

MAGIC  TREE HOUSE[®]

STEM Educators' Guide

Science

Technology

Engineering

Math

Includes Next Generation Science
Standards Correlations



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MagicTreeHouse.com MTHClassroomAdventures.org

STEM Subjects and the Magic Tree House Series

Dear Educator,

Young children are naturally curious. To keep that curious nature alive, it is important to surround children with activities that encourage learning. Often the classroom that necessitates structure stifles creativity. These science-based, STEM-focused activities will allow children the freedom to explore the connection between the Magic Tree House books and their corresponding nonfiction fact trackers.

Mary Pope Osborne's Magic Tree House series is enticing to children because of the imagination and excitement in the books. As a science educator, I loved to read and discuss Jack and Annie's adventures with my students; I engaged them in science experiments that related to the topics and motivated them to ask questions, solve problems, and collaborate with each other. I'm privileged to share some of those engaging hands-on activities, which can serve as springboards to science learning in conjunction with the books. These can be used in the classroom as science centers, as whole-class activities, or at home using inexpensive, easily obtained materials. These are not in-depth science lessons, but are meant to integrate science and literacy in an interactive and exploratory way, as well as to connect STEM with each book.

Conversation starters that follow each activity are

“teasers” to get the children thinking.

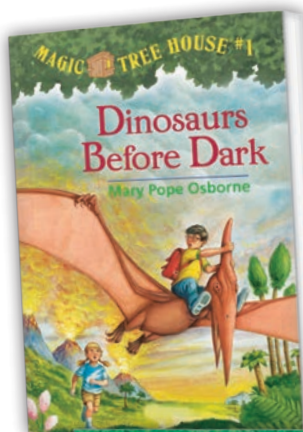
You will be amazed at where the students' imaginations take you!

—Marilyn Fitzsimmons, MEd, retired
Education Coordinator for Science
on the Road, Carnegie Science
Center, Pittsburgh

Mary Pope Osborne
and Will Osborne
received the 2015 Jupiter
Award for Outstanding
Contributions to Science
Education, presented by the
Morehead Planetarium
and Science Center.

*Note: Many of the supplies listed in the experiments in this guide can be acquired from home goods stores, from online educational suppliers, or from recycled materials.

STEM-Based Classroom Activities

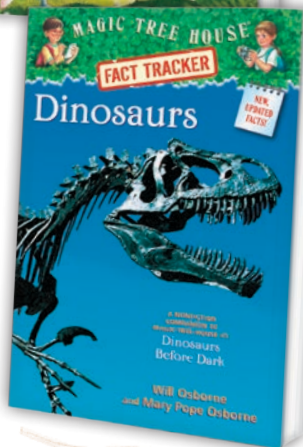


Magic Tree House #1: *Dinosaurs Before Dark* and its companion Fact Tracker, *Dinosaurs*

F&P: M • Lexile: 240L

PB: 978-0-679-82411-4 • HC: 978-0-375-86988-4 • EL: 978-0-375-89418-3 • 

Jack and Annie are ready for their first fantasy adventure in the bestselling chapter book series, the Magic Tree House! Where did the tree house come from? Before Jack and Annie can find out, the mysterious tree house whisks them to the prehistoric past. Now they have to figure out how to get home. Can they do it before dark . . . or will they become a dinosaur's dinner?



F&P: Q • Lexile: 690L

PB: 978-0-375-80296-6 • EL: 978-0-307-97508-9

When Jack and Annie got back from their adventure in Magic Tree House #1: *Dinosaurs Before Dark*, they had lots of questions. When did the dinosaurs live? What other animals lived at that time? Which dinosaur was biggest? How do we know about dinosaurs? Find out the answers to these questions and more as Jack and Annie track the facts.

ACTIVITIES

Name	Diet	Size	Geological Period	Other Characteristics
<i>Pteranodon</i>	Carnivore	25–33 feet (wingspan); 6 feet tall at hips	Cretaceous (85–75 million years ago)	Flying reptile; close relative of dinosaurs
<i>Triceratops</i>	Herbivore	30 feet tall	Cretaceous (72–65 million years ago)	Charged its enemy like a rhinoceros
<i>Anatosaurus</i>	Herbivore	42 feet tall	Cretaceous (73–65 million years ago)	Slow-moving
<i>Tyrannosaurus</i>	Carnivore	40 feet long; 15 feet tall at hips	Cretaceous (85–65 million years ago)	Huge feet; short arms

Have students use a piece of rope or string to estimate the length of each prehistoric creature in the table above. Estimate how many of each kind of creature could line up in the hallway or on the playground, and then use a tape measure to see how close they came.

Let students become paleontologists and make a new dinosaur discovery. Create a dinosaur out of nonhardening clay.

Conversation starter: If you had unearthed these dinosaur bones, what characteristics would help you identify it as carnivore, herbivore, or omnivore? Make a video of the student describing his/her discovery using a smartphone or video recording device and email it to parents.

ACTIVITIES continued

Collect plastic ferns, plants, smooth stones, and play-food meats. Spread them out and have students determine which foods were eaten by carnivores and which by herbivores.

Conversation starter:

Who would have eaten the stones, and why? Stones were ingested by herbivores (known as gastroliths) to aid in grinding food during the digestion process.

Have the students create a timeline (example can be found in the Fact Tracker *Dinosaurs*) to show when each creature lived. Add more dinosaurs as found in the Fact Tracker book.

Conversation starter:

Why do years go in reverse as we approach the present?

Create a *Tyrannosaurus* footprint (30 inches x 18 inches). Have the students trace their shoes onto construction paper, cut them out, place them inside the footprint, and count how many human feet fit inside the dinosaur's print.

Conversation starter: Can we estimate how tall this dinosaur might have been by comparing the ratio of foot length to height? Try it and see.



Magic Tree House #8: *Midnight on the Moon* and its companion Fact Tracker, *Space*



F&P: M • Lexile: 320L

PB: 978-0-679-86374-8 • EL: 978-0-375-89425-1 •

Jack and Annie are whisked forward in time and land at an international space station on the moon. There they don space suits and go exploring on the lunar surface in search of the fourth object needed to free the enchantress Morgan le Fay from a powerful spell.

F&P: S • Lexile: 700L

PB: 978-0-375-81356-6 • GLB: 978-0-375-91356-3 • EL: 978-0-307-97518-8

When Jack and Annie got back from their adventure in Magic Tree House #8: *Midnight on the Moon*, they had lots of questions. How did the universe begin? How long does it take to get to the moon? How hot is the sun? What does it feel like to be in space? Find out the answers to these questions and more as Jack and Annie track the facts.

ACTIVITIES

Re-create the moon's surface using aluminum pie plates and sand (regular play sand squirted with water) or white Shape-It! or colored Moon Sand. Have students drop balls of different sizes and weights from different heights onto the moon surface to create craters.

Conversation starter: How do the different sizes and weights of the balls affect the size and depth of the craters?

View the moon's surface using 3D glasses. Pictures of the moon's surface and astronauts walking on the moon can be found on the Internet.

Conversation starter: What does 3D stand for? How do 3-D glasses change your view of the surface?

Simulate what happens in space with no air by using a Microscale Vacuum Apparatus. When shaving cream or marshmallows are put inside the small vacuum chamber, a dramatic change in size happens that sends the students into outer space with enthusiasm!

Conversation starter:

How do we know there is air exerting pressure on objects on Earth?

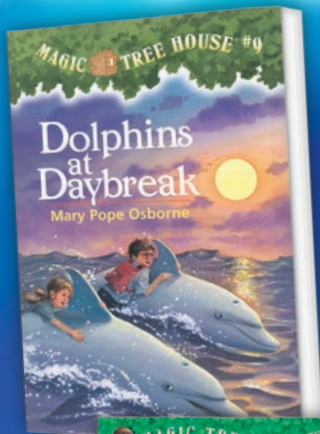
If Earth were the size of a basketball, the moon would be the size of a tennis ball. Have students model how far away the moon is from the Earth by using a basketball (Earth) and a tennis ball (moon). Challenge them to research the average distance between the Earth and the moon, and then convert that distance to feet in order to model it in the classroom. Have students tape their estimates on the floor using masking tape. (The correct distance is 23 feet and 7 inches).

Conversation starter:

Why do we need to use an average distance, rather than an exact distance, between the moon and the Earth for this experiment?



Magic Tree House #9: *Dolphins at Daybreak* and its companion Fact Tracker, *Dolphins and Sharks*



F&P: M • Lexile: 350L

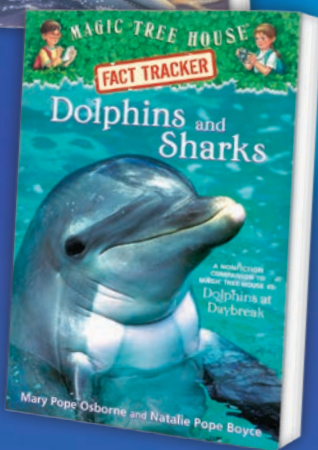
PB: 978-0-679-88338-8 • EL: 978-0-375-89426-8 • Q

Jack and Annie are off in the Magic Tree House again, this time to a whole new world under the ocean. Complete with a giant octopus, a hungry shark, and dolphins to the rescue, this Magic Tree House book delivers an underwater adventure kids can dream about.

F&P: Q • Lexile: 730L

PB: 978-0-375-82377-0 • EL: 978-0-307-97527-0

When Jack and Annie got back from their adventure in Magic Tree House #9: *Dolphins at Daybreak*, they had lots of questions. Did dolphins ever live on land? How do dolphins communicate? How do sharks hunt for food? Which sharks are the most dangerous? Find out the answers to these questions and more as Jack and Annie track the facts.



ACTIVITIES

Prepare one clear container of salt water and one of tap water. Take two raw eggs and demonstrate the difference in density between the salt water and fresh water by having a student gently drop an egg into each container. The egg will float in the salt water and sink in the fresh water because the salty water molecules are packed closer together, causing the egg to become buoyant.

Conversation starter: Does changing the amount of salt in the “ocean” container change the experiment? Let the children experiment with other objects that sink in fresh water to see if they will float in salt water.

Create mini-sub, also known as Cartesian divers, out of ketchup packets and recycled 20–24 ounce-thick plastic bottles. Place the packet in the empty bottle, fill the bottle with water, and cap it. Have the students figure out how to make the mini-sub sink. Lay out pipettes and steel nuts and have the students explore how to create a mini-sub using these materials instead of the ketchup packet.

Conversation starter: What must a real submarine do to dive below the surface of the ocean?

View the legs of an octopus in pictures and experiment with suction cups to feel how an octopus attaches itself to objects. Mini Magdeburg hemispheres work nicely for this. Window suction cups of various sizes can be used as well.

Conversation starter: What influences how much weight a suction cup will hold?



Magic Tree House #12: *Polar Bears Past Bedtime* and its companion Fact Tracker, *Polar Bears and the Arctic*



F&P: M • Lexile: 440L

PB: 978-0-679-88341-8 • EL: 978-0-375-89469-5 • ♻️

The Magic Tree House transports Jack and Annie to the freezing Arctic. There, they must solve the final riddle to become master librarians. But it's not going to be easy—especially when they have cracking ice, a seal hunter, and a prodigious polar bear to deal with. Will they be able to solve the riddle before they get iced themselves?



F&P: Q • Lexile: 730L

PB: 978-0-375-83222-2 • GLB: 978-0-375-93222-9 • EL: 978-0-307-97534-8

When Jack and Annie got back from their adventure in Magic Tree House #16: *Polar Bears Past Bedtime*, they had lots of questions. Why is the Arctic so cold? What did the first people of the Arctic eat? How do polar bears cross thin ice? What other animals live in the Arctic? Find out the answers to these questions and more as Jack and Annie track the facts.

ACTIVITIES

As a hands on experiment, dissect owl pellets and have students identify the rodents the owls consumed by using owl pellet bone charts (available by online search).

Conversation starter: What would happen if owls were not prevalent in places where rodents exist?

Model polar bears lying flat on the ice with a bed-of-nails kit. This allows students to visualize how spreading out mass (polar bear's body lying flat) increases the amount of weight the ice can hold before cracking.

Conversation starter: How do the polar bears learn this technique?

Create igloos using biodegradable packing peanuts made from cornstarch. Put out wet sponges and let students touch the peanuts to the sponges and stick the peanuts together to form the shape of an igloo. Then perform experiments by putting some of the peanuts in water and watching them disappear.

Conversation starter: How does the rate of disintegration change when you use hot water vs. cold water? How are these biodegradable peanuts good for the environment?

Model icebergs and glaciers. This is an informative global warming experiment that shows that melting glaciers might be more of a concern to climatologists than melting icebergs. Show the students a clear container of water with ice, representing icebergs in the Arctic Ocean. Mark the level of the water on the outside of the container with a marker, and set it aside to let the ice melt. After the ice has melted, notice the water level again. Take an identical container and add water to the same level as the first container. Now add ice to the second container, simulating a melting glacier that starts on a thick ice sheet and melts into the ocean.

Conversation starter: How did the levels compare? How will melting glaciers affect the level of the world's oceans with global warming?

Magic Tree House #23: *Twister on Tuesday* and its companion Fact Tracker, *Twisters and Other Terrible Storms*

F&P: M • Lexile: 310L

PB: 978-0-679-89069-0 • GLB: 978-0-679-99069-7 • EL: 978-0-375-8480-0 • ♻️

Jack and Annie are whisked to a Midwestern prairie in the 1870s. They visit a one-room schoolhouse and learn about the hard life of the pioneers. When they return to the magic tree house, Jack and Annie spot a twister on the horizon. Is there time to warn the teacher and the children back at the schoolhouse? Or should Jack and Annie just save themselves?

F&P: R • Lexile: 680L

PB: 978-0-375-81358-0 • GLB: 978-0-375-91358-7 • EL: 978-0-307-97526-3

When Jack and Annie got back from their adventure in Magic Tree House #23: *Twister on Tuesday*, they had lots of questions. How do tornadoes form? What kinds of tools can help predict bad storms? Where did the biggest snowfall on record happen? How fast are hurricane winds? Find out the answers to these questions and more as Jack and Annie track the facts.

ACTIVITIES

Model a tornado using two plastic bottles (2-liter or 1-liter) attached with a vortex bottle connector or “tornado tube” (available at most online educational suppliers). Fill one bottle with blue-colored water and add glitter for effect before attaching the tube. Stand the bottles upright and have students figure out how to make a funnel form as the water moves through the tube and into the bottom bottle.

Conversation starter: How did the movements the students made affect the strength of the funnel?

Compare our jumping ability to a grasshopper’s. Set up a tape measure marked off in feet and inches. Let students test how far they can jump. A grasshopper can jump 20 times its length. Have the students measure their heights and multiply by 20. Prepare to be amazed!

Conversation starter: If a grasshopper is three inches long, how far can it jump?

Demonstrate Bernoulli’s principle by using a “WindTube” balloon (available at most online educational suppliers). Students can practice blowing up the eight-foot-long tube with one breath. Fast-moving air has low pressure. The air from their lungs is fast-moving, and therefore has low pressure. When the outstretched tube is held away from the mouth when air is blown into it, high-pressure air around it comes into the tube at the same time, equalizing the pressure and blowing up

the WindTube with one long breath.

Technology connection: Make a video using a smartphone or video recording device and record the results of each child’s try. Email it to parents to see and discuss with their child.

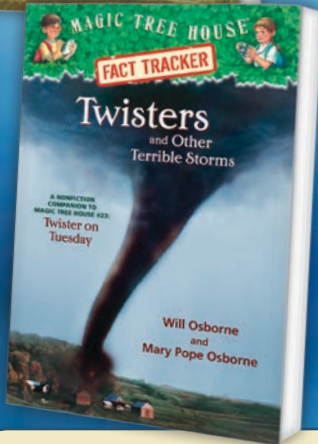
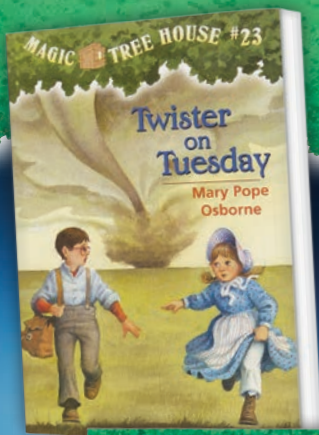
Conversation starter: Why do tornadoes move fast?

Make chalk. Take plaster of Paris, which is made from gypsum, and mix with water and add dry tempera paint for color. Stir together in a plastic cup to form a pastelike substance. Let dry and remove from cup, then use as sidewalk chalk.

Conversation starter: Since technology includes any tool that humans have devised from earth materials for their use (not just computers or electronics), what other inventions can be called technology?

Use a leaf blower to demonstrate the power of wind. Create a graph showing the distance different objects will fly in the airstream.

Conversation starter: What kinds of balls will balance in the upward stream of air, and what happens to each when the stream of air is tilted or cut off?



Magic Tree House #35: Night of the New Magicians



F&P: N • Lexile: 590L

PB: 978-0-375-83036-5 • EL: 978-0-375-89457-2 • ♻️

Merlin sends Jack and Annie on a mysterious mission to Paris, France, over 100 years ago. There they must find four magicians and give them an urgent message from Merlin himself. When Jack and Annie land in Paris, they make their way to the 1889 World's Fair. Below the Eiffel Tower, built especially for the fair, there are thousands of exhibits from all over the world. But how will Jack and Annie find the magicians in the crowds of people? And who are the magicians anyway? Jack and Annie are about to find out in another adventure filled with history, magic, and amazing surprises!

ACTIVITIES

The Magician of Iron was Gustave Eiffel.

Set up an experiment using iron nails. Spritz them with water periodically to see how they change over time.

Conversation starter: If oxygen rusts iron and oxygen molecules are in air and rain, how has the Eiffel Tower stood for so long without rusting and collapsing?

Let students create towers and different structures using sturdy recycled paper towel rolls and other recycled cardboard pieces.

Conversation starter: How would your tower withstand high winds? What has allowed the Eiffel Tower to withstand high winds?

The Magician of Sound was Alexander Graham Bell.

Create a variation on the paper-cup-and-string telephone by using Slinky Pop Toobs. Have students whisper a message after stretching tubes to four times their length and connecting tubes together to form a telephone wire.

Conversation starter: What happens to your voice as it moves through the tubes?

The Magician of Light was Thomas Alva Edison.

Have students design an experiment comparing an incandescent lightbulb to a CFL bulb. Put two unshaded lamps on a table along with a radiometer. Warn students not to touch the bulbs.

Conversation starter: When does the radiometer spin, and why?

Create red, green, and blue lights by covering LED flashlight bulbs with theater gels, and have students shine the flashlights onto a bright white surface. Let them experiment with making different combinations of light by mixing the light from two or more flashlights.

Conversation starter: How can you produce white light? How are the primary colors of light different from the primary colors of paint?

The Magician of the Invisible was Louis Pasteur.

Simulate the spreading of germs by using Glo Germ Powder. Have one or two students, unknown to rest of group, rub the powder onto their hands, but tell them not to say anything to anyone, just go about their normal activities. Let them pass out pencils, papers, books, or other items to the class. Before the next bathroom break, explain what was done and shine an ultraviolet light (black light) on their hands, clothing, and face. Then go around the room to see how the powder has spread.

Conversation starter: What has this experiment revealed about how germs are spread?

Conduct a hand-washing activity using Glo Germ Lotion. Have students rub the lotion onto the fronts and backs of their hands, shine a black light onto their hands, and then send them to the washroom to wash their hands in their normal way. Test again with the UV light.

Conversation starter: Where do germs like to hide on hands? How can you be sure that you're getting rid of more germs when you wash your hands?



Magic Tree House #39: *Dark Day in the Deep Sea* and its companion Fact Tracker, *Sea Monsters*



F&P: N • Lexile: 520L

PB: 978-0-375-83732-6 • GLB: 978-0-375-93731-6 • EL: 978-0-375-89461-9 • ♻️

Jack and Annie continue their quest for the secrets of happiness—secrets they need if they're going to save Merlin. But when the magic tree house leads them to a tiny deserted island in the middle of the ocean, they're not sure who needs help more—Merlin or themselves! The brother and sister team are soon rescued by a ship of explorers and scientists. But the crew isn't looking for the secrets of happiness. The crew is looking for a sea monster!



F&P: R • Lexile: 720L

PB: 978-0-375-84663-2 • GLB: 978-0-375-94663-9 • EL: 978-0-375-98328-3

When Jack and Annie got back from their adventure in Magic Tree House #39: *Dark Day in the Deep Sea*, they had lots of questions. How big is a giant squid? What is a dragonfish? How do deep-sea creatures find food when it's so dark down there? What do scientists think mythical sea monsters might really be? Find out the answers to these questions and more as Jack and Annie track the facts.

ACTIVITIES

Thousands of sea creatures exist in the oceans. These are some examples that can be used in the exercise below:

- Giant sea star: 24 inches in diameter
- Giant Mekong catfish: 9 feet long
- Bottlenose dolphin: 10 feet long
- Giant Pacific octopus: 14-foot-long arms
- Tiger shark: 12 feet long
- Giant oceanic manta ray: 23 feet across
- Giant squid: 33 feet long
- Sperm whale: 40 feet long

Measure a length of cord and mark 10 feet increments. Attach pictures of sea animals (printed from the Internet) at the distances of their lengths, beginning at the start of the cord. Wrap the cord around a cylindrical object, such as a kite cord or paper towel roll. Have students unwind the cord to see how large these animals grow. There are different ways to do this experiment. Give out duplicate pictures and have the students guess the length of each animal, or have the students walk off the lengths they think the animals would grow to before showing them the actual lengths.

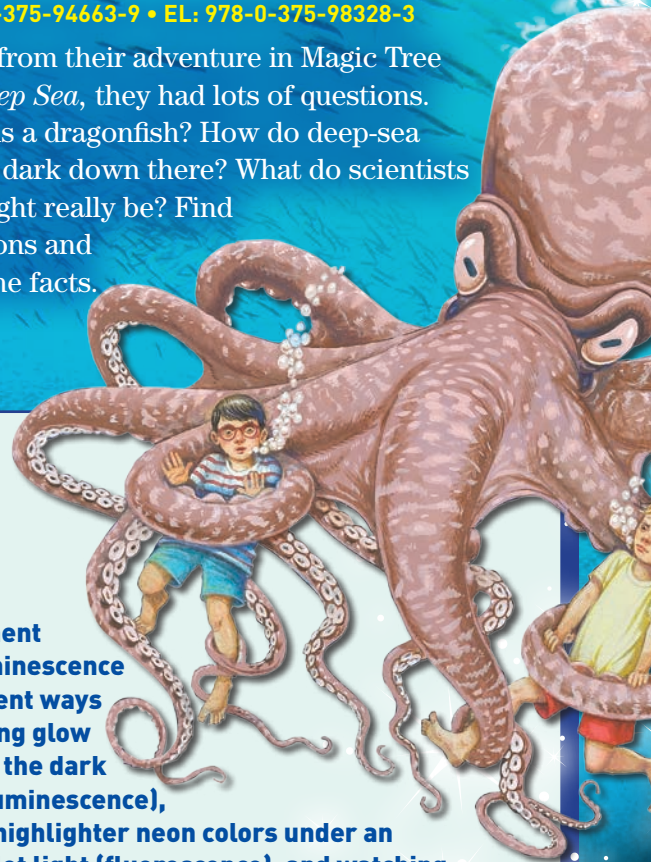
Conversation starter: Why do the animals appear smaller than they really are when viewed in their saltwater habitat?

Experiment with luminescence in different ways by lighting glow sticks in the dark (chemiluminescence), shining highlighter neon colors under an ultraviolet light (fluorescence), and watching glow-in-the-dark items after exposing them to UV light (phosphorescence).

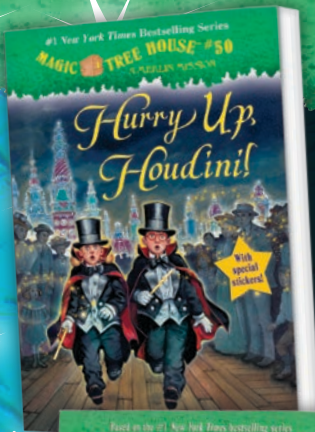
Conversation starter: Why is the light produced by marine creatures called bioluminescence? What other animals produce bioluminescence?

Using a tank of water, a toy diving submarine, and baking powder, let the students explore how the submarine can dive and surface like the real thing.

Conversation starter: Where are the bubbles coming from, and how are they affecting the motion of the sub?



Magic Tree House #50: *Hurry Up, Houdini!* and *Magic Tricks from the Tree House*



F&P: M • Lexile: 520L

PB: 978-0-307-98048-9 • GLB: 978-0-307-98046-5 • EL: 978-0-307-98047-2 • ♻️

On their latest mission for Merlin, Jack and Annie are sent back in time to Coney Island, to meet the legendary magician, Harry Houdini! But they're not just there to have fun—they will learn about how he accomplishes his magic tricks, and all the hard work it took to learn them.

F&P: P • Lexile: 750L

PB: 978-0-449-81790-2 • EL: 978-0-449-81792-6

This time Jack and Annie are tracking the tricks! When Jack and Annie went back in time to meet Houdini, they learned that the most famous magician of all time didn't use real magic at all. It was a trick! Now they've tracked down all the best, most fun, most tricky magic tricks and put them together in one book with simple instructions, easy-to-follow diagrams, and tips from Jack and Annie, *Magic Tricks from the Tree House* is tailor-made to teach kids how to wow friends and family in their very own magic shows.



ACTIVITIES

Houdini used illusion, gimmicks, and transformations to perform his magic tricks. Many science experiments look like magic, but have true science behind them

Broom Battle:

Have the student being tricked hold a broom upside down, keeping both hands just under the bristles. The object for him is to touch the broom handle to a target (like a coaster) placed on the floor. Another student will be able to prevent him from hitting the target with just one finger of pressure by pushing against the end of the broom handle (near the floor).

The science behind the magic: The broom handle is an example of a lever. The farther away the effort is applied (the finger pushing against the broom) from the load (the broom bristle end), the easier it is to do work, which in this case is to keep the broom from hitting the target.

Ziplock Water Lock:

Fill a ziplock freezer bag three-quarters full with water and zip tightly. Hold the bag up with one hand by the zipper. Have a student take a very sharp pencil and stab it all the way through the bag,

leaving the pencil protruding out the other side. No water should leak from the bag. Let another student poke another pencil through. How many pencils can they put through the bag?

The science behind the magic: Ziplock freezer bags are made of polymers, which are long chains of molecules that are flexible, yet strong, and will immediately and tightly wrap around the pencil, preventing water from leaking.

Lost-and-Found Coin:

Place a coin at the bottom of an empty mug or similar opaque container. Have a student lower his head until the coin just disappears from his sight below the top edge of the mug. Then slowly pour water into the mug, telling him to keep his head in the same position. The coin will become visible again.

The science behind the magic: Adding water causes light from the "hidden" coin to refract, or bend, as it passes from water into the air. This makes the coin appear again without having to change your viewing angle.

X Won't Mark the Spot:

Near the center of an index card, place a small circle using a black felt-tip marker. At a point two inches to the right of the circle, make a small X. Have a student close his left eye and hold the card at arm's length in front of his right eye. Have him stare at the circle as he moves the card slowly toward his right eye. At some point the X will mysteriously disappear. If the card is moved closer or farther away, the X will reappear.

The science behind the magic: In the retinas of our eyes, there are light-sensitive cells that allow us to see light, and our optic nerves carry that message of light to our brain. Near the center of the retina, where the optic nerve enters the back of the eye, there are no such cells. When the image of the X falls on the "blind spot," you won't see it.

The following

NEXT GENERATION SCIENCE STANDARDS*

can be correlated to many of the experiments and activities in this guide.

DIMENSION #1: Practices

Asking questions, developing and using models, planning and carrying out investigations, using math and computational data, constructing explanations and designing solutions, and obtaining, evaluating, and communicating information

DIMENSION #2: CROSSCUTTING CONCEPTS

Patterns, cause and effect, scale, proportion and quantity, and structure and function

DIMENSION #3: DISCIPLINARY CORE IDEAS

PS1.A Structure and Property of Matter

PS2.A Forces and Motion

PS2.C Stability and Instability in Physical Systems

PS3.C Relationship Between Energy and Forces

PS4.B Electromagnetic Spectrum

LS1.B Growth and Development of Organisms

LS2.A Interdependent Relationships in Ecosystems

ESS1.B Earth and the Solar System

ESS2.A Earth's Materials and Systems

ESS2.D Weather and Climate

ETS2.B Influence of Engineering, Technology, and Science on Society and the Natural World

***Framework for K–12 Science Education, National Research Council, 2012**

For a complete listing of the standards, visit nextgenscience.org/next-generation-science-standards

Check out these titles for more Magic Tree House STEM connections

