

BE MOSQUITO SMART:

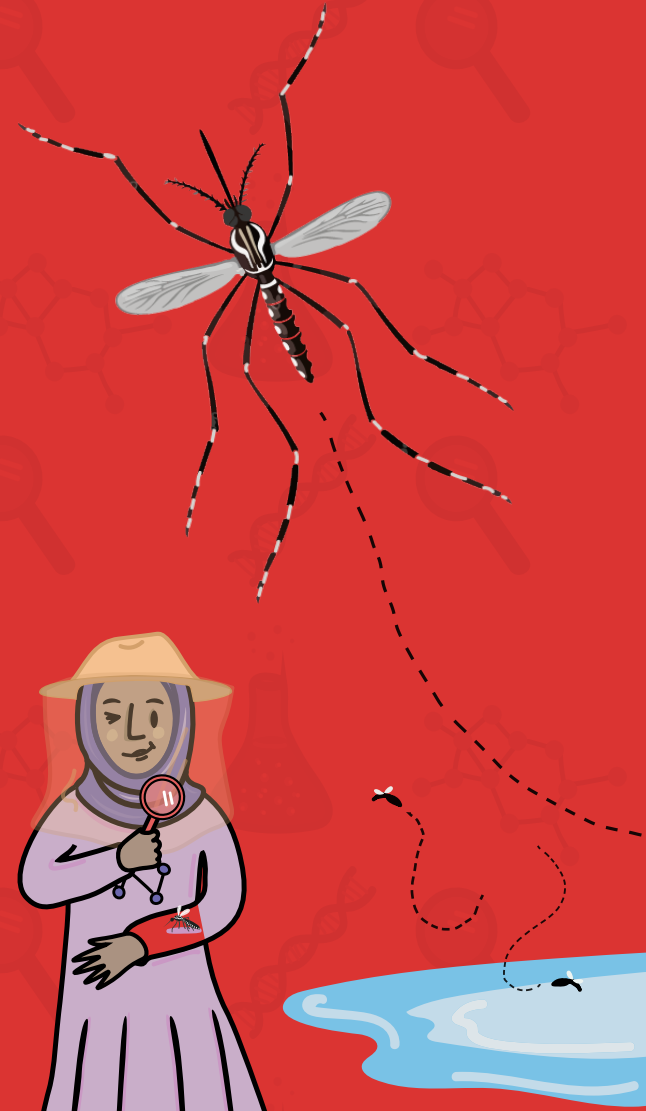
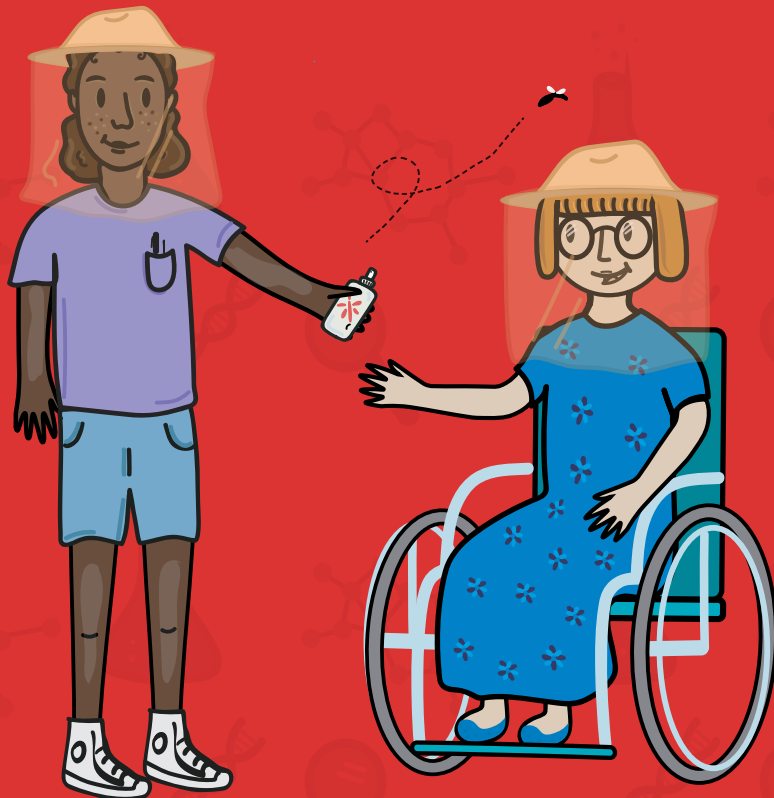
KNOW THE ENEMY

Target Population:

Students, ages 9–14

STEM²D Topics:

Science, Technology, Mathematics, Design



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Be Mosquito Smart: Know The Enemy is part of the STEM²D Student Activity Series. The content and layout were both developed by the Smithsonian Science Education Center as part of Johnson & Johnson's WiSTEM²D initiative (Women in Science, Technology, Engineering, Mathematics, Manufacturing, and Design), using a template provided by FHI 360 and JA Worldwide. This series includes a suite of interactive and fun, hands-on activities for girls (and boys), ages 5-18, globally.

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BE MOSQUITO SMART: KNOW THE ENEMY

Topics: Science, Technology, Mathematics, Design

Target Population: Students, ages 9–14

ACTIVITY DESCRIPTION

In this activity, students learn about mosquitos, including their anatomy, environments, what attracts them, why mosquitos “bite,” and the dangerous diseases they carry. Students gain knowledge through research and then participate in a competitive, interactive game to be the first to complete their mosquito. In addition to data collection, students use interpersonal skills needed in STEM²D careers such as presenting ideas and working as a collaborative team. This activity is adapted from the Smithsonian Science for Global Goals, *Mosquito! Module*.

ESTIMATED TIME:

This session typically takes one hour to complete.



STUDENT DISCOVERIES

Students will:

- Participate in a team-based learning experience.
- Learn how STEM²D—science, technology, engineering, mathematics, manufacturing, and design—subjects are used in the study of mosquitos and diseases they carry.
- Build important STEM²D skills such as problem-solving, decision-making, and data collection.
- Consider STEM²D concepts including the life cycle of the mosquito, diseases, environments, and climate change.
- Become aware of how the transmission of mosquito-borne diseases influences many different fields, including medicine, agriculture, cell biology, physiology, and ecology.
- Recognize that STEM²D offers diverse and exciting career opportunities, including those connected with disease control.
- Have fun experiencing STEM²D.

GETTING READY

Materials: Suggested materials preparation prior to the activity with students.

- Activity Leader Checklist
- Tell My Story form
- 1 Student Assessment Handout per student
- Be Mosquito Smart questions, cut out and placed in body part categories
- Watch or timer, 20 seconds
- Cut-out Mosquito Body Parts, for six complete mosquitos (THIS NEEDS TO BE DRAWN SO THAT ALL PARTS CAN BE PLACED TOGETHER)
- For each team of students (six teams of four students each):
- Handout: List of Mosquito Body Parts
- 24 Certificates
- Camera (optional)

Student Preparation:

One week before the day of the J&J event, have students research mosquitos, including their anatomy, environments, what attracts them, why mosquitos “bite,” and the dangerous diseases they carry. Have the students bring their research notes with them (hard copy or electronically) to the event. See Internet safety below.



Estimated Materials Cost:

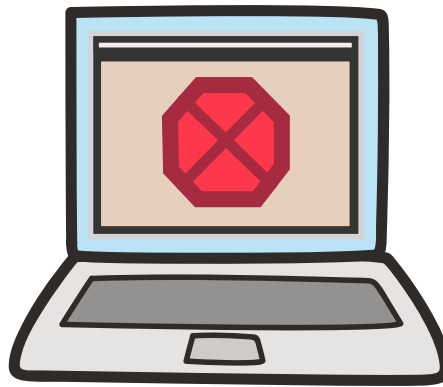
Activity leaders can expect to spend less than \$5 on materials when completing this activity with 24 students, including printing the student handouts, assuming that students have their own crayons or colored pencils.

Internet Safety (Taken from the Mosquito! Module)

Having access to the Internet opens doors to information that were once impossible to access. Today students can learn just about anything on the Internet. Interactions with people from across the globe enable students to stay connected

with family members, friends, and fellow citizen scientists. Thanks to the Internet, collaboration has been made easier.

It is very important to protect yourself and your identity when using the Internet; this is especially important for children under the age of 13. For this reason, the United States federal government passed the Children's Online Privacy Protection Act (COPPA) in 1998. This act prevents websites from obtaining information from children without parental consent. Even with the act in place, though, there are still many dangers out there in cyberspace.



The following is a list of recommended Internet safety precautions:

- Always follow your classroom and home Internet rules.
- Only visit websites you have permission to visit.
- Use a screen name to protect your identity, and never give out personal information such as your birthday, phone number, address, Social Security number, or any other identification number. Screen names should not include personal information. If a website is asking for this information, get your teacher, parent, or guardian.
- Do not share your log-in information with anyone, not even your best friend.
- Although selfies are popular, avoid sharing personal photos and videos. Once your image is on the Internet, it is out there for all to see, not just the person you shared it with.
- Avoid opening e-mails from unknown senders or e-mail addresses you don't recognize. If you are not sure about an e-mail, check with your teacher, parent, or guardian. If you are still not sure the e-mail is safe, when in doubt, throw it out.
- Never agree to meet anyone in person that you met on the Internet. If someone is asking to meet with you, get your teacher, parent, or guardian.
- Do not buy anything or sign up for anything online before getting permission from your teacher, parent, or guardian.
- Always get permission from your teacher, parent, or guardian before downloading

and opening e-mail attachments.

- Avoid cyber bullying by not sending or replying to anything mean, nasty, offensive, insulting, or malicious.
- If you ever receive an inappropriate e-mail or message, or one that makes you feel uncomfortable, tell your teacher, parent, or guardian.
- Know which websites are safe and which ones are not. Never visit inappropriate or unsafe websites. If you are not sure which sites are safe and which ones are not, check with your teacher, parent, or guardian.

Additional Resources

1. <https://kidshealth.org/en/kids/internet-safety.html?ref=-search&WT.ac=msh-k-dtop-en-searchclk>
 2. <https://kidshealth.org/en/kids/online-id.html?ref=-search&WT.ac=msh-k-dtop-en-search-clk#>
 3. <https://kidshealth.org/en/teens/internet-safety.html?ref=-search&WT.ac=msh-t-dtop-ensearch-clk>
 4. <https://www.nypl.org/help/about-nypl/legal-notice/internet-safety-tips>
 5. <https://www.nypl.org/sites/default/files/safekidslist.pdf>
- COPPA
1. <http://www.coppa.org/coppa.htm>
 2. <https://www.epic.org/privacy/kids/>

ACTIVITY LEADER PREPARATION

1. Read **Spark WiSTEM²D**. This is essential reading for all volunteers interested in working with youth, as it provides important background knowledge about STEM²D, strategies for engaging students, and tips for working with groups of students. Download at STEM2D.org.
2. Review the **Activity Leader Checklist** for details and specific steps for planning and preparing to implement this activity.
3. See the **STEM²D Student Activities Overview** for additional information.



STEP-BY-STEP ACTIVITY:

BE MOSQUITO SMART: KNOW THE ENEMY

Welcome and Introductions (15 minutes)

- Greet the students.
- Tell the students your name and your organization/company. Talk about your educational and career path. Use the Tell My Story form as a basis for your remarks. Be prepared to describe your job or a typical day, and provide information about your background including:
 - Your education – focus on secondary and post-secondary classes and courses
 - Current work projects
 - Interests and hobbies
 - Why you love STEM²D, and how your work is connected.
- Ask the students or any volunteers helping today to introduce themselves.
- Use Conversation Starters to learn more about the students and their interests.
- Discuss the opportunities that exist in the local community to support students as they develop their interests and personal experiences.
- Tell the students that your career is only one of the many careers available in STEM²D – science, technology, engineering, mathematics, manufacturing, and design.
- Explain that STEM²D careers are high-demand, high-growth careers and are predicted to remain in demand over the next 10 years.
- Some STEM²D careers do not require a college degree and offer young people exciting, high-paying opportunities. Stress the importance of gaining mathematics skills and engineering practices to succeed in any STEM²D career.

CONVERSATION STARTERS: CAREER PLANNING

- When you consider your future, what are you most excited about?
- Do you see yourself working with others, for a large company, with your friends, for yourself? Why or why not?
- What does the perfect work day look like to you? Are you outdoors? Are you working alone, or with others? Do you solve problems? Do you fix or build things?

CONVERSATION STARTERS: LEARNING ACTIVITY

- How many of you remember the last time you got a mosquito bite? Where were you? Describe the environment.
- Before you started your research on mosquitos, how many of you were aware of the dangerous diseases that mosquitos can carry?
- Are any of you aware of mosquito control in your communities?
- In the activity you are going to be doing, you will be in teams of four (six teams in all). Each team requests a question connected to a mosquito body part, and gets 20 seconds to answer. If time is called, the question goes to the next team. Team members can consult each other and look at their research. Each team tries to gather all the body parts to complete their mosquito (18 parts in all). Are you ready?



Instructions:

1. Divide the class into teams of four. You may want to consult the classroom teacher for the best combinations.
2. Tell the Be Mosquito Smart teams the order in which they will be asked the questions.
3. Review the rules and begin.
4. Questions are arranged by mosquito body parts, so a team should request a leg question if they need a leg, a proboscis question if they need a proboscis, and so on. The difficulty of the questions will vary. The object is for each team to complete their mosquito by answering the questions correctly.
5. One J&J volunteer will read a question directed at the team, and if needed, repeat the question before timing begins.
6. A second J&J volunteer will be the timer.
7. A third J&J volunteer delivers the body part to a team when they have answered a question correctly. Body parts may be taken from other teams to make the experience more fun and competitive.
8. The game ends when one team has all 18 mosquito parts.

Reporting Results:

Ask each team to reveal one fact about mosquitos they researched and were able to answer correctly when asked a question, and two new facts they learned while playing the game.

Give positive feedback after each team reports, and encourage the other students to applaud their efforts.

This is a good time to take pictures of each team and their complete or incomplete mosquito.

Student Reflection (10 minutes)

Distribute the Student Handouts. Have the students reflect on this activity by answering the following questions:

- What did you find most fascinating about mosquitos?
- Did you have fun playing the game? What made it fun?
- Who are you going to tell about today's mosquito activity? Why?
- Why is it important to know about mosquitos?
- What might you do differently because of the knowledge you gained?
- Would you consider a career in the field of disease control? Explain.



After a few minutes ask the students to share their thoughts.

Thank the students for participating.

This is a great time to present each student with a certificate that has been prepared ahead of time with each student's name and signed by the Johnson & Johnson volunteer. Also, pass out the WiSTEM²D posters to each student.

EXTENDED LEARNING

1. Assign each student team a mosquito-borne disease to research and report about to the class.
2. Invite someone to speak to the class who works in mosquito control for the community. Ask them what a good class project might be to assist their work.
3. Have the class bring in mosquito specimens to observe under a microscope and identify the species.
4. Research careers in mosquito-borne disease control.

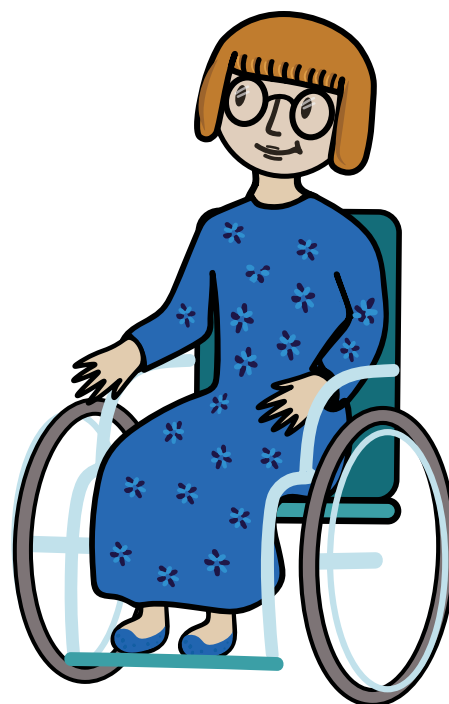
ACTIVITY LEADER REFLECTIONS

After the activity, take a few minutes to reflect on the following:

- What went well and what could be improved?
- What would you do differently next time?
- How comfortable did you feel leading the learning experience?
- Do you have a better understanding of the STEM²D concepts?
- How useful was the information presented in the **Spark WiSTEM²D**?
- Will you volunteer for this type of experience again?

RESOURCES AND REFERENCES

1. Smithsonian Science for Global Goals, *Mosquito! Module*.
2. Smithsonian Science Education Center
3. "Why the Menace of Mosquitos Will Only Get Worse," *New York Times Magazine*, The Climate Issue, April 20, 2017
4. The America Mosquito Control Association
5. U.S. Centers for Disease Control
6. U.S. Department of Agriculture
7. University of California–Davis, Entomology and Agriculture Departments
8. www.mosquitomagnet.com



BE MOSQUITO SMART QUESTIONS

HEAD, THORAX, ABDOMEN QUESTIONS

Name two diseases carried by mosquitos.
(Malaria, West Nile, Zika, Dengue fever)

How long does it take for a mosquito to develop from egg to adult?
(10 to 14 days)

How many tubes does the mosquito proboscis have?
(Two)

How long does a male mosquito live?
(10 days)

To what body part are the wings of the mosquito attached?
(Thorax)

Why do female mosquitos need the protein in blood?
(To help develop eggs)

How many compound eyes does a mosquito have?
(Two)

What disease carried by mosquitos was of great concern during the summer Olympics in Brazil?
(Zika)

What are the two peak mosquitos times of day?
(Early morning hours and at dusk)

True or false: There is a commercially produced bacteria that can be put into stagnant water to kill mosquito larvae.
(True)

True or false: Most mosquitos remain within one to three miles of where they hatched.
(True)

True or false: Mosquitos have sensors that can detect carbon dioxide?
(True)

What does CDC stand for?
(Centers for Disease Control)

True or false: DEET, a mosquito repellent, kills mosquitos.
(False, mosquitos don't like the smell of DEET.)

How many simple eyes does a mosquito have?
(Two)

What gas do mosquito larvae (wigglers) breathe?
(Oxygen)

True or false: Some species of adult female mosquitos hibernate.
(True)

True or false: Mosquitos generally fly below 25 feet.
(True)

True or false: There have been no cases reported in the United States of the Zika virus infection carried by mosquitos.
(False)

True or false: Commercial mosquito traps lure mosquitos by simulating warm, moist carbon dioxide-filled human breath.
(True)

True or false: Climate change is altering the environment in ways that could increase the potential of mosquito-carried diseases.
(True)

True or false: More than 5,200 US citizens have been infected with the Zika virus.
(True)

LEGS, WINGS QUESTIONS

True or false: Mosquitos have four clear-veined wings attached to their abdomen.
(False, two wings attached to the thorax)

True or false: A mosquito has eight legs.
(False, six)

True or false: Female mosquitos can lay six eggs at a time.
(False)

Name two mosquito breeding places.
(Flowerpots, birdbaths, gutters, or anyplace with stagnant water)

True or false: Dengue fever is carried by mosquitos.
(True)

True or false: Mosquitos like breezes.
(False, breezes, even from a fan, can throw off a mosquito's senses, making it difficult to fly)

True or false: There is a lemon-scented geranium flower that is known to repel mosquitos.
(True)

True or false: Zika virus infection is carried by mosquitos.
(True)

True or false: Malaria is carried by mosquitos.
(True)

True or False: Mosquito-related diseases kill 725,000 people each year.
(True)

True or false: Only female mosquitos "bite."
(True)

True or false: Mosquitos prefer temperatures below 50 degrees Fahrenheit.
(False)

How many clear-veined wings does a mosquito have?
(Two)

Name a disease carried by mosquitos.
(Malaria, West Nile, Zika, Dengue fever)

Does the male mosquito live longer than the female mosquito?
(No, a male lives 10 days and a female 42 to 56 days)

How many legs does a mosquito have?
(Six)

True or false: Measles is carried by mosquitos.
(False)

True or false: Only male mosquitos "bite."
(False)

True or false: Female mosquitos only attack at dusk when the sun is setting.
(False)

True or false: Female mosquitos attack day and night.
(True)

True or false: Female mosquitos lay their eggs on leaves.
(False)

True or false: Dark-colored clothing retains heat, attracting more mosquitos than light-colored clothing.
(True)

True or false: Installing a bug zapper on your patio will control mosquitos.
(False)

True or false: There is a cure for the Zika virus infection that causes birth defects.
(False, there is no cure)

True or false: The mosquito-carried Zika virus infection has been reported in more than 60 countries.
(True)

True or false: Human sweat attracts female mosquitos.
(True)

Which attracts more mosquitos, light-colored clothing or dark-colored clothing?
(Dark-colored clothing, because it retains heat)

True or false: Skin lotions and perfumes attract mosquitos.
(True)

True or false: Female mosquitos lay their eggs in stagnant (standing) water.
(True)

True or false: Mosquitos fly hundreds of miles in their life span.
(False)

True or false: Female mosquitos can beat their wings up to 500 times per second.
(True)

True or false: Female mosquitos have a pointed stinger on their abdomen that they use to pierce our skin to get blood.
(False)

True or false: Mosquitos are one of the fastest flying insects.
(False)

True or false: Male mosquitos attack during the day and female mosquitos attack at night.
(False, male mosquitos do not attack, females can attack day or night)

True or false: Mosquitos have been around since the Jurassic Period, making their species more than 210 million years old.
(True)

True or false: There have been no cases of West Nile virus in the United States.
(False)

What is considered to be the deadliest animal in the world?
(Mosquito, because of the diseases it can carry)

True or false: A large percentage of a bat's diet is mosquitos.
(False)

True or false: Dragonfly larvae eat mosquito larvae and adult dragonflies prey on adult mosquitos.
(True)

PROBOSCIS QUESTIONS

Name four diseases carried by mosquitos.
(Malaria, West Nile, Zika, Dengue fever)

How many species of mosquitos are known world-wide?
(3,500)

What virus infection transmitted by mosquitos causes a broad array of birth defects and neurological disorders?
(Zika)

What are the functions of the two tubes found in the female mosquito's proboscis?
(One to draw blood and one to pump out saliva containing a mild pain-killer and anti-coagulant)

How many different species of mosquitos are found in the United States?
(175)

What do mosquitos feed on most of the time?
(Fruit and plant nectar)

How many eggs can a female mosquito lay at a time?
(Up to 300 eggs)

How many eyes does a mosquito have?
(Four eyes: two compound eyes and two (ocelli) simple eyes)

How do male mosquitos locate females mosquitos?
(By the sound of their fast-moving wings)

What is the top speed for mosquito flight?
(About 1.5 miles per hour)

Where are the sensors on a mosquito that can detect carbon dioxide that is released when we breathe?
(On the antennae)

What is the name of the chemical in human sweat that attracts female mosquitos?
(Octenol)

How are diseases spread by mosquitos?
(Mosquitos spread diseases from parasites that are passed into a victim through the mosquito saliva released when drawing blood)

What fish feeds on mosquito larvae and is used worldwide to help control the mosquito population?
(Mosquitofish)

Name the one US state where Zika virus infection has not been reported.
(Alaska)

EYES, ANTENAE QUESTIONS

How long does a female mosquito live?
(42 to 56 days)

Name three diseases carried by mosquitos.
(Malaria, West Nile, Zika, Dengue fever)

What does "mosquito" mean in Spanish?
(Little fly)

How many teeth do mosquitos have?
(None)

What is the long, pointed mouthpart female mosquitos use to pierce our skin called?
(Proboscis)

Where does a female mosquito lay her eggs?
(In stagnant, standing water)

True or false: A female mosquito can drink up to three times her weight in blood.
(True)

For approximately how many days does mosquito larvae live in stagnant water?
(10 days)

True or false: Mosquitos prefer temperatures over 80 degrees Fahrenheit.
(True)

True or false: Mosquito larvae are called wigglers.
(True)

True or false: Mosquito eggs cannot survive through the winter. (False)

True or false: Male mosquitos locate females by the sound made by rubbing their back legs together.

(False)

Where do female mosquitos have heat sensors that can detect the warmth of the blood in your body?

(Around their mouthparts)

True or false: Mosquitos have heat sensors on their antennae that can detect the warmth of the blood in your body.

(False, on their mouthparts)

True or false: The swelling and itching of a mosquito "bite" is a minor allergic reaction to the mosquito saliva released when the female draws blood.

(True)

True or false: Mosquitos spread diseases from parasites that attach to their feet.

(False, from parasites that are released with the mosquito saliva)

True or false: West Nile virus transmitted by mosquitos first appeared in the United States in 1999 in New York.

(True)

Name one country where there has been a large outbreak of West Nile virus, which is transmitted by mosquitos.

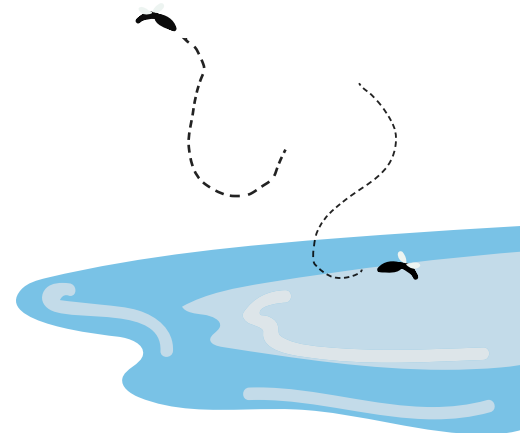
(South Africa, Israel, Romania)

True or false: Malaria transmitted by mosquitos kills more than 1 million people a year, primarily in Africa.

(True)

True or false: West Nile and Zika viruses can cause high fever and paralysis.
(True)

True or false: Besides terrible birth defects, Zika can cause fever, rashes, red eyes,
and joint pain.
(True)



ACTIVITY LEADER CHECKLIST:

DID YOU . . .

- ☐ Read Spark WiSTEM2D? This is essential reading for all volunteers interested in working with youth. It defines the STEM2D principles and philosophy and provides research-based strategies and tips for engaging and interacting with female students. Download at www.STEM2D.org.
- ☐ Visit the implementation site and observe the young people? (optional) If visiting, take note of the following:
 - ☐ How does the site encourage orderly participation? For example, do the young people raise their hands when responding to questions or during discussions? How are interruptions handled? Do you see any potential problems with managing the class of young people?
 - ☐ What does the site do to make each student feel important and at ease?
 - ☐ How is the room arranged? Will you need to move desks or chairs for any part of your presentation?
 - ☐ How can you engage the site representative in your presentation?
- ☐ Meet with and finalize the logistics with the Site Representative?
 - ☐ Confirm the date, time, and location of the activity?
 - ☐ Confirm the number of students attending? Knowing this will help you decide how to group the students into teams, as well as the appropriate materials to purchase.
- ☐ Recruit additional volunteers, if needed?
- ☐ Prepare for the activity:
 - ☐ Read the entire activity text prior to implementation?
 - ☐ Customize the activity, if desired, to reflect your background and experiences, as well as the cultural norms and language of the students in your community?
 - ☐ Complete the Tell My Story Form, which will prepare you to talk about your educational and career path with the students?
 - ☐ If teams are needed for this activity, please ask the teacher in advance to organize the students into teams.
- ☐ Practice your presentation, including the hands-on, minds-on activity? Be sure to:
 - ☐ Do the activity; make sure you can explain the concepts to students, if needed, and that you know the correct answers.
- ☐ Obtain the required materials (see the Materials and Estimated Materials Costs sections) and, if asked for in the Getting Ready section, photocopy the Student Handouts and Materials Testing Sheets. In addition:
 - ☐ Organize the materials to ensure each team has everything listed in the Materials section—keep in mind some materials are shared among the teams.
- ☐ Prepare the space? Specifically:
 - ☐ Make sure tables and chairs are arranged to accommodate teams of students.
 - ☐ Bring a camera, if desired, to take photographs.
- ☐ Obtain and collect permission slips and photo release forms for conducting the activity if applicable?
- ☐ Have fun!

Tell My Story Form

This form will help volunteers serving as activity leaders prepare to talk about their **STEM²D** interests, education, and career path.

ABOUT YOU

Name: _____

Job Title: _____

Company: _____

When/Why did you become interested in STEM²D? _____

What do you hope young people, especially females, will get out of this activity? _____

FUN FACT

Share a little about your background. Ideas:

- Share a memory from childhood where you first had your spark or interest in STEM.
- Detail your journey; highlight what you have tried, what you learned, steps to success, etc.
- Failures or set backs are also great to talk about—difficulties, and/or challenges and how you overcame them.

EDUCATION AND CAREER PATH

What classes/courses did you take in secondary school and in college that helped or interested you most?

How did you know you wanted to pursue a STEM²D career?

What was your postsecondary path, including the institution you attended and your degree? *If you switched disciplines, make sure you explain why to the students.*

What your current position entails. *Be sure to include how you use STEM²D on a typical work day.*





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