support, prompt them to form opinions by asking: *Were you surprised by the quote based on what you observed? Why or why not? How do you think the geography of our community (e.g., urban vs. rural environments) impacted what we found? What other factors may have impacted what we found?*

KEY SKILLS

21st Century Student Outcomes

Learning and Innovation Skills

- ✓ Communication and Collaboration

21st Century Themes

- ✓ Environmental Literacy

Critical Thinking Skills

- ✓ Understanding
- ✓ Applying
- ✓ Analyzing

Science and Engineering Practices

- ✓ Planning and Carrying Out Investigations
- ✓ Analyzing and Interpreting Data
- ✓ Obtaining, evaluating, and communicating information

Geographic Skills

- ✓ Acquiring Geographic Information

CONNECTIONS TO STANDARDS

National Science Education Standards

(K-4) A-1: Abilities necessary to do scientific inquiry
(K-4) A-2: Understandings about scientific inquiry
(K-4) G-1: Science as a human endeavor
(5-8) A-1: Abilities necessary to do scientific inquiry
(5-8) A-2: Understandings about scientific inquiry
(5-8) G-1: Science as a human endeavor
(5-8) G-2: Nature of science

Next Generation Science Standards

3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

Common Core State Standards for Mathematics

CCSS.MATH.CONTENT.1.MD.C.4
Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another.

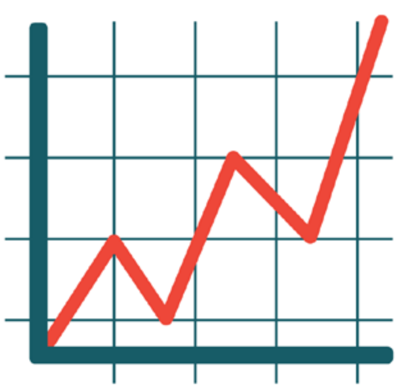
CCSS.MATH.CONTENT.6.SP.B.5
Summarize numerical data sets in relation to their context, such as by: Reporting the number of observations.

Common Core State Standards for English Language Arts
CCSS.ELA-LITERACY.W.3.1.
Write opinion pieces on topics or texts, supporting a point of view with reasons.

CCSS.ELA-LITERACY.W.4.1.
Write opinion pieces on topics or texts, supporting a point of view with reasons and information.

CCSS.ELA-LITERACY.W.5.1.
Write opinion pieces on topics or texts, supporting a point of view with reasons and information.

National Geography Standards
Standard 1: How to use maps and other geographic representations, geospatial technologies, and spatial thinking to understand and communicate information.



ADDITIONAL ACTIVITY IDEAS

Use these quick, 5-10 minute additional activity ideas for a variety of purposes. Use them as warm-up activities to introduce students to topics or as learning extensions in museums, classrooms, or at home.

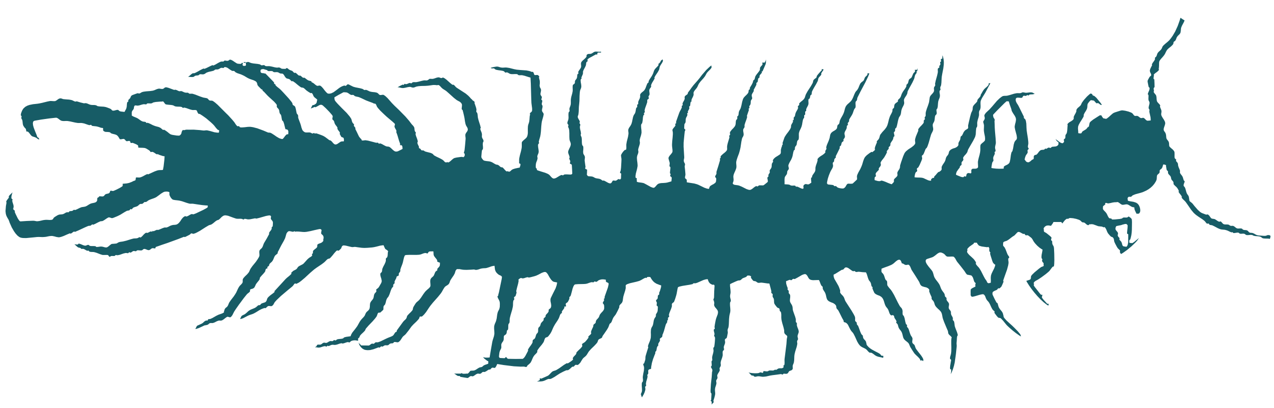
SCIENCE

Discuss the various "homes" arthropods inhabit. Starting with the concept of home, ask why insects might design their homes in different ways or why they might live alone or in groups. For example: Why do many spiders spin and live on webs? Why do ants live in large colonies? (what animals need to survive and how their habitats support those needs)

Honey bees communicate about food sources through a series of movements called the "waggle" dance. Ask a group of students to imagine they are an arthropod and design their own dance to communicate an important message, such as the location of nearby food, a warning, or advertising one's location. How does their dance compare to insect communication they've observed? How does it compare to insect communication they saw in the film? (purposes and methods of animal communication)

Discuss examples of animal adaptations and reasons for them. Ask students to describe some of the insect adaptations they learned about in the film, including bioluminescence, radar, camouflage, and speed. (animal adaptations)

Review the definition of *metamorphosis* with students. **Metamorphosis** means a major change in appearance or character of someone or something. In the film, a caterpillar undergoes metamorphosis to become a butterfly. Review the stages of this metamorphosis with students: egg, larva, pupa, and adult. (animal life cycles)



TECHNOLOGY AND STORYTELLING

To create this film, filmmakers had to invent a completely new type of camera. Discuss with students: What role did technology play in the storytelling of the film? What specific tactics did filmmakers use to tell the stories of these arthropods? Explore how filmmakers used close shots, slowed-down or sped up footage, and other tactics to present insects as having exciting superpowers. (storytelling craft and structure; technology creativity and innovation)

Filming arthropods, some less than a millimeter long, has been one of the most challenging projects yet for these filmmakers, requiring new cinematographic solutions. Have students discuss and, if possible, practice taking photographs of tiny things. Explain that this practice is known as macro photography. Why might it be so challenging? Discuss issues of scale and limitations of camera lenses. (technology; communication)

Illustrate for students how 3D film technology works. 3D films overlay two images, which our eyes fuse together with the help of polarized glasses. This allows us to see the depth of objects. Have students compare a 2D square (a piece of paper) with a 3D square (a cube, such as a dice). Discuss the difference between 2D (length and width) and 3D (length, width, and depth). How does 3D change your experience as a filmgoer? (storytelling; craft and structure)

ENGINEERING

Engineers have learned from nature how to use sound and radio waves to locate objects. Drawing design inspiration from nature is a practice called **biomimicry**. For example, whirligig beetles use a simple form of radar, or radio waves, when they use water ripples to detect food or other beetles on the surface. Ask students to list any devices they know that utilize radar. Have students select one of the Mighty Micro Monsters' abilities featured in the film, and design an invention that draws its inspiration from this ability. (biomimicry, design)

Explain that some insects use colors or even glow to communicate, or send messages. This glow is called bioluminescence. Have students describe examples of this visual communication from the film. If possible, have students experiment with a black light and discuss why certain arthropods, like the red claw scorpion, glow under UV light. Ask students to identify examples of how we use color to communicate messages (e.g., red means stop), and discuss the role color plays in designing products. (design process, visual communication)

MATH

Have younger students go outside and count the number of insects they see. Collect and record the data by taking photographs. Print the photographs and, afterward, provide them to students and have them sort their observations into recognizable groups or categories. Have older students create line plots of the insects they discover. (counting with understanding and recognizing "how many" in sets of objects)

One defining characteristic of arthropod classes is the number of legs they have. Have young students identify examples of arthropods with six legs (e.g., beetles, bumblebees, butterflies) and those with eight (spiders). (counting with understanding and recognizing "how many" in sets of objects)

Have older students go outside and measure out a square foot on the ground. Students should count how many insects they see within that area. Using ratios and proportions, have students approximate the number of insects that might be found in a square mile on Earth. Students can then compare their findings with the information presented in the film. (ratio and proportion)

Symmetry is a defining characteristic of arthropods. Print out photos of arthropods and non-arthropods, and ask students to identify if they are symmetrical or not. Review the definition of symmetry with students and have students do a symmetry test on the photos of the organisms by folding the paper in various ways. (symmetry)

GEOGRAPHY

Using the species list in the film synopsis, have students research the ranges of the arthropods featured in the film and plot them on a map. What similarities and differences are there between insects found in similar places? And in different places? (animal ranges and characteristics)

Some arthropods have amazing abilities to cope with extreme temperatures. To survive cold winter temperatures, some insects use a strategy called diapause. An agent in their blood acts like an antifreeze, allowing them to be semi frozen until they thaw in the spring. Some insects freeze all the way through and are still able to survive! Have students identify climate zones on a map where these insects might live. (animal adaptations; animal ranges and characteristics)

Following the film, have a discussion about how organisms use and relate to their environment. Ask: *Did some organisms use their environment in different ways? How did organisms use the same environment differently?* (animal habitats)

LITERACY

Have students write an essay detailing which Mighty Micro Monster superpower they would want to have and supporting their opinion. (writing; text types and purposes)

In the film, the argiope spider creates dazzling spider webs. This is similar to a well-known literary spider, famous for creating beautiful webs. Ask students to recount the story of Charlotte's Web, including Charlotte's traits, motivations, or feelings and how her actions contributed to the sequence of events. Charlotte used her web to describe Wilbur's characteristics, or identity. Have students design their own spider webs representing their identity. (reading; key ideas and details)

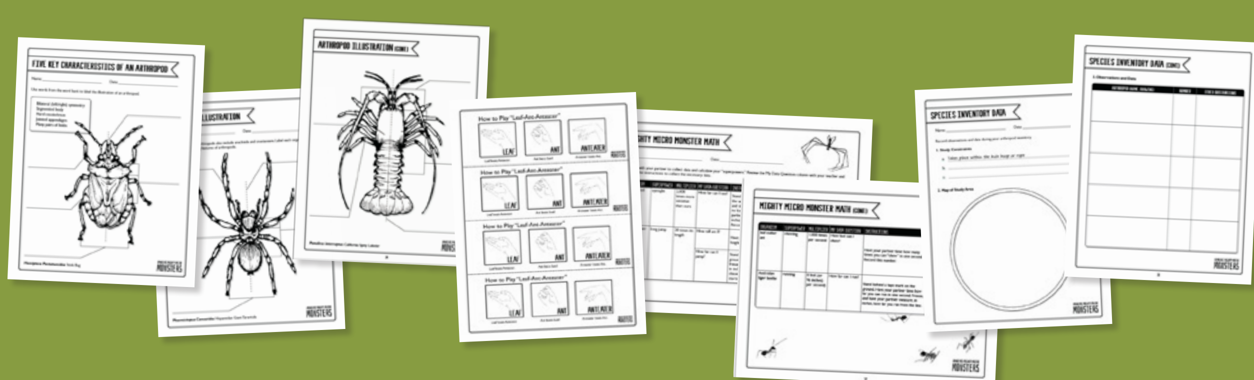
Have students create, write, and illustrate field journals. Take sheets of blank paper, fold them in half width-wise, and staple them to create booklets. Have students record an observed insect on each page, including labels, illustrations, additional observations, and predictions. (writing; text types and purposes)

APPENDIX

WORKSHEETS AND HANDOUTS

BEFORE VIEWING THE FILM

AFTER VIEWING THE FILM

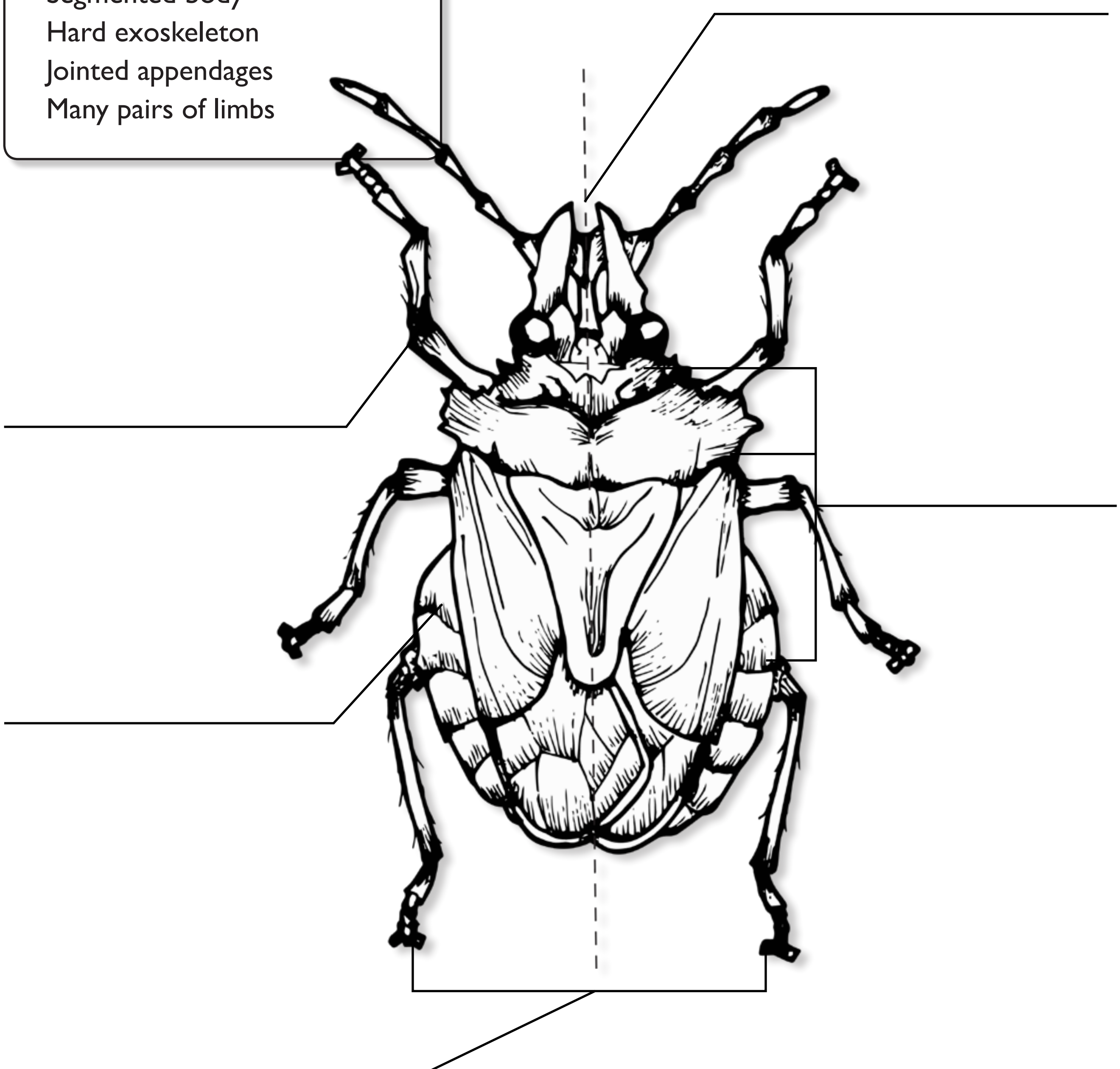


FIVE KEY CHARACTERISTICS OF AN ARTHROPOD

Name: ______________________________ Date: ______________________________

Use words from the word bank to label the illustration of an arthropod.

- Bilateral (left/right) symmetry
- Segmented body
- Hard exoskeleton
- Jointed appendages
- Many pairs of limbs



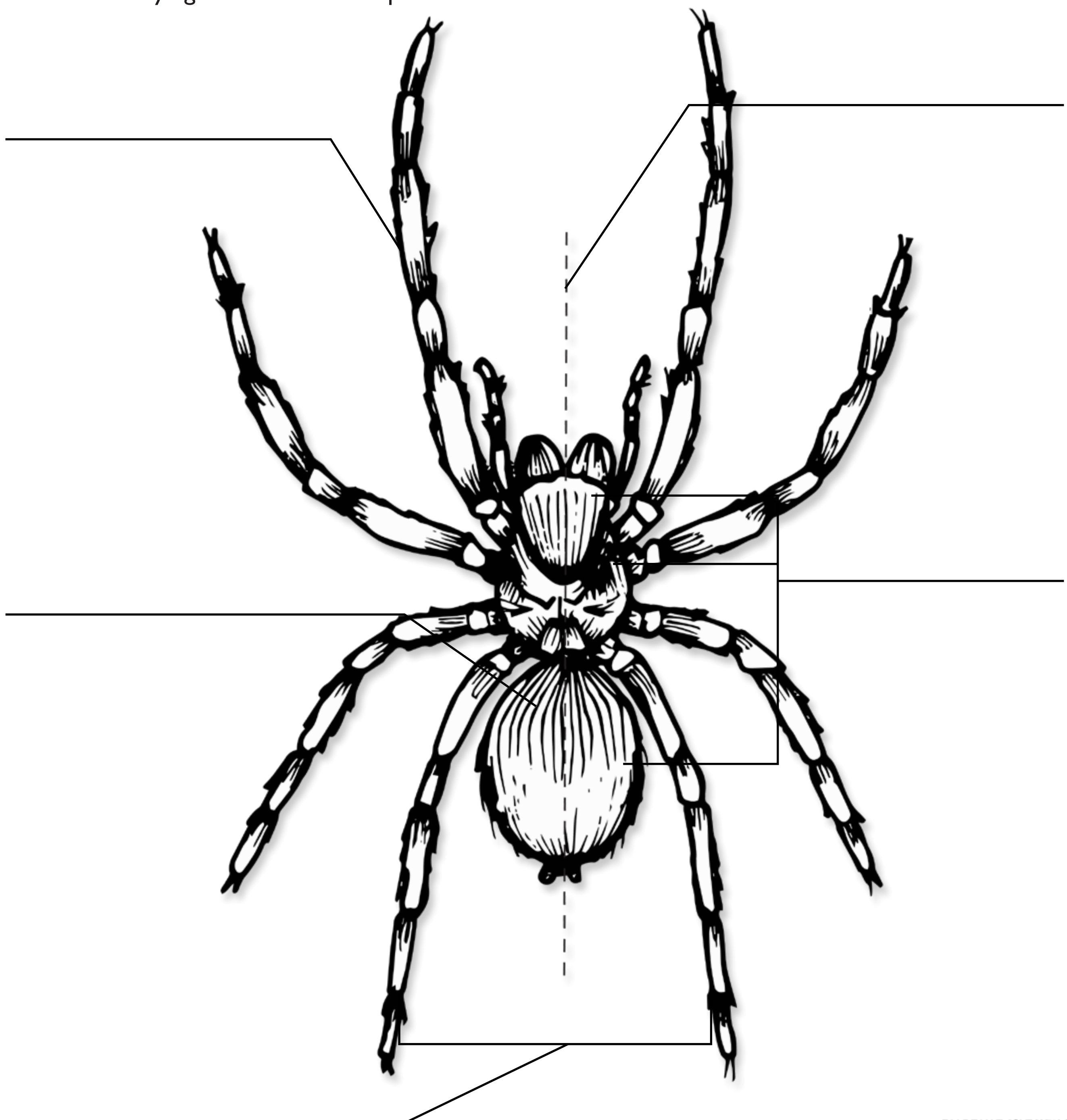
Halyomorpha halys stink bug

AMAZING MIGHTY MICRO MONSTERS

ARTHROPOD ILLUSTRATION

Name: ______________________________ Date: ______________________________

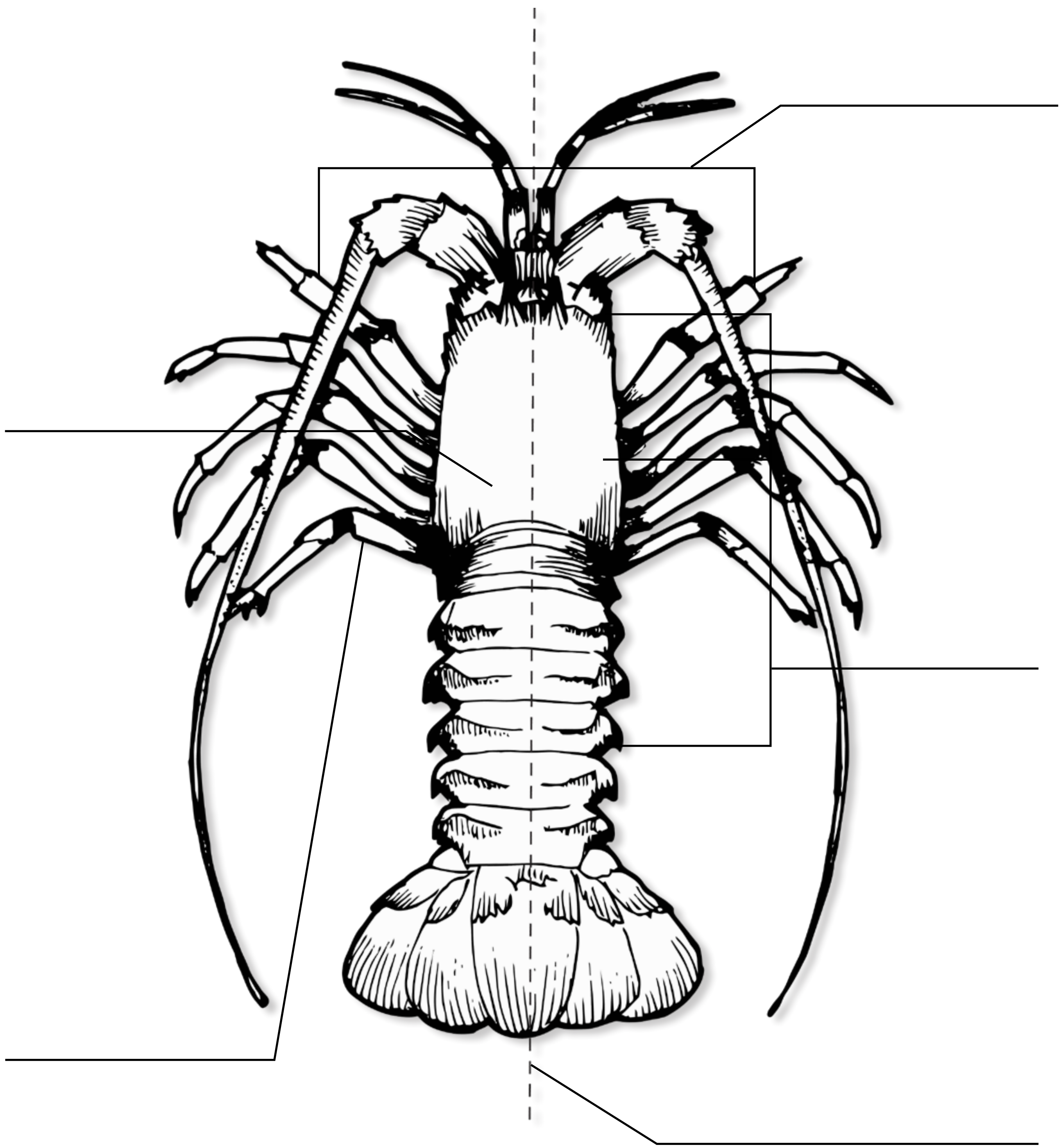
In addition to insects, arthropods also include arachnids and crustaceans. Label each organism with the five identifying features of arthropods.



Phormictopus cancerides Hatian brown tarantula

AMAZING MIGHTY MICRO MONSTERS

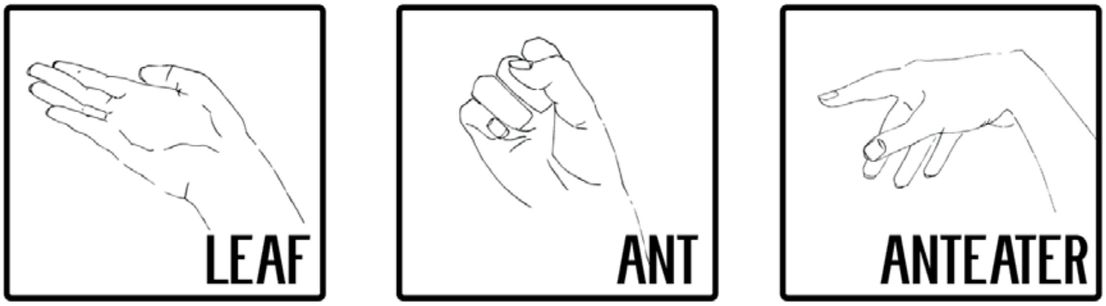
ARTHROPOD ILLUSTRATION (CONT.)



Panulirus interruptus California spiny lobster

AMAZING MIGHTY MICRO MONSTERS

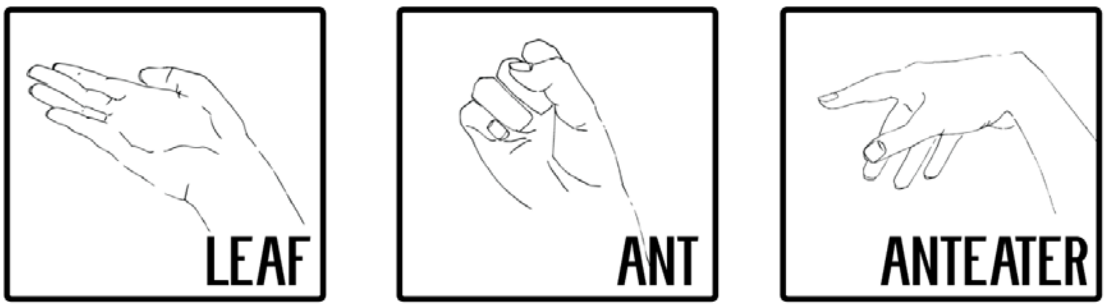
How to Play "Leaf-Ant-Anteater"



Leaf beats Anteater. Ant beats Leaf. Anteater beats Ant.

AMAZING MIGHTY MICRO MONSTERS

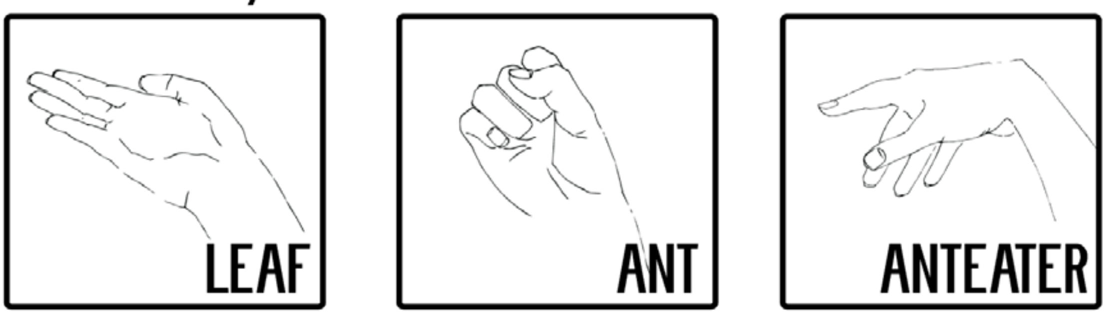
How to Play "Leaf-Ant-Anteater"



Leaf beats Anteater. Ant beats Leaf. Anteater beats Ant.

AMAZING MIGHTY MICRO MONSTERS

How to Play "Leaf-Ant-Anteater"



Leaf beats Anteater. Ant beats Leaf. Anteater beats Ant.

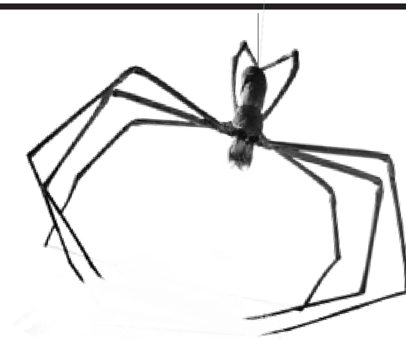
AMAZING MIGHTY MICRO MONSTERS

How to Play "Leaf-Ant-Anteater"

Leaf beats Anteater. Ant beats Leaf. Anteater beats Ant.

AMAZING MIGHTY MICRO MONSTERS

MIGHTY MICRO MONSTER MATH



Name: ______________________________ Date: ______________________________

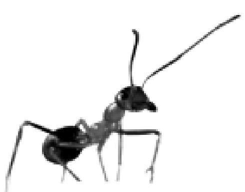
Work with your partner to collect data and calculate your "superpowers." Review the My Data Question column with your teacher and follow the instructions to collect the necessary data.

ORGANISM	SUPERPOWER	MULTIPLIER	MY DATA QUESTION	INSTRUCTIONS	MY DATA	MY "SUPERPOWER"
ogre-faced spider	eyesight	2,000 times more sensitive than ours	How far can I see?	Stand close to a board or wall, where the word "arthropod" is displayed, and slowly back away. When you can no longer read the board, have your partner measure the distance, in inches, between you and the board. Record this number.	_____ inches	
grasshopper	long jump	20 times its length	How tall am I?	Have your partner measure your height, in inches, and record it.	_____ inches	
			How far can I jump?	Stand behind a tape mark on the ground. Jump as far forward as you can, then freeze. Have your partner measure, in inches, how far the back of your closest foot is to the line where you started.	_____ inches	

AMAZING MIGHTY MICRO
MONSTERS

MIGHTY MICRO MONSTER MATH (CONT.)

ORGANISM	SUPERPOWER	MULTIPLIER	MY DATA QUESTION	INSTRUCTIONS	MY DATA	MY "SUPERPOWER"
leaf-cutter ant	chewing	1,000 times per second	How fast can I chew?	Have your partner time how many times you can "chew" in one second. Record this number.	_____ per second	
Australian tiger beetle	running	8 feet (or 96 inches) per second)	How far can I run?	Stand behind a tape mark on the ground. Have your partner time how far you can run in one second. Freeze, and have your partner measure, in inches, how far you ran from the line.	___ inches per second	



AMAZING MIGHTY MICRO MONSTERS

SPECIES INVENTORY DATA

Name: ______________________________ Date: ______________________________

Record observations and data during your arthropod inventory.

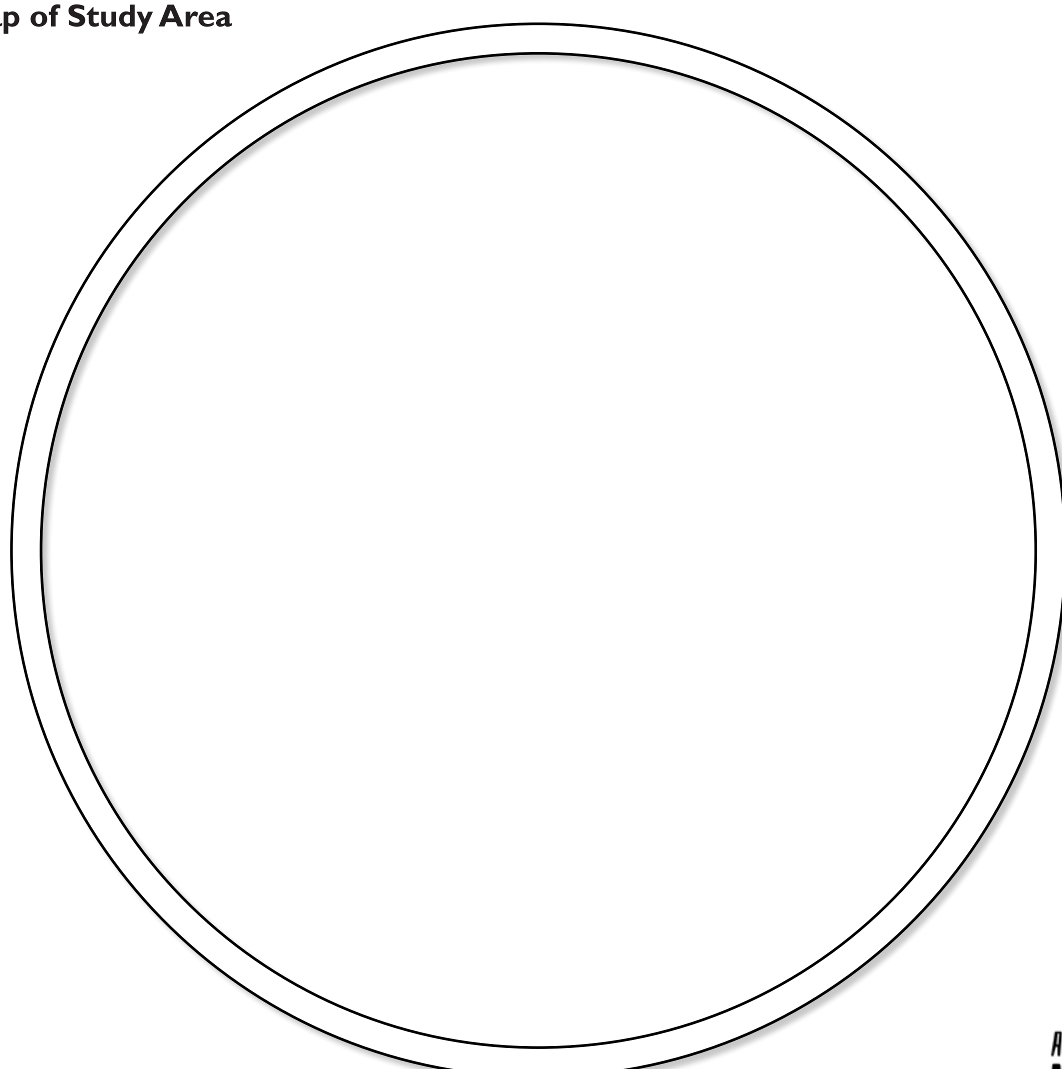
1. Study Constraints

a. Takes place within the hula hoop or rope

b. ______________________________

c. ______________________________

2. Map of Study Area



SPECIES INVENTORY DATA (CONT.)

3. Observations and Data

ARTHROPOD (NAME, DRAWING)	NUMBER	OTHER OBSERVATIONS

AMAZING MIGHTY MICRO MONSTERS

SPECIES INVENTORY DATA (CONT.)

ARTHROPOD (NAME, DRAWING)	NUMBER	OTHER OBSERVATIONS

4. Environmental Notes ____________________

AMAZING MIGHTY MICRO MONSTERS

GLOSSARY

arachnid	*noun.* Type of arthropod that has a body divided into two segments, with four pairs of (eight total) legs. For example, spiders and scorpions.
arthropod	*noun.* Invertebrate animal with a bilaterally symmetrical segmented body and an exoskeleton, jointed appendages, with many pairs of legs.
bar graph	*noun.* Graph using parallel bars to represent different values or categories of data.
biodiversity	*noun.* The variety of living organisms within an area.
characteristic	*noun.* Distinguishing feature of an organism or object.
classify	*verb.* To categorize or sort by type or characteristic.
constraint	*noun.* A limit or restriction.
crustacean	*noun.* Type of arthropod with a hard shell and segmented body that usually lives in the water. For example, lobsters, crabs and shrimp.
data	*noun.* Information collected in an organized manner, usually for scientific purposes.
ecosystem	*noun.* A system formed by the interactions of living and nonliving things in a given area.
entomologist	*noun.* Person who studies insects.
exoskeleton	*noun.* The hard outer body covering (a hard external shell) that provides structure and protection for an organism.
insect	*noun.* Type of arthropod that breathes in air and has a body divided into three segments, with six legs and usually wings.
invertebrate	*noun.* Organism without a backbone.
measurement	*noun.* A length, width, mass (weight), volume, distance or some other quality or size determined through a process.
multiplier	*noun.* A number multiplied with another number.

observation	*noun.* Something that is learned from watching and measuring an event or subject.
organism	*noun.* Living or once living thing, such as a type of plant, animal, or fungus.
predator	*noun.* Organism that hunts other organisms for food.
prey	*noun.* Organism that is hunted and eaten by other organisms.
segment	*noun.* A portion of a whole.
species	*noun.* A rank in the classification of organisms; a group of organisms with similar qualities that can reproduce with each other.
species inventory	*noun.* A study that identifies all the organisms living in a particular place.
symmetry	*noun.* Condition of having similar parts regularly arranged around a dividing line, plane, center, or axis.
taxonomy	*noun.* The science of identifying, classifying, and naming organisms.
unit	*noun.* Standard measure of size or composition.
vertebrate	*noun.* Organism with a backbone or spine.