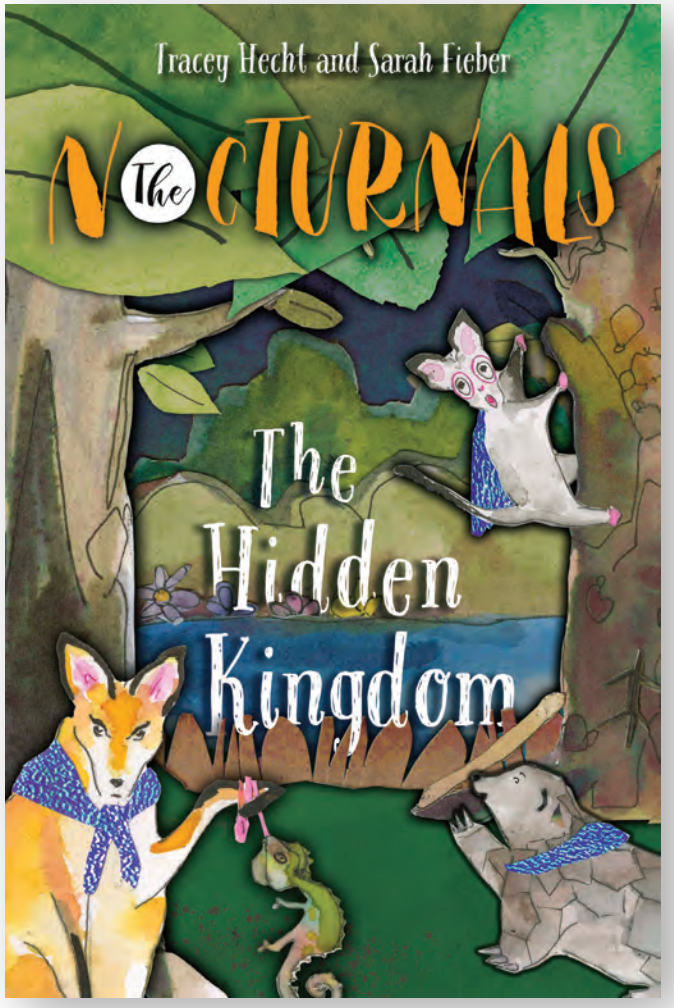
EDUCATOR'S SCIENCE GUIDE

The Nocturnals: *The Hidden Kingdom*



HC ISBN: 978-1-944020-11-8 • $15.99
PB ISBN: 978-1-944020-13-2 • $8.99

By
TRACEY HECHT
with illustrations by
KATE LIEBMAN

Series Overview

The Nocturnals series features three unlikely friends: Dawn, a serious fox; Tobin, a sweet pangolin; and Bismark, a pint-sized sugar glider. The stories all play out in their nighttime world with teamwork, friendship, and humor in every adventure.

For More Information:
www.nocturnalsworld.com

About the Book

In *The Hidden Kingdom*, Dawn the fox, Bismark the sugar glider, and Tobin the pangolin travel to a distant watering hole because the valley is dry and the animals are desperate for water. Along their journey, very strange things occur: the ground swirls under their feet, bark jumps off trees, and huge tumbleweeds chase after them. Is the forest suddenly alive? Only the Nocturnal Brigade can solve this mystery and unite the forest.

Next Generation Science Standards Alignments and Activities

The activities in this guide have been correlated with the Next Generation Science Standards (NGSS), which were developed by the National Research Council (NCR) of the National Academy of Sciences. The NCR's Framework for K–12 Science Education combines practices, crosscutting concepts, and disciplinary core ideas to address relevant science, technology, engineering, and math (STEM) concepts that students should learn.

This guide was written by Erica Colon, the president and curriculum designer of Nitty Gritty Science, which she started as a way to share her passion for teaching. She received her PhD and MEd from University of Hawaii at Manoa and her BS from SUNY at Oswego. She is a National Board Certified Teacher.

FABLED FILMS PRESS
NEW YORK CITY
fabledfilms.com

Activity 1

Searching for "Stick" Bugs

Background

Stick bugs, along with leaf bugs, are the sneaky sentinels who do the bidding of Kami the chameleon in *The Nocturnals: The Hidden Kingdom*. One of the reasons they can get away with their attacks is because they are masters of disguise and use camouflage to avoid being seen by the Nocturnal Brigade. Camouflage is an adaptation that enables a species to blend in with its environment, and as their name suggests, stick bugs resemble the branches and sticks of the plants on which they live.

Stick bugs are generally green or brown and thrive in areas where they can feed on leaves. They are most active at night and spend much of their day motionless, blending in with the plants to avoid being seen by predators.

Instructions

1. Before the activity, choose an item (such as colored toothpicks) that has one color that blends in well with your floor. That color will serve as the "camouflaged" stick bugs. You can also use a grassy area outside. For example, in a grassy area you can tell students that green toothpicks = stick bugs, red = lady bugs, orange = moths, yellow = butterflies, and blue = beetles.

2. Spread the 500 pieces (100 of each) in the designated activity area. You may need to mark off the area so students don't disrupt it upon entering the classroom.

3. At the time of the activity, place students into groups and give each group the *Searching for "Stick" Bugs* investigation. Discuss any lab safety rules and behavior expectations.

4. Allow students to conduct the investigation, collect data, and make observations. Trials of "search times" should be 10-15 seconds.

References and Helpful Links

- **https://kids.nationalgeographic.com/explore/wacky-weekend/hidden-animals/#ww-camouflage-orchid-mantis.jpg**
- **https://www.plt.org/educator-tips/camouflage-nature-examples**
- **https://www.nationalgeographic.org/encyclopedia/camouflage/**
- **https://www.nationalgeographic.com/animals/invertebrates/group/stick-insects/**

NEXT GENERATION SCIENCE STANDARDS USED IN THIS ACTIVITY

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

3-LS4-2: Biological Evolution: Unity and Diversity
- Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.

FABLED FILMS PRESS
NEW YORK CITY

fabledfilms.com

For more information:
nocturnalsworld.com

Student Activity 1

Searching for "Stick" Bugs

Problem

How does camouflage help stick bugs avoid being seen?

Inquiry Skills

Communication, observations, controlling variables, analyzing data, drawing conclusions.

Materials

- 500 colored toothpicks (5 different colors—100 each)
- Stopwatch
- Pencil and paper for recording data
- Colored pencils

Procedure

1. All groups are to stand around the designated area full of colorful "insects," one of them being the elusive stick bug.

2. After the signal to begin is given, one person from each group will see how many insects they can capture in the allotted time. Insects can only be captured one at a time.

3. Count the number of toothpicks of each color that you captured. Record your results in the data table provided.

4. Repeat steps 2 and 3 two more times with different members of the group. Calculate the average of each color of insect caught and record on the data table.

Data Table

Color of Insect	Part A: The Search			Average
	Trial 1	Trial 2	Trial 3	

Bar Graph

Use the space below to create a bar graph comparing the average number of each insect caught. Make sure to title your graph and label each axis.

Analyze and Conclude

1. What color insect was collected the least? Explain why this may have occurred.

2. What color insect was collected the most? Explain why this may have occurred.

3. Many stick bugs thrive in forests and grasslands. If there were to be a real drought, how would that affect the ecosystem and the safety of stick bugs?

Activity 2

Tongue Twister

Background

The Nocturnal Brigade has faced many unique animals along their adventures, but in *The Nocturnals: The Hidden Kingdom*, Tobin the pangolin meets his match when he gets caught, literally, in a tongue twister with King Kami the chameleon.

In this activity, students will learn that a pangolin's tongue is about 40 centimeters long, roughly equal to its body length, whereas a chameleon's tongue is 1.5 times the length of its body! To understand these ratios, students will measure their own body length, calculate how long their tongue would be if they had the same ratio as a chameleon, and then measure a piece of receipt tape according to their calculation so they can see a visual representation.

Option: A fun way to display this is to have an average human silhouette taped to a wall with an average (human) tongue length of 10 centimeters. Next, measure out receipt tape the full length of the human silhouette and tape it up for comparison. Share with students that this is how long their tongue would be if they had a tongue like a pangolin. Finally, measure out receipt tape a body length and a half, tape it up for students to see the comparison, and have them imagine how long their tongue would be if they had a tongue like a chameleon.

Take this lesson even further by challenging the students to create their own tongue twister. Once the tongue twisters are approved, have students write them along the length of the receipt tape for all to read and enjoy.

References and Helpful Links

- **https://news.nationalgeographic.com/2016/01/160105-chameleons-tongue-speed-animals-science/**
- **https://phys.org/news/2016-06-tongue-chameleon-sticky-secret-revealed.html**

NEXT GENERATION SCIENCE STANDARDS USED IN THIS ACTIVITY

4-LS1-1: From Molecules to Organisms: Structures and Processes

- Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

FABLED FILMS PRESS
NEW YORK CITY

fabledfilms.com

For more information:
nocturnalsworld.com

Student Activity 2

Tongue Twister

Materials

- Meter stick
- Receipt tape
- Colored pencils

Introduction

The tongue is a muscle in the mouth that helps us and other animals taste, chew, and swallow food. On average, a human's tongue is 10 centimeters long. While humans have the unique ability to use our tongues for speech, other creatures have also found their own special uses for their tongue.

Pangolins, unlike humans, are unable to chew because they do not have teeth, so they need to catch small insects that they can swallow whole. They are able to do this by using their long, sticky tongue to trap and eat insects. When not in use, a pangolin's tongue is rolled up deep in its chest cavity to its last pair of ribs. When extended, a pangolin's tongue is about 40 centimeters long, or the length of its entire body!

A chameleon's tongue is also unique, adapted for rapidly catching prey that strays within striking distance. This remarkably long tongue can measure one and a half of the chameleon's own body length and extends out faster than the human eye can follow, hitting prey in about 30 thousandths of a second!

In this activity, you will determine how long your tongue would be if humans had a tongue with the same body-length-to-tongue ratio as that of pangolins and chameleons. When you see how long your tongue could be, you will be absolutely tongue-tied!

Procedure

1. In a group, take turns using a meter stick to measure each other's body length (head to feet). Record your measurements.

2. Calculate the length of your pangolin-like and chameleon-like tongue in reference to the length of your body. Record your calculations.

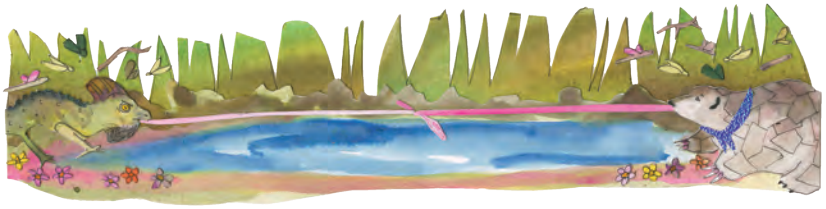
3. Using your calculations, measure out receipt tape to equal the length of your chameleon-like tongue. On the same receipt tape, measure and mark the length of your pangolin-like tongue.

4. Measure and mark the length of an average human tongue length, which is about 10 centimeters. Color in the different tongue lengths for better comparison.

Data

Body length	
Pangolin-like tongue length (equal to body length)	
Chameleon-like tongue length (body length × 1.5)	

Extension Activity



We use our tongues to taste, chew, and swallow food. But let's face it—the best part of having a tongue is to say TONGUE TWISTERS! Tongue twisters are specific sequences of words that are meant to be difficult to say if spoken too quickly or have similar sounds that require a high level of concentration.

Why don't you give this one a try? Say this phrase five times as fast as possible.

> **Toy boat.**

Too easy? Here's one that may have your tongue in knots:

> **How much wood would a woodchuck chuck if a woodchuck could chuck wood? He would chuck, he would, as much as he could, and chuck as much wood as a woodchuck would if a woodchuck could chuck wood.**

Now it's your turn to write a tongue twister. Using either the pangolin or chameleon as your inspiration, create a tongue twister of your own to try to stump a friend. Use books or online resources to find other tongue twisters and see how they use patterns to mix words and sounds together. Once your tongue twister has been written and approved by your teacher, write a final draft on your receipt tape and put it in a display area designated by your teacher so others can give it a try!

FABLED FILMS PRESS
NEW YORK CITY

fabledfilms.com

For more information:
nocturnalsworld.com

Activity 3

Water Conservation: A Hydrogel Investigation

Background

In *The Nocturnals: The Hidden Kingdom*, the creatures, led by the chameleon, were hoarding water during a drought to wreak havoc among the animals. In the real world, while the situation is different, the threat of drought is still there.

Droughts have increased in frequency and severity across the globe, leading to stress in crop yields. With the population growing, food demands will increase, which means water demands will also increase.

One solution to this problem is to use super-absorbent polymers (SAPs) in the farming industry. SAPs act like giant sponges and can soak up as much as 800 times their weight in water. When used in soil, they are able to store water and nutrients, enabling plants to grow in limited water conditions.

For this activity, students will be able to see the super-absorbency of these polymers by using sodium polyacrylate, which is used in baby diapers. Challenge students to come up with their own solutions for using water-absorbing polymers to help during a drought or water shortage.

FABLED FILMS PRESS
NEW YORK CITY

fabledfilms.com

For more information:
nocturnalsworld.com

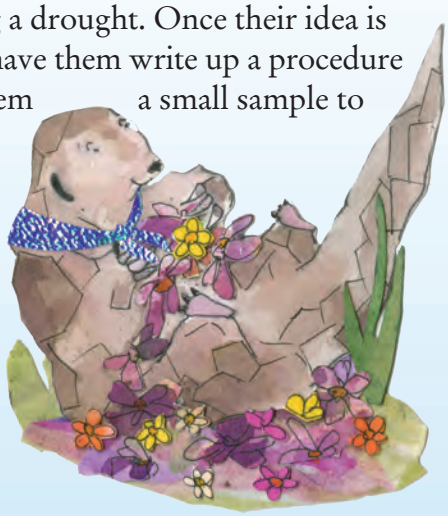
Instructions

1. Place students into groups and give each group the "Water Conservation: A Hydrogel Investigation" laboratory investigation. Discuss any lab safety rules and behavior expectations.

2. Students can collect materials, or you can already have the materials at stations. For younger students, you may want to have the sodium polyacrylate crystals already collected from the diapers and measured out ahead of time. **Tip:** The larger the diaper, the more polymer crystals you will be able to collect. One extra large diaper usually yields about 1½ tablespoons of crystals. You can also purchase sodium polyacrylate online.

3. Allow students to conduct the investigation, collect data, and make observations. Afterward, take time to explain SAPs and discuss how scientists are using them as a way of conserving water, especially in parts of the world that are plagued by drought.

4. Collect the extra sodium polyacrylate from each baggie and have students design their own test on how they could use SAPs to help during a drought. Once their idea is approved, have them write up a procedure and give them a small sample to test their hypothesis!



References and Helpful Links

- https://phys.org/news/2016-08-superabsorbent-polymers.html
- https://www.sciencenewsforstudents.org/article/explainer-what-are-polymers
- https://www.stem.org.uk/system/files/elibrary-resources/legacy_files_migrated/8567-catalyst_18_1_335.pdf
- https://www.stevespanglerscience.com/lab/experiments/baby-diaper-secret-vanishing-water/

NEXT GENERATION SCIENCE STANDARDS USED IN THIS ACTIVITY

3-5-ETS1-1: Engineering Design

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

3-LS4-4: Biological Evolution: Unity and Diversity

- Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

4-ESS3-1: Earth and Human Activity

- Obtain and combine information to describe that energy and fuels are derived from natural resources and that their uses affect the environment.

5-ESS3-1: Earth and Human Activity

- Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

Student Activity 3

Water Conservation: A Hydrogel Investigation

Problem

How much water can a paper towel absorb with and without a special polymer?

Inquiry Skills

Compare and contrast, observations, analyzing data, drawing conclusions, making an inference.

Materials

- XL diaper (or sodium polyacrylate crystals)
- Scissors
- Gallon-size plastic bag
- Cafeteria tray (or sheet pan)
- Dark construction paper
- ¼ teaspoon
- Eye dropper
- Brown paper towels
- 2 small cups
- Pencil

Setup

1. Line the tray with dark construction paper.
2. With a diaper on the tray, use scissors to carefully cut the diaper in half lengthwise. Put the diaper in a gallon-size zip-closing plastic bag. Gently pull the layers apart. Close the bag securely. Hold the bag from the top and shake for 30 seconds.
3. When you're done shaking the bag, you should notice little white granules collected in the bottom corner of the bag. These granules are a special water-absorbing chemical called sodium polyacrylate.
4. Slowly open the bag and carefully remove any cotton pieces that may have fallen into the granules.
5. Collect about ¼ teaspoon of the granules and place them in a cup. Give the bag with any unused granules to your teacher.

Procedure

1. Use the empty cup to trace two circles the same size on the brown paper towel. Label the circles A and B.
2. Use an eye dropper and add water, one drop at a time, to the center of circle A. Count the drops and continue to add them until the water reaches any edge of the circle. Record how many drops you added and any observations in the data table.
3. Place the ¼ teaspoon of sodium polyacrylate granules in the center of circle B.
4. Add the same number of drops to the pile of sodium polyacrylate as you did in the first circle. Compare your results and record your observations in the data table.
5. Continue to add drops until you have added a total of 100 drops of water. Record your observations in the data table.
6. Continue to add drops, 20 at a time, until the sodium polyacrylate does not absorb any more water or until your teacher says to stop. Record the total number of drops and any observations you have in the data table.

Data Table

Test	Observations
Circle A Adding drops of water to the paper towel	
Circle B Adding same number of drops to the paper towel with sodium polyacrylate	
Circle B Adding an additional 100 drops of water	
Circle B Continue adding water until the polymer does not absorb any more water.	

Analyze and Conclude

1. Compare the sodium polyacrylate before and after you added the water. How did it change?

2. Why do you think diaper companies use this polymer in their diapers?

3. Can you give examples of how some farmers may use these super water absorbers if they were to experience a drought or water shortage?

FABLED FILMS PRESS
NEW YORK CITY

fabledfilms.com

For more information:
nocturnalsworld.com