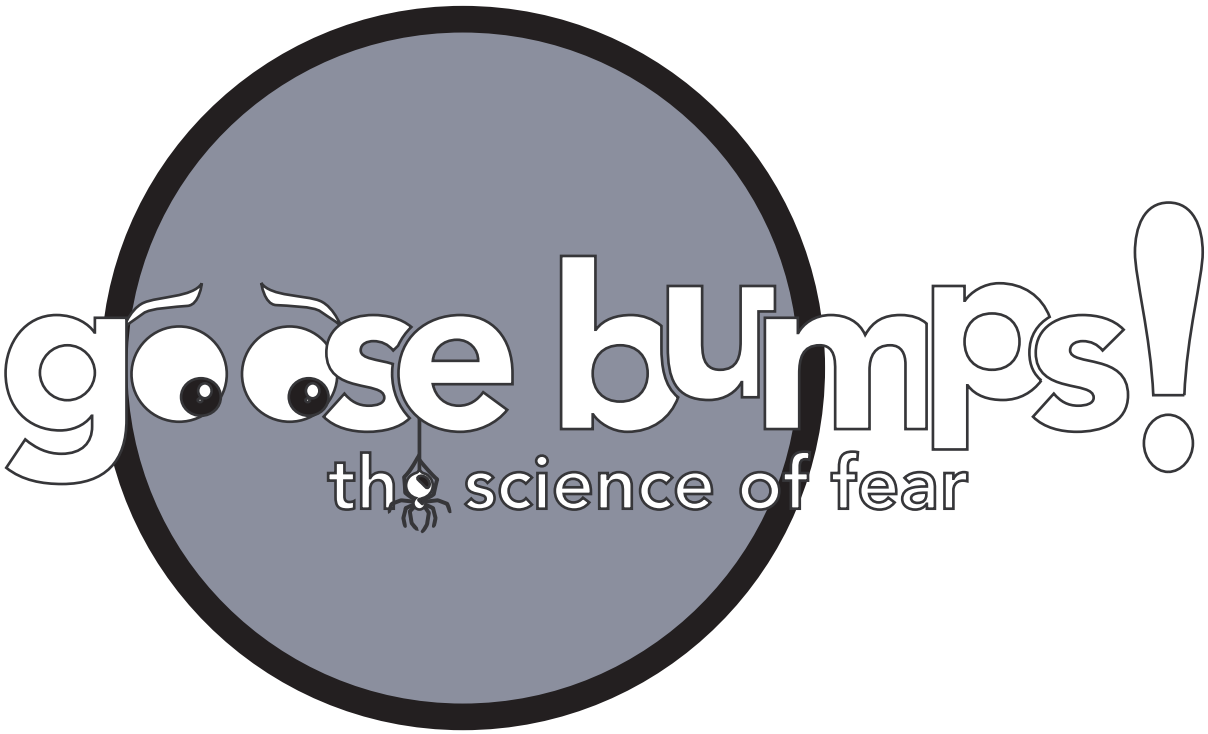
goose bumps!

the science of fear

grades K-8

California ScienCenter



a Teacher's Guide for Grades K-8

presented by

California ScienCenter

Amgen Center for Science Learning

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Goose Bumps! Teacher Guide Contents

About the exhibit:

Activities

Before your visit:

During your visit:

After your visit:

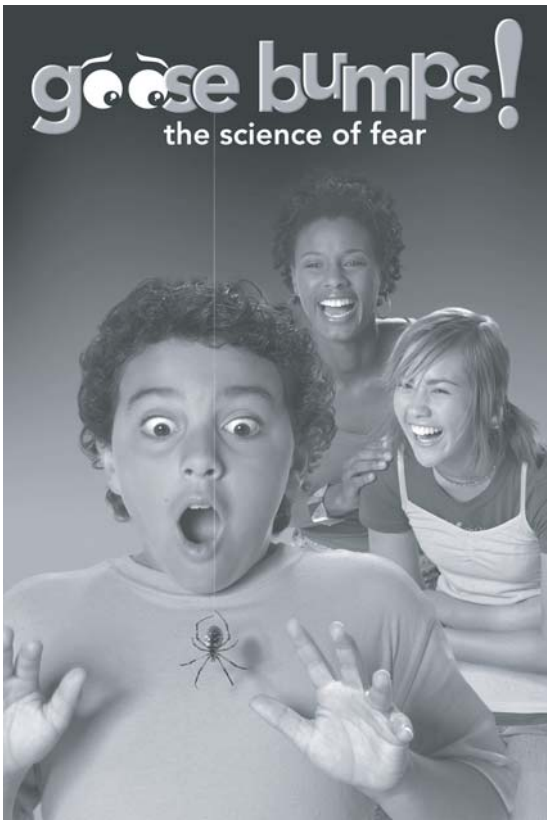
Introduction

Before your visit to *Goose Bumps! The Science of Fear,* prepare your students by going over the ideas presented in this guide. The recommended activities introduce key concepts highlighted in the exhibit and engage your students as they begin to understand the science of fear.

You don't have to complete the activities in order to enjoy the exhibit. However, they will enhance your students' experiences and help them retain what they learn about fear even after their visit.

You can also supplement your students' experiences by providing them with a guide or a few of the Key Questions (p. 12) to keep in mind. This will help them focus on the science of fear as they go through the exhibit.

After your visit, see what your students have learned and guide them to further investigations, using debrief questions (p.15).



Activity Tips

These tips will help you effectively implement the activities on the following pages and enhance the learning experience offered by *Goose Bumps! The Science of Fear.*

- Read through the background information and share it with your students while completing the corresponding activities. Terms and concepts introduced in the background information will be used throughout the guide.

- A degree of open-ended inquiry has been written into the activities. Results of these activities will vary from student to student.

- In this guide, you will see designations at the top of each page:

Teacher — Pages with this designation consist of activity instructions for the teacher.

Student — Pages with this designation are meant to be copied and distributed to students.

Designed for Grades K-8 — This designation provides recommended grade levels for each activity.

We hope this guide will help you and your students to get the most out of *Goose Bumps! The Science of Fear.*

goose bumps! the science of fear

Exhibit Highlights

Goose Bumps! The Science of Fear is a 6,000 sq. ft. traveling exhibition that provides a holistic view of fear science by examining physiological, neurobiological, and sociological aspects of fear. Engaging activities in *Goose Bumps!* allow visitors to experience fear in a safe and fun environment, rate their responses, understand the science behind the emotion, and reflect upon its personal meaning.

What to expect in the exhibit:

Fear Challenge Course
This section consists of four fear-inducing rooms that will allow your students to experience different fears while learning the difference between innate, learned, and prepared fears. The Challenge Course is optional, so your students can complete as many or as few activities as they like.

Fear Lab
The Fear Laboratory is a dramatic and highly interactive area that emphasizes the active and ongoing nature of fear research. Students will have an opportunity to learn about the neurobiology and physiology of fear via hands-on exhibits, audio/visual elements, learning games, and oversized interactive models.

Fear in the Wild
Here, your students will be immersed in a virtual setting in the animal kingdom. Your students will see how other animals use the freeze, fight, and flight responses to survive.

Fear Theater
From participating in a presentation on conditioning, to creating your own movie, Fear Theater is a section that focuses on fear and popular culture. An 11-minute, documentary-style movie about fear and popular culture is also an option.

Coping with Fear
This area will welcome your students into a calmer, pleasing space where they can learn that there are ways to cope with fears that lie anywhere on the fear spectrum, from everyday stress to anxiety disorders.

Goose Bumps! and the Science Standards

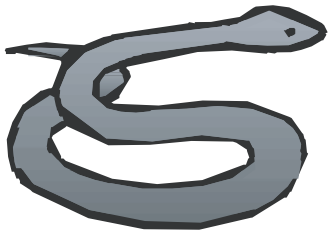
Exhibit Highlights:	National Science Standards (NSES):
Fear Challenge Course **Fear in the Wild**	Life Science - Content Standard C, Grades K-4: THE CHARACTERISTICS OF ORGANISMS: • The behavior of individual organisms is influenced by internal cues (such as hunger) and by external cues (such as a change in the environment). Humans and other organisms have senses that help them detect internal and external cues. Life Science - Content Standard C, Grades 5-8: REGULATION AND BEHAVIOR: • An organism's behavior evolves through adaptation to its environment. How a species moves, obtains food, reproduces, and responds to danger are based in the species' evolutionary history.
Fear Lab **Fear Theater**	Life Science - Content Standard C, Grades 5-8: REGULATION AND BEHAVIOR: • Behavior is one kind of response an organism can make to an internal or environmental stimulus. A behavioral response requires coordination and communication at many levels, including cells, organ systems, and whole organisms. Behavioral response is a set of actions determined in part by heredity and in part from experience.
Fear and Society **Coping with Fear**	Science in Personal and Social Perspectives - Content Standard F, Grades 5-8: RISKS AND BENEFITS • Individuals can use a systematic approach to thinking critically about risks and benefits. Examples include applying probability estimates to risks and comparing them to estimated personal and social benefits. • Important personal and social decisions are made based on perceptions of benefits and risks.
Educational Cart	Life Science - Content Standard C, Grades 5-8: REGULATION AND BEHAVIOR: • Behavior is one kind of response an organism can make to an internal or environmental stimulus. A behavioral response requires coordination and communication at many levels, including cells, organ systems, and whole organisms. Behavioral response is a set of actions determined in part by heredity and in part from experience.

Activity: Scary Touch Boxes

Designed for Grades K-2

Our brains gather information about our surroundings from our sensory organs—our eyes, ears, noses, tongues and skin. These organs contain sensory neurons that send information about the outside world to the brain. The brain makes sense of these signals, interpreting messages about objects, sounds, and other aspects of the world around us.

Our brains then coordinate bodily responses to these messages. Imagine a poisonous snake was slithering up your arm. You'd be in trouble if your brain didn't quickly make sense of the signals from your sensory neurons. Likewise, you do not see a threat until your brain interprets information from your eyes. The brain and sensory organs work together to tell us about our surroundings... sometimes to protect us from danger.



Activity Objective:
Students will explore the sense of touch and learn about how the brain perceives information about an unknown object.

This activity is best done in groups of 4.

Materials

- Cardboard shoeboxes, 1 per group of 4 students
- Scissors
- Mystery objects, 1 per shoebox
  Suggestions:
  "Scary" objects: rubber snake, things with pointy edges
  "Safe" objects: beanbag animal, ordinary household items
- Scraps of cloth, 1 per shoebox
- Stapler

National Science Education Standards Addressed:

Grade K-4, Life Science Standards

THE CHARACTERISTICS of ORGANISMS
The behavior of individual organisms is influenced by internal cues (such as hunger) and by external cues (such as a change in the environment). Humans and other organisms have senses that help them detect internal and external cues.

Teacher Preparation

Make the Touch Boxes before class.
1) Cut a hole the size of a fist into one end of each shoebox.
2) Staple a scrap of material to hang as a curtain in front of the opening in each shoebox. The curtain ensures that students will not be able to see inside the box.
3) Place one mystery object into each shoebox before class.

To Try with Students

- Review the five senses and the brain's role in them. Since the activity will focus on the sense of touch, ask students how they use their sense of touch. What kind of information about the world does this sense give them?

- Divide students into groups and hand out one Touch Box to each group. Remind them not to look inside the box.

- Ask students to take turns putting a hand into the box and feeling the object inside. What can they say about the object? Is it hard, soft, smooth, rough, etc.? Ask them to write down their perceptions.

- Once everyone in a group has had a chance to feel the object, ask the group to discuss their perceptions and write their predictions about what the object is and if it is "scary" or "safe." Scary objects are ones that might cause harm. After a short period of time (5 minutes should be enough), have groups move to another box to predict what's inside and whether it is scary or safe. After the groups have gone through all of the boxes, have each group present to the class, naming the objects they think are scary and safe, why they think that, and what they think the objects are. Reveal the mystery objects. Did their predictions support the conclusion—did they correctly identify the object? Did they need visual information to identify the object?

Activity: Scary Touch Boxes

Wrap Up

The brain receives messages from special sensory neurons called touch receptors. Touch receptors in the fingers collect specific information, related to touch, about objects. Is it smooth or rough? Hard or soft? Dull or sharp? Shaped like a box or a sphere? Our fingers are sensitive touch detectors - there are more touch receptors packed into the skin of our fingertips than anywhere else on the body!

Processing touch information involves the brain area dedicated to the sense of touch as well as the area with stored information about what different objects look like, what they may feel like, and different objects' names. Figuring out shape also relies on an area of the brain that keeps track of where body parts, such as hands, are in space. These areas of the brain, combined with touch receptors, work together to determine the identity of an object.

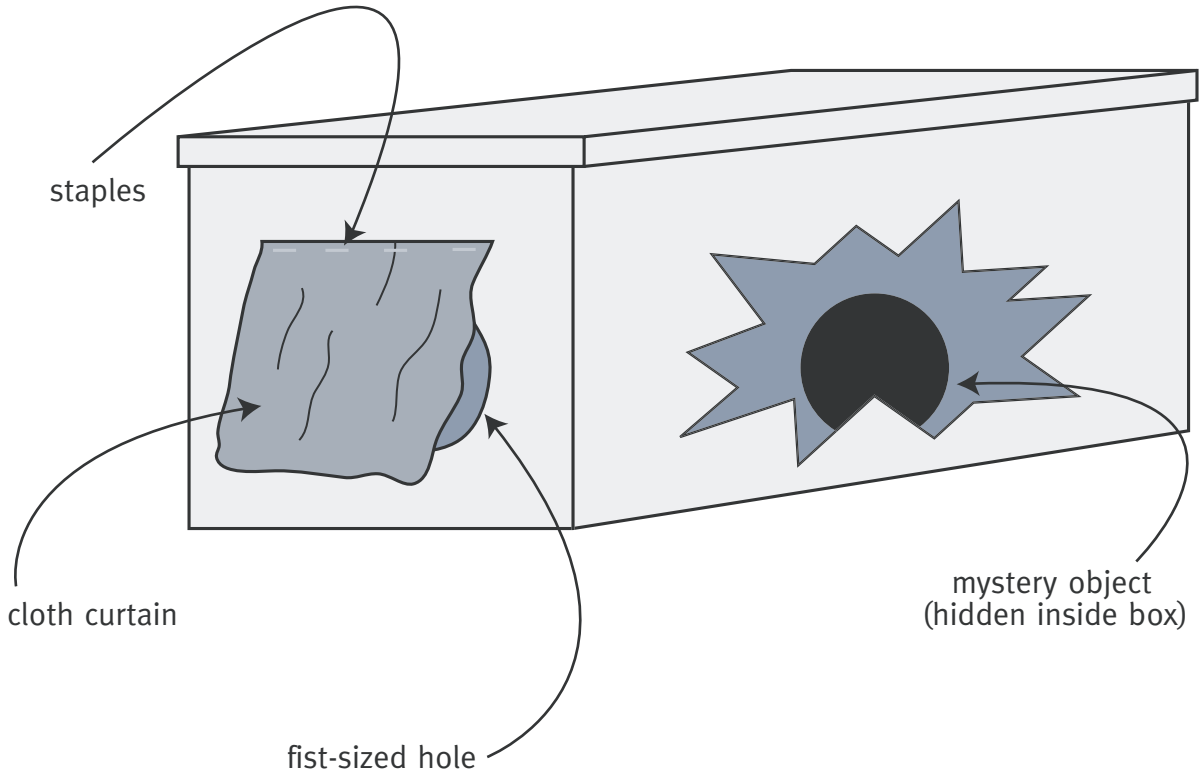
The brain response is a three step process.

1) First, your brain takes in information.
Example: You hear a loud buzzer.

2) Second, your brain processes the information.
Example: The brain registers the noise.

3) And third, your brain tells your body to take an action.
Example: You jump in shock.

What information did your students collect about the mystery objects? Would they have had an easier time processing information and determining the identity of the object if they had been able to use other sensory organs in this activity?



Activity: Facial Expressions

Designed for Grades K-8

When you get scared, your eyes might widen and your mouth might open in shock. You've just made a facial expression, which happens when your facial muscles move. In this case, you expressed the emotion of fear. Facial expressions can be voluntary ("Smile for the camera!") or involuntary (something startles you).

The way your face looks can convey your emotion to others. However, some facial expressions are more difficult to read than others because they involve the mixing of two or more emotions.

Activity Objective:
In this charades game, students will attempt to differentiate emotions based on percieved facial expressions, which will be made by fellow classmates.

This activity is done as a class.

Materials

• Emotion assignment—Write the names of emotions on small pieces of paper, or notecards (one emotion per card).

Be sure to make cards for all six primary emotions:
Happiness, Sadness, Anger, Fear, Disgust, Surprise

Also include some secondary emotions:
Acceptance, Boredom, Bravery, Curiosity, Desire, Disappointment, Envy, Hate, Jealousy, Loneliness, Love, Optimism, Paranoia, Shame, Stubborness, Thankfulness, Worry

Older students may come up with their own emotions.

National Science Education Standards Addressed:

Grade 5-8, Science as Inquiry Standards

Content Standard A:

Think critically and logically to make the relationships between evidence and explanations.

Background Information:

• There are six primary emotions (happiness, sadness, anger, fear, disgust, and surprise). Other emotions, such as boredom, optimism, paranoia and disappointment are secondary emotions—blends of two or more primary emotions.

• Primary emotions are easier to read on the faces of others because they are "pure." Secondary emotions are more difficult to read because they are mixes of two or more primary emotions.

Instructions:

1) Model several emotions and see if your kids can copy your expressions. Do this individually.

2) When you're ready to play the game, have one student draw a card and act out the emotion on the card for the class, without any verbal clues. Whoever correctly guesses the emotion in each round is the next actor.

• You may also split the class into two or more teams. In this case, each team has one person act out an emotion, and if his/her team correctly guesses it, they get a point. Teams take turns acting out emotions until the cards run out. The team with the most points at the end wins.

3) Discuss with your students which facial expressions were the easiest and which were the most difficult to act out and guess, and why.

Activity: Classical Conditioning

Designed for Grades 3-8

Ivan Pavlov was a Russian scientist who lived between 1849 and 1936. He is best known today for developing a technique called conditioning. Working with dogs, he famously found that behavior can be learned through the repeated pairing of one stimulus and its automatic response with another stimulus.

Pavlov noticed his dogs salivated just before their feeding. In a series of experiments, he began ringing a bell before feeding the dogs. Eventually, the dogs came to associate the ringing of the bell so strongly with food that they began salivating at the sound of the bell even without being fed.

Scientists use this technique today to study fear in the lab. They condition rats to fear a tone by shocking the rats' feet when they play a tone. After a few zaps, the rats freeze with fear whenever the tone sounds. In this way, scientists can reliably trigger the rats' freeze response by simply playing a tone.

You can apply this to your own experiences with fear. For example, your fear response might get going whenever you hear a particular song because it was playing when you were in a car accident. Or you might start to sweat and breathe harder when you smell rubber cement because a bully cornered you during arts and crafts when you were younger.

Activity Objective:
Students will become familiar with how conditioning works. They will also learn how we can learn to fear objects and situations through the same process. This activity is done as a class and in pairs.

Materials
Meter stick

To Try with Students:
Have a student sit in a desk in the front of the classroom, facing the class. The teacher will stand behind the student with a meterstick in hand. The teacher will tap the desk three times then tap the student once on the head. Repeat this pattern a few times. The class should see the student start to anticipate getting tapped on the head. Then tap the desk three times, but don't tap the student. The student should still react as if they were tapped.

Classical Conditioning Experiment:
a) Students will pair up. One student will be the tester and one will be the subject. They should repeat the experiment with the meter stick. Does the tester get the same results, even though the subject knows what is happening?

b) In their pairs, students should come up with their own way of conditioning someone. It can be similiar to what was done with the meter stick, or they may try something new. Each pair of students should combine with another pair to test out their experiment.

National Science Education Standards Addressed:

Grade 5-8, Life Science Standards

REGULATION AND BEHAVIOR
Behavior is one kind of response an organism can make to an internal or environmental stimulus.
A behavioral response requires coordination and communication at many levels, including cells, organ systems, and whole organisms. Behavioral response is a set of actions determined in part by heredity and in part from experience.

Tying it All Together:

The students and teacher will then discuss the experiments and answer the question "What is classical conditioning?" and discuss the following terms:
· stimulus
· response

Students should be able to describe how conditioning works.

Activity: Heart Rate When Scared

Designed for Grades 4-8

When you get scared, nervous, or stressed, your body releases hormones that cause your breathing to become faster and heavier, your muscles to tense, and your heart rate to increase. These reactions are part of the body's automatic fear response, which prepares us for fight or flight. By increasing heart rate, your body pumps more blood, which means that there will be increased flow of oxygen to the brain, heart and large muscles. Your senses will also become more sensitive and ready to help you react quickly.

In this activity, you will finally be able to pull a prank on your students (all in the name of science, of course)! With the help of an unexpected pop quiz, your students will measure their heart rates during the fear response and compare them to their heart rates at rest.

Activity Objective:
Your students should understand the changes experienced by the body when the fear response gets going, as compared to normal conditions.

This activity should be done in pairs.

Materials

- A clock (or watches)
- Two fingers to measure heart rate

Teacher Preparation
Prepare before lesson begins.

Create a fake pop quiz that has difficult questions and a very short time limit. You may want to use an old version of a test that is normally taken at the end of the year or difficult questions that are provided in the class textbook.

To Try with Students

1. Students should not know that they will have a fake pop quiz.
2. Have students take the difficult quiz in a short time limit, such as 5 or 10 minutes.
3. Pair students up with their neighboring classmates. One student should measure his/her heart rate while the other student keeps track of the time. Instructions and a recording sheet for this are on the following page.
4. Students should switch off so both students know their own heart rate.
5. You can finally announce that the quiz was fake.
6. Have students measure their heart rate again when they are relaxed after about 15 minutes.
7. Discuss how they felt during and after the "quiz" and compare their fearful and relaxed heart rates. Discuss why their hearts raced.

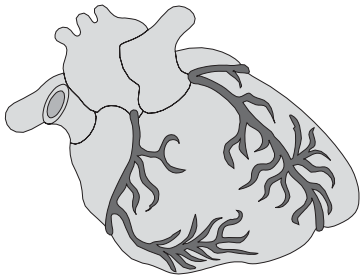
National Science Standards Addressed:

Grade K-4, Life Science Standards

THE CHARACTERISTICS OF ORGANISMS
The behavior of individual organisms is influenced by internal cues (such as hunger) and by external cues (such as a change in the environment). Humans and other organisms have senses that help them detect internal and external cues.

Grade 5-8, Life Science Standards

REGULATION AND BEHAVIOR
Behavior is one kind of response an organism can make to an internal or environmental stimulus. A behavioral response requires coordination and communication at many levels, including cells, organ systems, and whole organisms. Behavioral response is a set of actions determined in part by heredity and in part from experience.



Heart Rate When Scared

What to Do

1) Take your pulse by putting your index finger and middle finger on your wrist, just below your palm, or by placing those two fingers on your neck below the ear and jawbone.

2) Count the number of beats you have in one minute. Your partner should keep track of the time and let you know when a minute has passed.

3) Write your heart rate in the box below.

Your Heart Rate (Beats per Minute)

4. Trade roles and write your partner's heart rate in the box below.

Your Partner's Heart Rate (Beats per Minute)

5. Later, when you are relaxed, measure your heart rates again. This is your resting heart rate.

Your Heart Rate (Beats per Minute)

Your Partner's Heart Rate (Beats per Minute)

6. Did your heart rate change? If so, how?

7. What may have caused this?

8. What may have prevented your results from being 100% accurate?

Activity: How a Voltmeter Works

Designed for Grades 4-8

When we get scared, we sweat. It's not always noticeable, but emotions change the amount of moisture we produce. While it may be unpleasent, sweat is one of the body's natural responses to fear. It's one way the body prepares us to fight or flee danger; sweat evaporates and helps cool us down when our large muscles work hard.

Your skin's moisture can be measured using a voltmeter. A voltmeter is an instrument that is used to measure the electric current between two points. A small electric current is sent between two points on your skin—typically between two fingers. The voltmeter measures how much current gets through. Salt in your sweat helps the current flow, so when you sweat a lot, your reading boosts significantly. In this activity, your students will see how adding salt to water increases the conductivity, making the light glow brighter.

Activity Objective:
Students will learn how a voltmeter works using a model.

This activity can be done in partners or in groups.

National Science Education Standards Addressed:

Grade 5-8, Life Science Standards

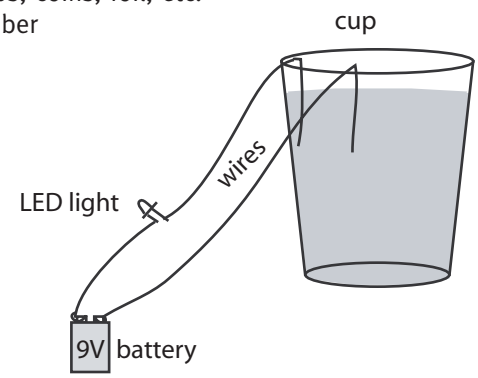
REGULATION AND BEHAVIOR
Behavior is one kind of response an organism can make to an internal or environmental stimulus. A behavioral response requires coordination and communication at many levels, including cells, organ systems, and whole organisms. Behavioral response is a set of actions determined in part by heredity and in part from experience.

Materials

- Cup
- Electrical wires
- Tape
- 9-Volt Battery
- Objects that conduct electricity: metal objects, paperclips, coins, foil, etc.
- Objects that do not conduct electricity: tape, wood, rubber
- LED light
- Water
- Salt
- Spoon or something to mix water with

Recommended:

- Wires with alligator clips
- Battery Cap for 9 volt battery, with wires
- Large LED light



Teacher Preparation
Fill plastic containers for each group with water.

To Try with Students
Have students create a simple circuit without the water by connecting the battery to the LED light using the wires. *Note: LED lights are polarized. If it does not light when connected to the battery, try turning the LED light so that the wires are switched.

Students should try inserting various objects into their circuit. Which objects conduct electricity? Which objects don't?

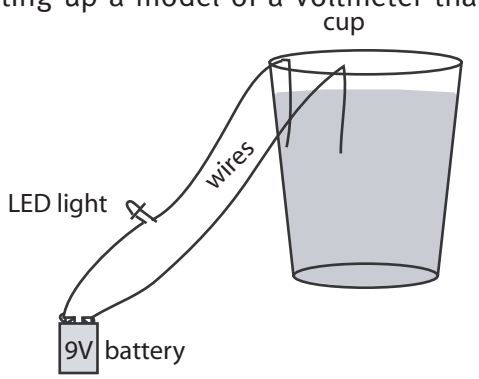
Ask students what they predict will happen with the plain water and why. The tap water represents the skin without sweat. The light will not shine as brightly without salt in the water because the conductivity is not as strong.

Ask students what they predict will happen when salt is added to the water and why. This represents sweat on the skin since sweat contains salt.

Discuss with your students how voltmeters work, compared to this activity.

How a Voltmeter Works

In a moment, you'll be setting up a model of a voltmeter that will look like the one below:



If there's no salt in the water, what do you predict will happen when the two free ends of the wires are placed in the water and why?

What do you predict will happen if there is salt in the water and why?

Set up the model so that it looks like the diagram above. Place the free ends of both wires into the water. How did the results compare to your prediction?

Now pour salt into the water and mix it with a spoon so that the salt dissolves. Place the ends of the wires into the water again. How did your results compare to your prediction this time?

Based on your class discussion, how does a voltmeter work and how can it be used to detect someone's fear?

goose bumps! the science of fear

Key Questions

Questions for your students to consider while they're interacting with the exhibit:

Fear Challenge Course

**** Fear of Animals Room*** - How did you feel before you reached into the box? What do you think is in the box?

**** Fear of Electric Shock Room*** - While you were waiting for the zap on your finger, how did you feel? What was your reaction to the zap?

**** Fear of Loud Noises Room*** - When you heard the loud noise, even when you were expecting it, how did you react? Watch your slow motion video and describe your reaction.

**** Fear of Falling*** - Compare the video of people's faces as they experience the exhibit. Do you see reactions that are the same or different? Describe your observations.

What are the Odds? - Compare your predictions to that of what actual risk levels are in the categories and see if what you think matches with the actual. Did your predictions match to the exhibit's data? Why or why not?

Expression Comparison - Looking at the large images of facial expressions and observing people's reactions to the Fear Rooms, describe a face that shows fear versus a face that shows sadness. Compare the facial expressions and describe what makes each expression unique.

Fear Lab

Mr. Goose Bumps - Observe Mr. Goose Bumps as he encounters a dog. You might have to observe for a few minutes. Explain how his body reacted to the encounter by creating a narrative or a story about what happened to Mr. Goose Bumps.

Triggering Fear - What happens in the game when the eye sees the snake and the fear response is triggered? Why do you think that there are two pathways that deliver the message to the amygdala?

Fear in the Brain - Do all the different animal brains have amygdalae? What does this tell you about the amygdala's usefulness for survival?

Danger or No Danger? - Were you able to correctly identify whether the images represented "Danger" or "No Danger"?

Key Questions, continued

Fear in the Wild

Freeze Game - You are an animal simulating gathering fruit in an African savannah. What strategy should you use to avoid getting attacked by the predator (the leopard)?

Flight - What are the factors that causes animals to flee from a predator? List as many factors as you can.

Fight - Often fighting is a last resort. What do animals do to try to avoid a fight? What are some tools animals use when they have to fight?

Survival Game - In the simulation, which level of fearfulness (low, medium, or high) helped creatures survive the best? What does this tell you about an appropriate level of fear?

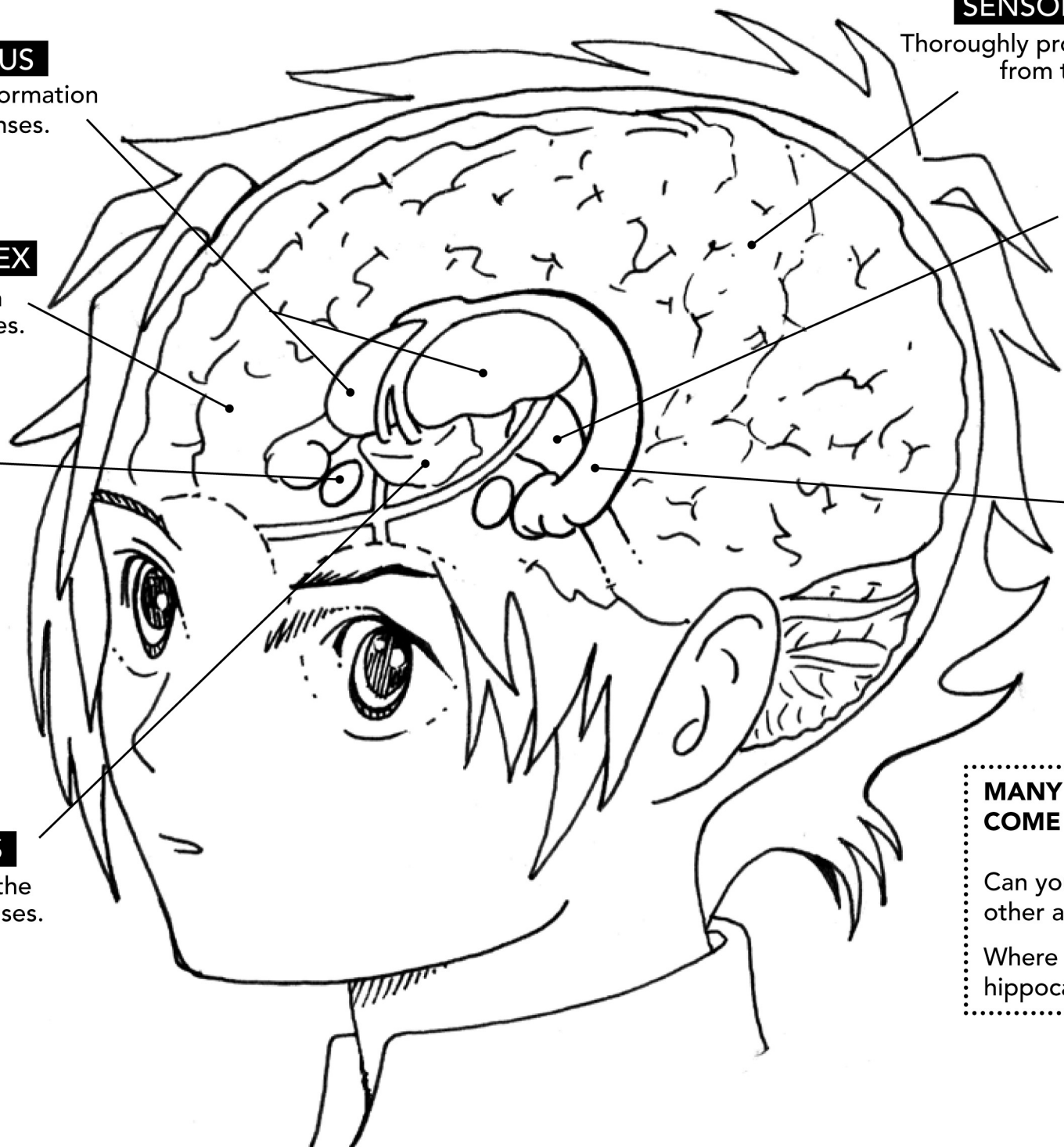
Fear Theater

Conditioning - Looking at the measurements of the victim... er, volunteer, explain what happens when the volunteer is conditioned to respond to the noise and light effects. What did the presenter do to extinguish, or get rid of, the volunteer's conditioned fear?

Moral Panics - Can fears spread from one person to another? What are some ways they can do so?

Coping with Fear - When you looked at the Fear Over a Lifetime illustrated murals, could you remember what you were afraid of when you were younger? How have your fears changed? Do you think fear is only for some people, or is it something that everyone experiences?

COLOR THE BRAIN'S FEAR SYSTEM



THALAMUS
Passes along information from the senses.

SENSORY CORTEX
Thoroughly processes information from the senses.

PREFRONTAL CORTEX
Analyzes the event in light of past experiences.

BRAIN STEM
Triggers the freeze response and some of the bodily changes associated with fear.

AMYGDALA
Scans for threats and coordinates the full-body response.

HIPPOCAMPUS
Helps create context and memories.

HYPOTHALAMUS
Jump starts several of the body's defensive responses.

MANY BRAIN AREAS COME IN PAIRS.

Can you find the other amygdala?

Where is the other hippocampus?

Debriefing the Fear Exhibit Experience:

If you want to know what your students learned from their exhibit experience, then a conversation with your kids is in order.

A debrief is a way to check in with your students to see what they've learned after sharing a common experience. A debrief can be formal or informal, structured or loose; it's really up to you. Some suggestions:

Think, Pair, Share—Students pair up and write responses to the questions below. Then they share their answers with their partners and present their findings to the class.

QuickWrite—Students answer the questions below in their journals. The instructor then selects students who will share their responses with the rest of the class.

Concept Mapping—Students work in groups to create a visual map of their learning experience using poster board. The groups (no more than 4 per group) will then share with the rest of the class by posting their map at a designated area. This area will serve as a "gallery" where students can look at each other's work and comment on shared experiences.

Some Sample Debrief Questions:

What was your favorite part of the exhibit? Explain how this piece of the exhibit worked and what you learned from it.

What happens to the body when we get scared?

Why would fear be a good thing for organisms? Explain how fear can help an organism survive.

What is the role of the amygdala?

What are some of the ways that scientists measure fear? Give examples from your experience with the exhibit.

goose bumps!
the science of fear

"I survived the Fear Exhibit!"

This is to certify that

_____

has successfully interacted with the *Goose Bumps!* exhibit and lived to tell about it.

Given this _____day of _____in the year _____

_____

Teacher

Mr. Goose Bumps

_____

Mr. Goose Bumps

Additional Resources

Print

Arnold, Nick and Tony de Saulles. Collection of *Horrible Science* books. New York: Scholastic, Inc.

Szpirglas, Jeff. *Fear This Book: Your Guide to Fright, Horror, and Things That Go Bump in the Night*. Maple Tree Press: Toronto 2006

McCann, Jesse. *Fear Factor: Yikes! Scariest Stunts Ever!* New York: Scholastic, Inc. 2006.

On the Web

Goose Bumps! The Science of Fear exhibit website
http://www.fearexhibit.org/

The California Science Center
http://www.californiasciencecenter.org

Neuroscience for Kids - University of Washington
http://faculty.washington.edu/chudler/neurok.html

Science Museum of Minnesota - Habits of the Heart
http://www.smm.org/heart/

Illinois State Museum - Spider Collection Online
http://www.museum.state.il.us/ismdepts/zoology/spiders/

Nutrition Exploration for Kids, Parents and Teachers
http://www.nutritionexplorations.org

Phobia Top 10
http://www.phobia-fear-release.com/phobia-top-10.html

The Brain from Top to Bottom
http://thebrain.mcgill.ca/flash/index_d.html

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Scared Man - Image Source/PunchStock