



Education Guide

Contents

Exhibition Overview	3
Goals of the <i>Animationland</i> Exhibition	3
Accessibility	5
Exhibit Fact Sheet	6
Sample Floor Plan	7
Exhibit Descriptions and Visitor Facilitation Tips	8
Procedures and Daily Maintenance	17
Activities for Museum, Informal, and Classroom Settings	19
Active Learning Log for School Groups	20
Active Learning Log Answer Key	23
Glossary	26
Resources	27
Appendix A: Facilitation Cards and Print Masters for Character Construction	29
Appendix B: Museum and Informal Education Activities	38
Let's Explore Flipbooks	39
Make Your Own Thaumatrope	47
Create Your Own Foley Sound Effects	55
Appendix C: Classroom Activities	62
Seeing Spots—The Illusion of Color	63
Fooling the Brain—The Illusion of Motion	69
Build Your Own Zoetrope	77
Plan of Action	84

Exhibition Overview

Animationland is a 2,000-square-foot, highly interactive traveling exhibition that brings together art, math, science, and technology by exploring the exciting world of animation. Through a series of hands-on exhibits, graphics, and videos, visitors explore the process of animation. The exhibition features original characters and worlds throughout in colorful illustrations, animation, and larger-than-life graphics.

Animationland is ideal for both families and school groups with children ages 6–12. The exhibition invites the visitor to become the animator, thus creating a unique and highly personalized experience for visitors of all ages. As they bring their own creations to life, visitors have the chance to experiment with a variety of animation tools and techniques, such as storyboarding, character design, drawing techniques, stop-motion animation, movement, timing, and sound effects.

Goals of the *Animationland* Exhibition

Following the philosophy that animation is an accessible way to engage visitors with STEAM (science, technology, engineering, art, and math) learning, the exhibition’s main message is “I can use animation to tell my stories.”

Engaging students

The exhibition has characteristics believed to encourage learning in informal environments.

National Research Council (2010), *Surrounded by Science: Learning Science in Informal Environments*.
<https://www.nap.edu/catalog/12614/surrounded-by-science-learning-science-in-informal-environments>

- Engaging participants in multiple ways, including physically, emotionally, and cognitively
- Encouraging participants to have direct or media-facilitated interactions with phenomena of the natural world and the designed physical world in ways that are largely determined by the learner
- Providing multifaceted and dynamic portrayals of science
- Building on the learner’s prior knowledge and interest

- Allowing participants considerable choice and control over whether and how they engage and learn

Engaging families

The exhibits have family-friendly characteristics.

USS Constitution Museum (2018), *Engage Families: A Guide to Family Engagement in Exhibits and Programs*. <https://engagefamilies.org/>

- MULTI-USER—allows for several sets of hands and bodies
- MULTI-SIDED—the family can cluster around
- MULTI-MODAL—appeals to different learning styles and levels of knowledge
- ENCOURAGE CONVERSATION—leads to shared understanding of the content
- MULTI-OUTCOME—sufficiently complex to foster group discussion
- AUTHENTIC & DISTINCTIVE—content, materials, environments, and activities that stand out
- RELEVANT—exhibit provides links to visitors’ existing knowledge and experience
- ACCESSIBLE—can be comfortably used by children and adults
- FUN & PLAY—helps make families more receptive to learning

Engaging girls

The exhibition incorporates EDGE (Exhibit Designs for Girls’ Engagement) design attributes.

Dancstep & Sindorf (2016), *Exhibit Designs for Girls’ Engagement: A Guide to the EDGE Design Attributes*. <https://www.exploratorium.edu/education/research-evaluation/edge>

- EXHIBIT LABELS—use drawing; have image of a person (here interpreted as characters)
- EXHIBIT LOOK-AND-FEEL—familiar objects; homey, personal, homemade, delicate; playful, whimsical, or humorous
- EXHIBIT INTERACTIONS—multiple stations or sides; space to accommodate three or more people; visitors can watch others to preview; open-ended activities

Accessibility

Animationland exhibits are fully wheelchair accessible and designed to ADA (Americans with Disabilities Act) standards.

The exhibits in *Animationland* have multisensory features that make them more accessible to people with visual and hearing impairments.

Visually impaired:

- *Shape the Characters*: use tactile tracing plates to draw animation characters
- *Be a Foley Artist*: make sound effects with physical objects; audio cues for starting and ending the activity
- *Make Stop-Motion Magic*: all buttons and controls have differing shapes; objects provided are physically shape-based
- *Plan and Pose*: audio cues combined with large, visual numbers and light cues prompt visitors when pictures will be taken; cues for starting and ending the activity

Hearing impaired:

**The majority of Animationland exhibits are visual!*

- *Be A Foley Artist*: make sound effects with physical objects; written cues onscreen prompt visitors to add sound effects using real objects at the right times
- *Plan and Pose*: number and light cues tell visitors when pictures will be taken

Exhibition Fact Sheet

ANIMATION LAND

Tracey the pencil dog & her crew of fun-loving friends guide visitors through a magical world in *Animationland*. Hands-on interactives teach the science behind the art of animation and big, bright environments create an immersive setting. Examples of professional and amateur animation inspire visitors & demonstrate the power of storytelling. Light tables for drawing & a variety of stop-motion stations allow visitors to explore how they too can use animation to tell their own stories.

Animationland is designed to appeal to a wide range of visitors, with emphasis on those aged 6 to 12 and their families.



Cost: \$50,000 for a 3-month venue, plus shipping

Requirements: 2,000 sq. ft. gallery space
Min. doorway dimensions for carted exhibit:
4' W x 8'H x 10'L
Min. floor space to store carts: 400 sq. ft.
110 Vac 15-amp power
3-5 days for installation and take-down
Minimum ceiling height: 9 ft.

Components: Mechanical and electronic interactives
Light tables for tracing and drawing
Full-body participatory stop-motion booth
Foley room

Shipping: Shipped in one (1) 53-ft. trailer

Supplemental: Instruction Manual

Materials: Marketing Kit
Educator's Guide

Availability: Contact OMSI's Traveling Exhibits Service at:
503-797-4628 | travelingexhibits@omsi.edu

THEMATIC AREAS



Dreaming It Up

Through an inviting entryway lies Tracey's bright animation studio where visitors meet the *Animationland* crew. Interactive experiences introduce the fundamentals of animation, and light tables with materials for tracing or drawing encourage everyone to participate.

Stop-Motion Studio

Activity stations with lots of fun props let visitors create their own stop-motion animations. Cameras capture the action, screens at eye level play the animation, and monitors above let other visitors watch the fun.

You're the Star

Visitors become the stars of an animation, capturing themselves moving around a gridded floor or making it appear that they are floating or teleporting. A Foley room packed with creative noisemaking devices encourages visitors to add sound to an animation clip.

An Interactive Exhibit Designed and Produced by:
Oregon Museum of Science and Industry
1945 SE Water Avenue
Portland, Oregon 97214
503.797.4628 | www.omsi.edu

OMSI

Sample Floor Plan

The following is a suggested floor plan for the *Animationland* exhibition installed in a 2,500-square-foot exhibit hall. Many arrangements are possible for your facility.

- 01. Magic Doorway
- 03. Picture after Picture
- 04. Create a Storyboard
- 05. Shape the Characters
- 06. Share Your Creations
- 09a. Make Stop-Motion Magic—Prickle Desert
- 09b. Make Stop-Motion Magic—Forgotten Forest
- 09c. Make Stop-Motion Magic—Comfort Peaks
- 09d. Make Stop-Motion Magic—Blub-Glub Village
- 14. Plan and Pose
- 16. Be a Foley Artist
- 19a. Title Graphic
- 19b. *Animationland* Map
- 19c. Exhibition Welcome
- 19d. Environment—Tracey’s Studio
- 19e. Environment—Prickle Desert
- 19f. Environment—Comfort Peaks
- 20a. Tracey
- 20b. Drop
- 20c. Rooth
- 20d. Uno

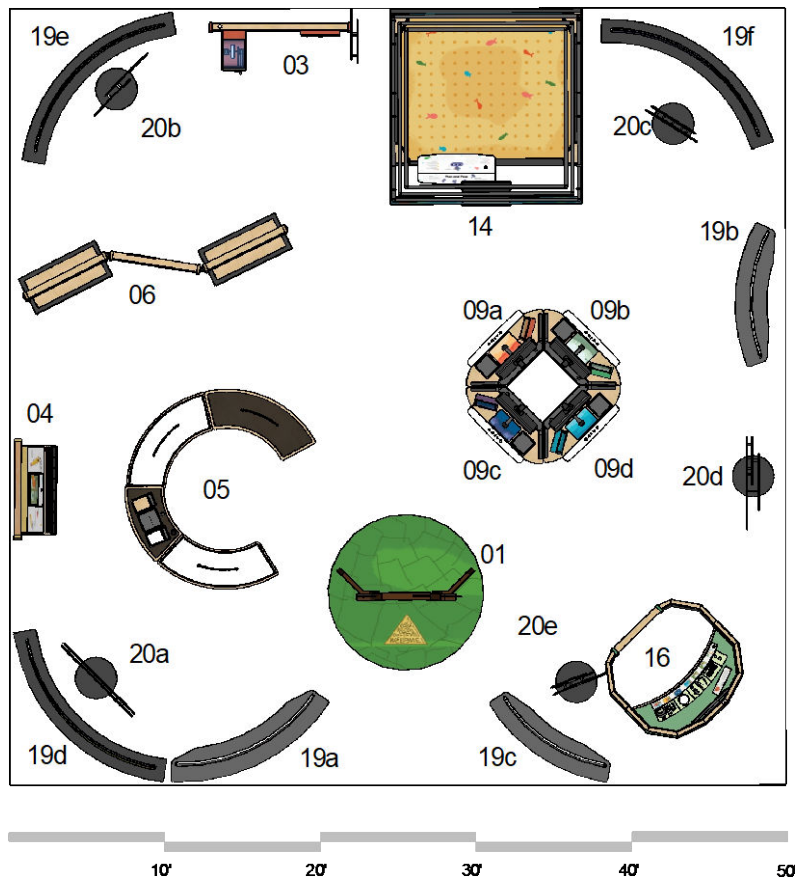


Exhibit Descriptions and Visitor Facilitation Tips

The descriptions below include the title, description, and an image of each exhibit component. In addition, Facilitation Tips offer notes for facilitating or maintaining a specific exhibit component. These tips include the Bright Idea labels that appear on most interactive components (marked on exhibit graphic panels by a star).

Animationland consists of five visual worlds: Tracey's Studio, Prickle Desert, Comfort Peaks, Blub-Glub Village, and Forgotten Forest.

ENTRY AREA

Title Graphic

The title graphic features the stacked color version of the logo.



Animationland Map

The map gives visitors an overview of the magical realm they will enter. It features the characters and the worlds where they live.



Exhibition Welcome

The welcome panel features Tracey, the pencil-dog, and tells visitors a short narrative of her life in *Animationland*. The backside of the panel has a large image of all the characters joined together, a possible photo op for visitors.



Magic Doorway

This portal with a kid-sized doorway welcomes visitors into Tracey's Studio on Turtleback Island.



TRACEY'S STUDIO

Tracey & Environmental Graphics

This thematic area is highlighted by a large fabric environmental panel and a character photo op that add to the immersive quality of the exhibit.

Mr. Turtle peers through the window of Tracey's Studio, where visitors see what objects Tracey chooses to surround herself with in her creative process. Tracey, the pencil-dog brought *Animationland* to life when she drew the worlds and the characters that live there.



Create a Storyboard

Animators often use storyboards to develop their story, an important element in the animation process. In this interactive component, visitors place storyboard cards into cardholders on a large panel on the front, marked by indicator lights. Visitors place between two and eight of ten cards in any order they choose and press the PLAY button to see an animation reflecting the chosen cards. Rails behind the cardholder panel store unused cards.



Facilitation Tips:

- Suggest trying the Bright Idea: *Have an idea for a shorter story? You do not need to fill all eight slots.*
- When a visitor has created a storyboard, challenge them take the last frame they used and make it the first frame. How does that change the story?
- Suggest that visitors draw their own original storyboards at the drawing stations.

Shape the Characters / Create Your Own Storyboard

A drawing studio brings out the artist in everyone. Visitors can trace the *Animationland* cast of characters using transparencies and light tables, recreate them using simple shape stencils and the instructions on signage, or draw their own creations freehand. Basic geometric shapes form the foundation of many animated characters, and learning to combine these shapes into characters is a powerful creative tool.



Visitors may also draw storyboards, supported by graphics on the unlit table. A pencil sharpener and bins for stencils, paper, and pencils sit atop a locked cabinet that stores replacement supplies.

Facilitation Tips:

- Suggest the Bright Ideas located on Share Your Creations (see below).
- As needed, print templates for visitors to draw characters and storyboards (see Appendix A for print masters).
- Print and laminate challenge cards (see Appendix A for print masters). Challenge visitors to pick one or multiple cards and draw a character using those constraints.
- Partner draw! Each partner takes turns drawing one line of one character. Did the character turn out differently than you imagined?

Share Your Creations

After spending some time in Tracey's Studio, visitors may want to share their artwork with others. This component provides cords and clothespins to display their creations.

Facilitation tips:

- Seed the display with a couple of drawings and storyboards.
- Suggest trying the Bright Ideas:
- Bright Idea 1—Make your drawing come to life at a stop-motion animation station.
 - Bright Idea 2—Create your own original character using the basic shapes.



PRICKLE DESERT

Drop & Environmental Graphics

This thematic area is highlighted by a large fabric environmental panel and a character photo op that add to the immersive quality of the exhibit.

Prickle Desert, drawn in vivid reds and oranges, is home to snakes, reptiles, and many happy cactuses. Here, Drop (the last drop of water in Prickle Desert) hangs out with a friendly cactus.



Picture after Picture

This component includes two interactives exploring the fundamentals of animation. A mutoscope replica is operated by a hand crank. This causes a reel of images inside the mutoscope to flip around (a Rolodex-like version of a flip book), creating an animation. A video component allows an animation to be seen at different frame rates (fps, or frames per second) using a dial with a range of 1 to 24 fps.



Facilitation Tips:

- Visitors may want to know how many pictures are in the mutoscope. A typical mutoscope reel held 850 pictures, about 1 minute of animation.
- Use the skills you learned at the Be a Foley Artist station to create sound effects for the animation playing on the mutoscope.

COMFORT PEAKS

Rooth & Environmental Graphics

This thematic area is highlighted by a large fabric environmental panel and a character photo op that add to the immersive quality of the exhibit.

Smiling mountains and bizarre space creatures inhabit the tourist destination of Comfort Peaks. Rooth is the lumbering mountain who brought visitors to the Comfort Peaks by making them cozy.



Make Stop-Motion Magic

Visitors create their own animation at four (4) stop-motion activity stations supplied with a variety of fun props. Cameras capture images from above and play the animation back on a screen at eye-level. Other monitors above the visitors' heads mirror what is happening so that bystanders can see each animation as it is created and when it is done. Attractor videos displaying the work of students at OMSI's summer animation camps play while these stations are not in use.



Facilitation Tips:

- Suggest trying the Bright Ideas.
 - Bright Idea, Prickle Desert background: *Do you have drawings from the drawing area? If you do, you can use them for your animation.*
 - Bright Idea, Comfort Peaks background: *Anything can be a character. Try making a character with something in your pocket.*
 - Bright Idea 3, Blub-Glub Village background: *Test your timing. Make one thing move as slow as possible while something else moves twice as fast.*

- Bright Idea, Forgotten Forest background: *Try some planning. Think about how a character will come onscreen, move about, and leave the screen.*

BLUB-GLUB VILLAGE

Plan and Pose

Set in the underwater world of Blub-Glub Village, this iconic full-body experience encourages visitors to use a gridded floor to plan the action in a 14-frame animation. By way pixilation (a stop-motion technique), they can capture images of themselves moving around the floor and make it appear as if they are floating or teleporting. Finished animations play on screens located on the outside of the exhibit.

Facilitation Tips:

- Suggest trying the Bright Ideas.
 - Bright Idea—Warm-up: *Start on one of the fish and take a path across the floor.*
 - Bright Idea—Float in mid-air: *Jump for every camera shot. (Hint: Stay close to the back wall.)*
 - Bright Idea—Teleport: *Do some poses on one of the fish. Partway through your 14 frames, move to a fish far away.*
- Suggest shorter visitors stand near the back wall to help them stay in the camera frame.
- Challenge visitors to make an animation using one or more of these constraints:
 - You can only move from fish to fish.
 - You must stand on one dot the entire time.
 - Can you make an animation of yourself growing taller? Shrinking?



- Create an animation where your arm disappears.
- Can you make an animation of yourself traveling very fast?
Very slow?

FORGOTTEN FOREST

Uno & Environmental Graphics

Life-sized plywood figures provide opportunities for visitors to take memorable photos.

Uno is the skeptical resident of Forgotten Forest that loves to shake the trees to listen to the sound they make. Simple stacked geometric shapes make up the trees of Forgotten Forest, where brightly colored bugs make their homes.



Be a Foley Artist

Foley artists record sounds from a wide variety of sources to add to animations. This “Foley studio” shows visitors how to add the sounds to a short animated clip using ordinary objects and props. The objects lay along the tabletop in sequence so visitors can easily add the sounds to the clip as it plays.



Facilitation Tips:

- Suggest trying the Bright Idea: *Want to do this activity as a group? One person can play the pitch bender every time Kari flies through the air.*
- Encourage visitors to plan ahead which sounds they may want to play differently.

- Carry a few random items with you. Tell visitors that you want to create an animation of a snake and ask them to use the items you have to create snake sound effects.
- Ask visitors to close their eyes. Make a sound with a random object and ask the visitors to tell you what they imagine that sound would accompany.

Examples: thunder tube, zipper, coconut shells, or a leather wallet.

- See also the activity, Create Your Own Foley Sound Effects in Appendix B.

Procedures and Daily Maintenance

As needed, call OMSI's Traveling Exhibits Technical Manager for assistance at 503.797.4660.

Opening

- Make sure all touch screens and computer-based activities turn on and work properly.
- Make sure the lights in Plan and Pose attached to the structural frame turn on and work properly.
- Make sure the drawing area has enough paper and colored pencils. Account for tracing transparencies and stencils in the drawing area.
- Look through the visitor-posted drawings and remove anything inappropriate.
- Make sure all exhibit surfaces and the exhibition area are clean.
- Account for all blocks in stop-motion animation stations and place in the storage bins.
- Make sure mutoscope works properly.

Throughout the Day

- Throughout the day, make sure to clean tabletops, especially in the drawing area. Use a soft, lint-free, non-abrasive cloth dampened with water (or Method All-Purpose Cleaner if water is not sufficient) to clean the surface. Dry the surface immediately with a soft, lint-free, non-abrasive cloth.
- Refresh the stock of paper and colored pencils in the drawing area.
- Keep the tabletops throughout the exhibition neat to encourage appropriate activity.
- On busy days, take down character drawings throughout the day to allow room for afternoon creations.
- Make sure Plan and Pose floor is clear to limit trip hazards.
- Pieces may travel between Make Stop-Motion Magic stations—sort them into correct stations throughout the day.

- On busy days, ensure groups are taking turns at popular stations.

Closing

- Make sure all computer-based activities and videos turn off.
- Make sure that the tethered objects in Be a Foley Artist are stored properly and are not dangling over the front side of the exhibit.
- Move the stepstool back to the mutoscope if it has moved away.
- Arrange grey stools (20 total):
 - Two for each stop-motion station
 - Two for Be a Foley Artist
 - Five for the tall drawing table.
 - Five for the tall light table.
- Place the four yellow stools at the short light table.

General Cleaning

Please see the Cleaning section of the Instruction Manual for general cleaning instructions.

NOTE: Never stack stools on the exhibit components during floor cleaning. The stool legs can damage the surfaces, especially the light tables.

Activities for Museum, Informal, and Classroom Settings

Animationland activity guides (see appendices) support both formal and informal educators in offering options for facilitating fun, interactive activities to do before, during, and after visiting the exhibition.

Museum and Informal Education Activities (Appendix B)

Let's Explore Flipbooks!

Visitors explore the process of animation while drawing and assembling reusable flipbooks.

Make Your Own Thaumatrope

Visitors design and assemble a pre-animation optical toy and discover how it works.

Create Your Own Foley Sound Effects

Visitors create different Foley sounds and learn about the history of sound effects in animation and motion pictures.

Classroom Activities (Appendix C)

Seeing Spots—The Illusion of Color

Students observe cartoons through a magnifying lens to discover the illusion of many colors is made from tiny dots of only four colors.

Fooling the Brain—The Illusion of Motion

This activity introduces one of the important optical illusions that make animation possible.

Build Your Own Zoetrope

Students learn about the history of animation and the science of apparent motion by creating an animation toy.

Plan of Action

Students make a storyboard and act it out.

ANIMATIONLAND

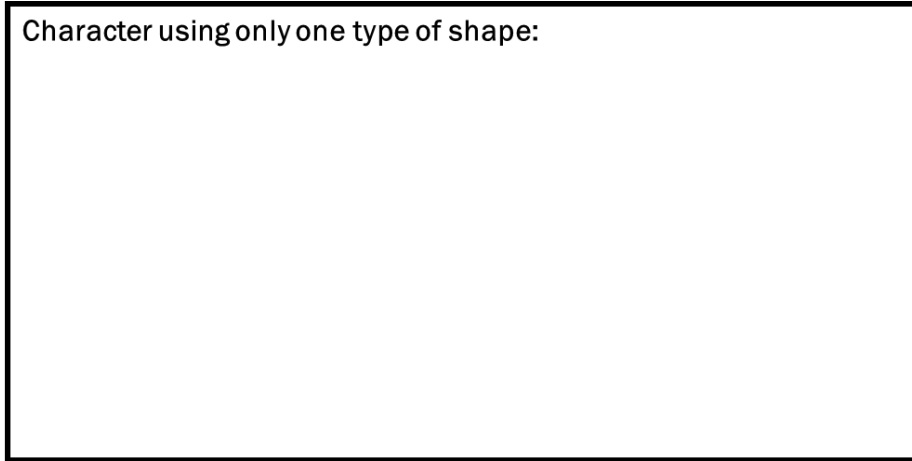
Active Learning Log

Draw!

Station: Shape the Characters

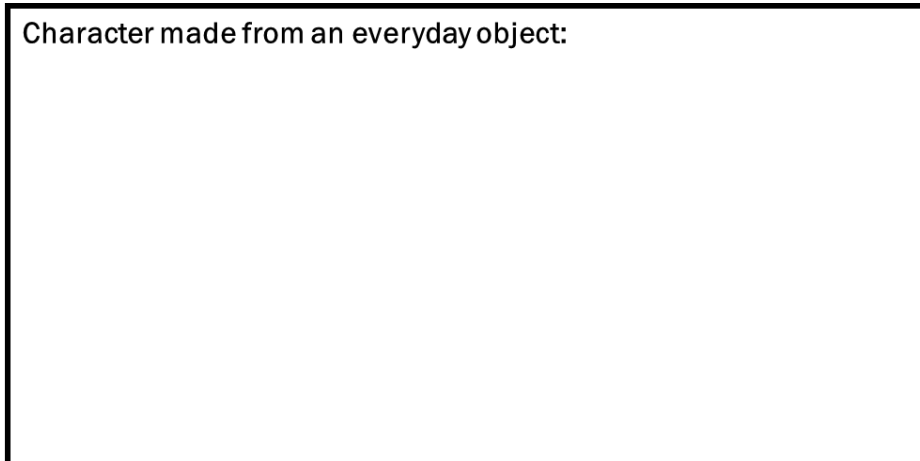
1. Can you draw a character using only one type of shape?

Character using only one type of shape:



2. Characters can be made of non-living objects like pencils or clouds. Draw a character made from an everyday object.

Character made from an everyday object:



Plan!

Station: Create a Storyboard

1. Storyboards are similar to what kind of picture books?

2. Would an animator create a storyboard at the beginning, middle, or end of their project?

Beginning	Middle	End
-----------	--------	-----

3. If you were an animator, would you create a storyboard? Why or why not?

Observe!

Station: Picture after Picture

1. Play with the mutoscope—does it remind you of anything?

Fun Fact! Originally, the mutoscope allowed only one person to see the images at a time!

2. Observe the animation at 12 and 24 frames per second. Does the animation appear to be moving slower or faster at 24 frames per second? Can you explain your answer?

Challenge!

Station: Be a Foley Artist

1. What is a Foley artist's role in animation?

2. Choose a random item—what kind of sound does it make? What kind of animation would it bring to life?

Math in Animation!

Station: Plan and Pose

1. This exhibit takes 14 pictures and strings them together to make a 2-second pixilation animation. How many pictures would we need to take to make a 4-second animation? 10-second?

4 second animation = _____ pictures

10 second animation = _____ pictures

Hint! A 4-second animation is twice as long as a 2-second animation!

Collaborate!

Station: Make Stop-Motion Magic

1. Grab a partner and take turns positioning each frame of your stop-motion animation!
2. How did teamwork influence your final animation?

ANIMATIONLAND

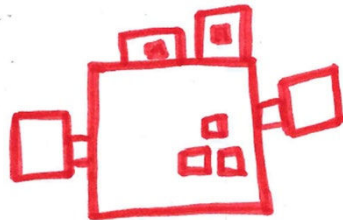
Active Learning Log

Draw!

Station: Shape the Characters

3. Can you draw a character using only one type of shape?

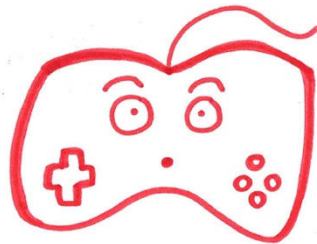
Character using only one type of shape:



Answers will vary. Example answer: Robot made entirely out of squares.

4. Characters can be made of non-living objects like pencils or clouds. Draw a character made from an everyday object.

Character made from an everyday object:



Answers will vary. Example answer: Character made from a video game controller.

Plan!

Station: Create a Storyboard

4. Storyboards are similar to what kind of picture books?

Comic books.

5. Would an animator create a storyboard at the beginning, middle, or end of their project?

Beginning

Middle

End

6. If you were an animator, would you create a storyboard? Why or why not?

Answers will vary. Example answer: Yes— I would make a storyboard because I think it would help me plan my animation and keep my story moving forward.

Observe!

Station: Picture after Picture

3. Play with the mutoscope—does it remind you of anything?

A flipbook, old movies, animation, etc...

Fun Fact! Originally, the mutoscope allowed only one person to see the images at a time!

4. Observe the animation at 12 and 24 frames per second. Does the animation appear to be moving slower or faster at 24 frames per second? Can you explain your answer?

The animation appears faster at 24 frames per second as more frames allows for increased movement within the same amount of time.

Challenge!

Station: Be a Foley Artist

3. What is a Foley artist's role in animation?

A Foley artist creates the sound that accompanies the animation.

4. Choose a random item—what kind of sound does it make? What kind of animation would it bring to life?

Answers will vary. Example answer: a zipper makes a purring sound that could bring an animated cat to life!

Math in Animation!

Station: Plan and Pose

2. This exhibit takes 14 pictures and strings them together to make a 2-second pixilation animation. How many pictures would we need to take to make a 4-second animation? 10-second?

4 second animation = 28 pictures

10 second animation = 70 pictures

Hint! A 4-second animation is twice as long as a 2-second animation!

Collaborate!

Station: Make Stop-Motion Magic

3. Grab a partner and take turns positioning each frame of your stop-motion animation!
4. How did teamwork influence your final animation?

Answers will vary. Example answer: My animation was different when I worked with a partner because they had new ideas that I never would have considered.

Glossary

Animation	A process that creates a moving image out of still images such as drawings, photographs, or computer graphics.
Frame	A frame is a static image. A series of frames filmed in sequence makes an animation.
Frame rate	The number of frames that play during one second of animation, usually expressed by frames per second (FPS).
Mutoscope	A hand-cranked animation viewer invented in the late 19th century. A person turned a handle while looking in the viewer, while a light illuminated moving pictures flipping past the viewer.
Pixilation	A stop-motion animation technique that uses people instead of physical objects
Stop-motion animation	An animation technique that uses physical objects instead of drawn pictures.
Storyboard	A series of sketches illustrating key points of action in a show or film.

Resources

Books

Bellmont, Laura. Animation Lab for Kids: Fun Projects for Visual Storytelling and Making Art Move. Beverly, MA: Quarry Books, 2016.

Bliss, John. Art That Moves: Animation around the World. Chicago, IL: Raintree, 2011.

Pagano, David. The LEGO Animation Book: Make Your Own LEGO Movies! San Francisco, CA: No Starch Press, 2017.

Reid, Emily. Monster Claymation. New York, NY: Windmill Books, 2017.

Saldaña, Zoë Wilkinson. Filming Stop-Motion Animation. Ann Arbor, MI: Cherry Lake Publishing, 2018.

Websites

Animation World Network

<https://www.awn.com>

Resource for current animation news worldwide.

Brickfilms.com

<http://brickfilms.com>

Online community that has information and resources for making stop-motion animation using construction toys such as LEGO bricks. How-to videos are in the blog.

Flipbook!

<http://www.benettonplay.com/toys/flipbookdeluxe/guest.php>

Web app with a simple interface. An onionskin feature fades the most recent drawing so it's easy to gauge what adjustments to make for drawing the next frame. There is a gallery for animators to share their work and view others'. Requires Adobe Flash.

How to Draw for Kids

<https://www.artforkidshub.com/how-to-draw>

Website with lessons on drawing, painting, sculpting, origami, and cutout. Easy-to-follow lessons include supply lists, lesson length, and an instruction video.

Apps & Software

Stop Motion Studio –iOS, Mac, Android, and Windows

Toontastic—iOS and Android

Appendix A

Facilitation Cards and Print Masters for Shape the Characters and Create Your Own Storyboard



**Challenge
Card!**



**Challenge
Card!**

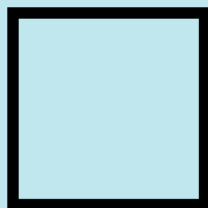


**Challenge
Card!**



**Challenge
Card!**

Can you draw a character using only squares?



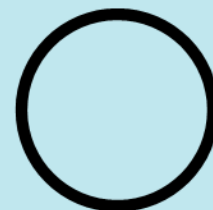
Can you draw a character using only triangles?



Can you draw a character using a hexagon?



Can you draw a character using only circles?





**Challenge
Card!**



**Challenge
Card!**



**Challenge
Card!**



**Challenge
Card!**

**Draw yourself
as an animated
character.**

**Draw a
character that
moves using
wheels.**

**Create a
character that
is helping
someone else.**

**Draw a
character that
only eats pizza.**



**Challenge
Card!**



**Challenge
Card!**



**Challenge
Card!**



**Challenge
Card!**

Design a character that could survive arctic temperatures.

Draw a character that can fly.

Create a character that lives in the ocean.

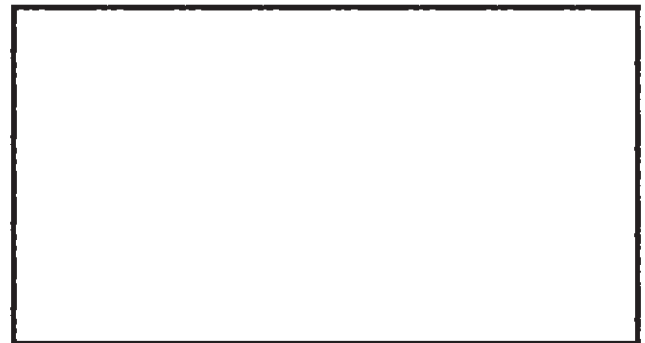
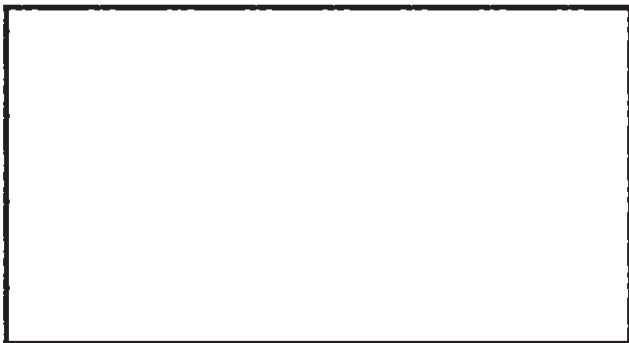
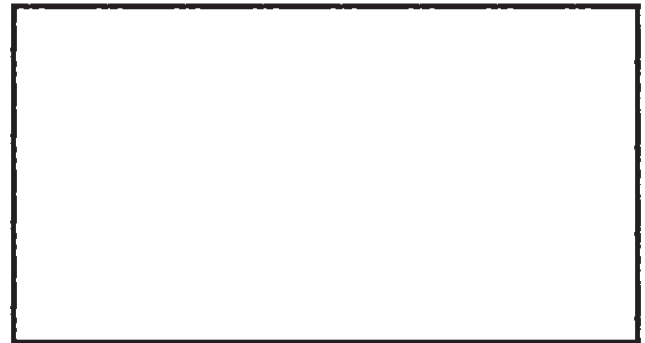
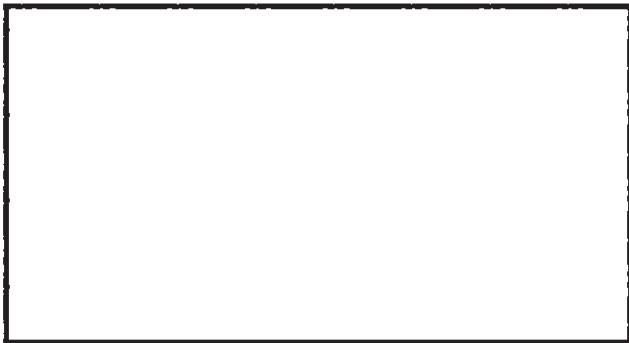
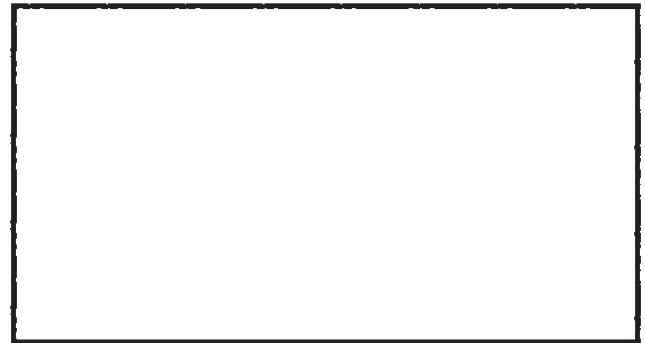
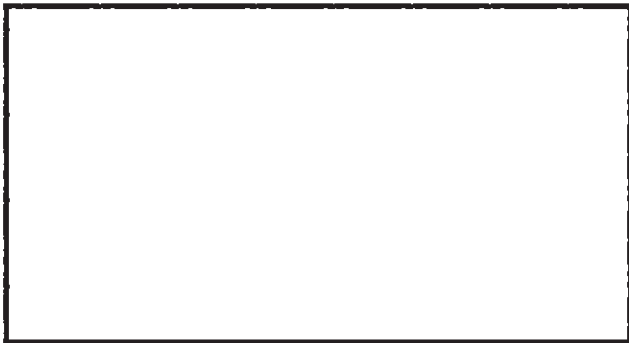
Design a character that could survive on Mars.

Draw a character.

ANIMATIONLAND

Draw a storyboard.

Use the boxes to show the order of what happens in your story.



Appendix B

Museum and Informal Education Activities

ANIMATIONLAND

Let's Explore Flipbooks!

Visitors explore the process of animation while drawing and assembling reusable flipbooks.

Science Topics

Apparent Motion
Design

Process Skills

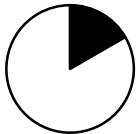
Visualizing
Testing

Grade Levels

2-8

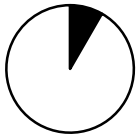
Time Required

Advance Preparation



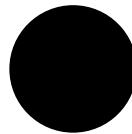
10 minutes

Set Up



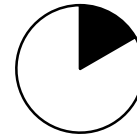
5 minutes

Activity



60 minutes

Clean Up



10 minutes

Supplies Needed

- ❑ 24 pieces of white copy paper
- ❑ Face, Tree, and Blank templates (see Masters A, B and C)
- ❑ 12 assorted colors of *EXPO Low Odor Dry Erase Markers*
- ❑ 10 2x2 inch pieces of felt
- ❑ 15 medium sized binder clips
- ❑ 4 small containers (e.g. sandwich bags or food storage containers)
- ❑ Laminator
- ❑ Laminating sheets (5 MIL thickness is recommended)

Advance Preparation

- ❑ Make eight single sided copies of Master A. Repeat for Masters B and C.
- ❑ Cut and laminate copies of Master A. Store them in a small container. Repeat the steps for Masters B and C.
- ❑ Place binder clips in a small container.

To conserve paper, the flipbook pages are designed to be reusable. The steps listed above should not be repeated until flipbook pages need to be replaced due to excessive use or damage.

Set Up

- ❑ Place the four containers of materials, 12 dry erase markers and 10 felt squares in the activity area.
- ❑ Make sure the flipbook pages are wiped clean if they were previously used.
- ❑ Discard any damaged flipbook pages if needed.
- ❑ Help visitors understand that all animations are created from a series of still images, each slightly different from the one before.
- ❑ Give visitors the opportunity to create their own animations.
- ❑ Introduce visitors to the techniques used to create a flipbook.

Introducing the Activity

- ❑ Welcome! Today we are going to be animators exploring the art of making a flipbook.
- ❑ Have you ever made a flipbook before? Creating a flipbook is a fun and easy way to make a short animation without using film.
- ❑ Like cartoons, flipbooks are made by drawing a series of pictures, each picture slightly different than the one before.

Creating the Flipbook:

Visitors create their flipbooks by drawing pictures on each page. There is no set amount of pages for a successful flipbook. Just remember: more pages equal **more action**. Having pre-made or store bought flipbooks available for visitors to look at is extremely helpful (see also SUGGESTIONS below).

1. Plan

- ❑ The first job of an animator is to decide what the cartoon or animation is going to be about. What do you want your flipbook to be about?
Suggest drawing a smile turning into a frown, clouds moving across the sky, or a growing flower.
- ❑ To help plan your flipbook, start by drawing the first page and the last page. That way you will know how your animation will begin and how your animation will end.
Some visitors may also want to draw some of the in-between pages.
- ❑ Finish your flipbook by adding all of the in-between drawings. Remember, each drawing should closely resemble the one before it! Making subtle changes to each picture in your flipbook will result in a more natural and realistic movement of the images drawn.

Animator's Tip: If you have the same picture twice in a flipbook, stop-motion sequence, or animated film, the action of the figure in the picture will appear to be smoother.

2. Assemble

- ❑ After the drawings are completed it is time to assemble the flipbook.
- ❑ Take all of the drawings and stack them together, checking to make sure they are in the correct order.
- ❑ Give each visitor two binder clips.
- ❑ Before securing the pages together, make sure that all of the pages are square at the bottom.
- ❑ Place the binder clips at the top of the flipbook.

3. Flip

- ❑ With your left hand hold the top of the flipbook.
- ❑ Take your right thumb and index finger and flip the pages. Try flipping the pages at different speeds.
- ❑ Now that you have seen your animation, are there any changes you want to make? Can you make the animation smoother by adding more drawings?
- ❑ Was the animation as long as you thought it would be?

Animator's Tip: It takes an incredible amount of work to make even a short animation. A 10-minute cartoon, for example, requires 14,400 pictures!

4. Clean

- ❑ Remove the binder clips and put them back into the small container.
- ❑ Clean the flipbook pages with felt squares so that the next visitor can use them.

Clean Up

- ❑ Check to see that the flipbook pages are clean.
- ❑ Store the flipbook pages in the small containers.
- ❑ Collect the dry erase markers and recap if needed.
- ❑ Check to see that all of the binder clips are put back into the small container.
- ❑ Collect any other materials that were used.
- ❑ Store the activity in designated place.

Explanation

History of the flipbook

One of the most enduring of animation toys, the flipbook, first showed up in history in 1868 through John Barnes Linnett's patent for a "kineograph" (meaning "moving picture"). The flipbook was a big step towards modern animation since, unlike its predecessors the zoetrope and phenakistoscope, it employed a linear rather than a circular sequence of images. Flipbooks have been used throughout history as novelty toys for children and as a tool for advertising. In 1894, W.K.L. Dickson and Herman Casler invented a mechanized version of the flipbook, called the mutoscope, patented by Casler. Instead of being bound in a book, the pages of the mutoscope were attached to a cylinder which could be rotated by a handle or crank. Mutoscopes were a common sight in penny arcades and carnivals until the mid-20th century.

Why does a flipbook work?

A flipbook, like all other types of animation, is made from a series of images, each one slightly different than the one before. When these images are flashed, or "flipped," in front of our eyes, objects in the images appear to move. The illusion of motion in movies and flipbooks used to be attributed to the "persistence of vision" theory. This explanation has since been disproved. Today, scientists call this phenomenon "apparent motion" because it appears to us that the objects are really moving, even though we know that they are not. Why does it work? Certain cells in our brain are specially designed to detect motion. These cells "analyze" the information coming from our eyes and look for patterns that indicate moving objects. Scientists have recently discovered that when we watch a film or animation, the same brain cells that detect real motion are activated. In other words, to our brains, there is no difference between real motion and the "apparent" motion in a cartoon or movie.

The Process of Animation

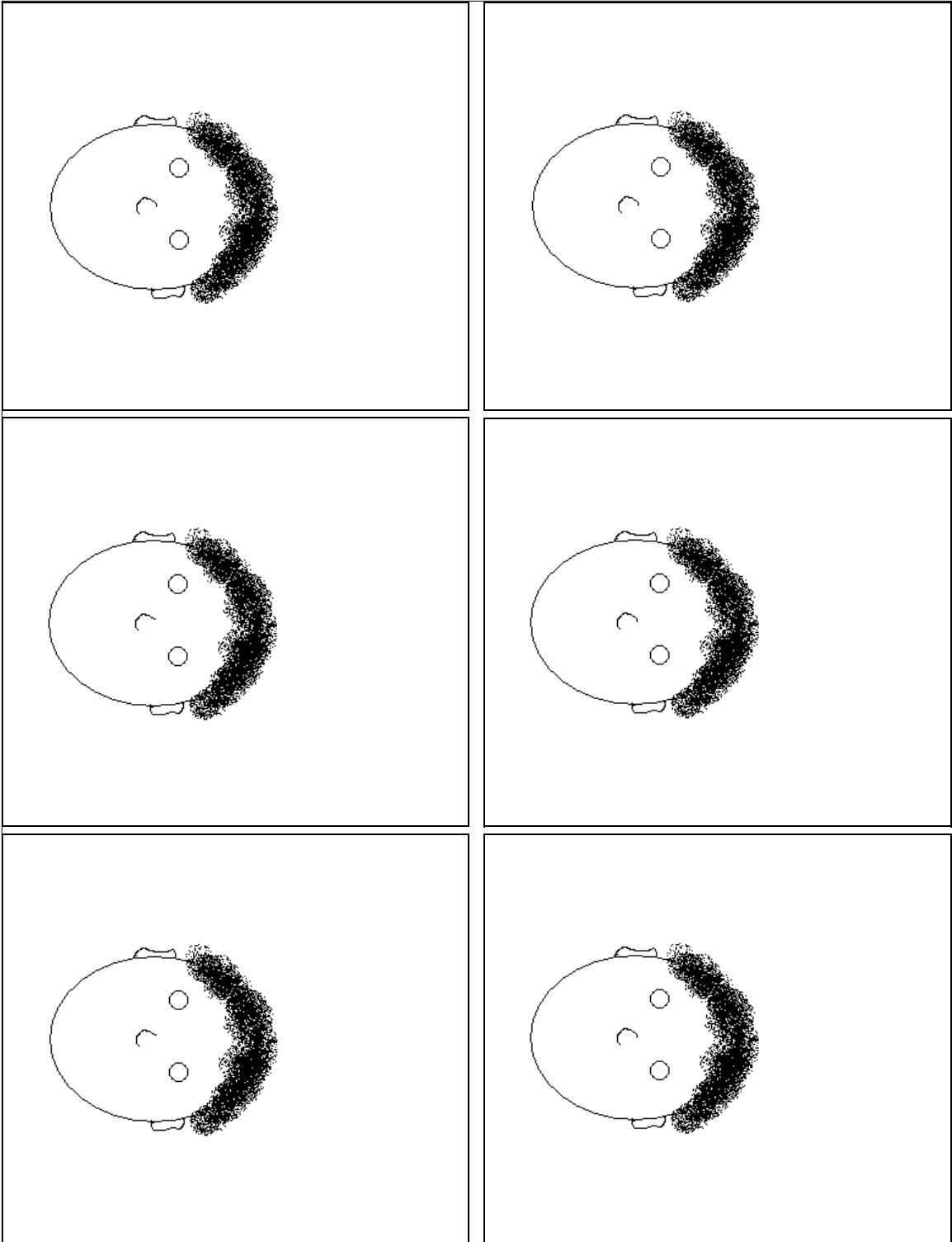
Professional animators use many of the same steps used to make a flipbook when they make a cartoon. Before the animators begin drawing, they make a storyboard, which is sort of like a large comic strip, to show all of the important scenes and actions in the film. The storyboard is like a flipbook where all the pages have been laid out separately on a wall. When animators are drawing, a key animator usually starts by drawing all the important frames in a cartoon. Later, an in-betweener draws the frames in-between the key frames. Throughout the animation process, professional animators will check their animations by

flipping through the drawings as if they were a flipbook, or by filming the rough drawings and synchronizing them to the soundtrack.

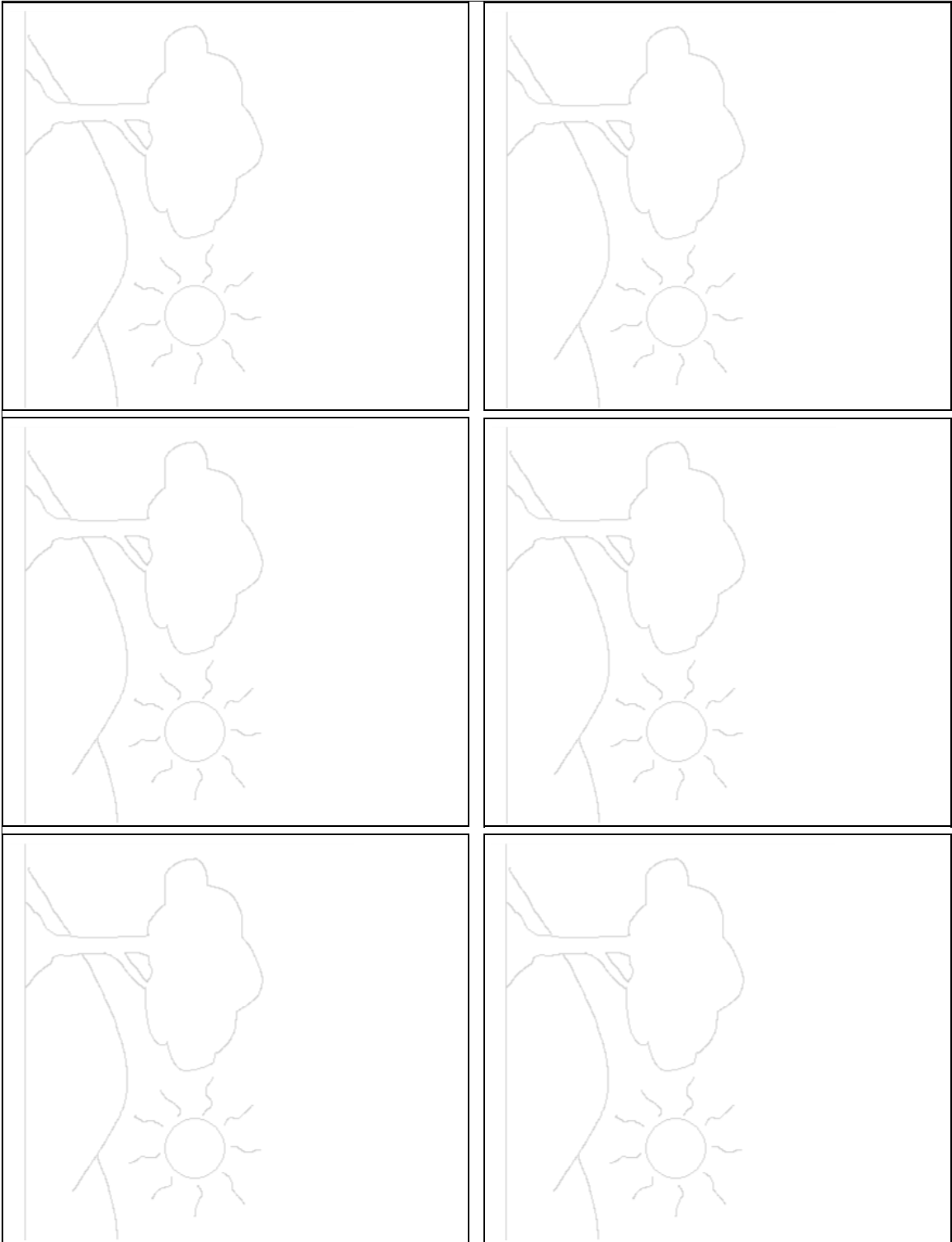
Optional Extensions

- ❑ Using craft trays or lunch trays will give visitors their own “designated area” to create their flipbook.
- ❑ Store activity materials in a large container, clearly labeled for easy access.
- ❑ Contact paper can be used if a laminator is unavailable. Please note that EXPO Low Odor Dry Erase Markers are suggested for both laminate and contact paper. Different brands can be difficult to erase.
- ❑ Have blank regular paper squares so interested visitors can make a flipbook to take home.
- ❑ Show visitors pieces of actual film from movies to illustrate 24 frames per second.
- ❑ Show visitors a phenakistoscope.
<https://publicdomainreview.org/collections/phenakistoscopes-1833/>
Image discs in the public domain that you can download are on Wikimedia Commons. https://commons.wikimedia.org/wiki/Main_Page

Master A



Master B



Master C

ANIMATIONLAND

Make Your Own Thaumatrope

Visitors design and assemble a pre-animation toy and discover how it works.

Science Topics

Design

Process Skills

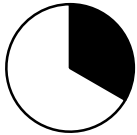
Visualizing
Testing
Following Instructions

Grade Levels

3-8

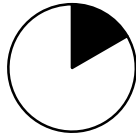
Time Required

Advance Preparation



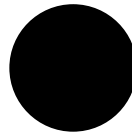
20 minutes

Set Up



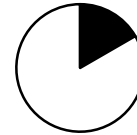
10 minutes

Activity



60 minutes

Clean Up



10 minutes

Supplies Needed

- Thaumatrope templates (see masters A, B, and C)
- White cardstock
- 2 single-hole punchers
- Rubber bands
- 4 small containers, e.g., sandwich bags
- Child-safe scissors
- Washable markers or crayons

Advance Preparation

- ❑ Make single sided copies of Master A on white cardstock. Repeat steps for Master B and C (*Note: Template C is used to make all three designs of thaumatropes. More than double will be needed for C versus A and B.*).
- ❑ Cut copies of Master A into squares along the dotted lines. Repeat steps for Master B and C.
- ❑ Punch holes with the single hole punch where indicated on Master A copies. Repeat steps for copies of Master B and C (*Note: This step can be done at the table with the visitor if desired*).
- ❑ Store cut and hole punched copies of Master A in a small container. Repeat steps for Master B and C.

Set Up

- ❑ Organize thaumatrope squares into three piles (A, B and C) and place in activity area.
- ❑ Place crayons or washable markers in activity area.
- ❑ Place small container of rubber bands in activity area.
- ❑ Place single-hole punchers in activity area.
- ❑ Place a variety of pre-made effective examples in activity area.

Introducing the Activity

- ❑ Welcome! Have you ever heard of a thaumatrope?
- ❑ The thaumatrope is a toy that was invented in 1826—almost 200 years ago!
- ❑ It was also used by scientists of the time who were trying to understand how our eyes and brain work.
- ❑ Would you like to make one?

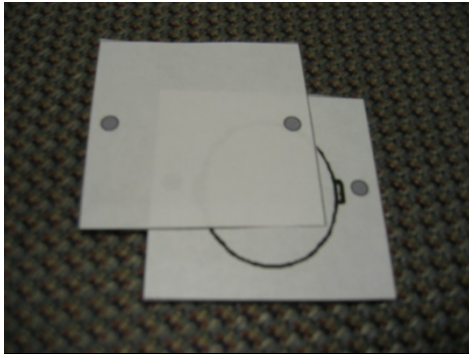
Activity

Creating the Thaumatrope:

- ❑ The secret of the thaumatrope is to create two pictures that, when you spin them, will combine to form one image.
- ❑ Show visitors some examples of pre-made thaumatropes.

- What type of picture do you want to create? (Visitors can make up their own design or use the face or tree template)

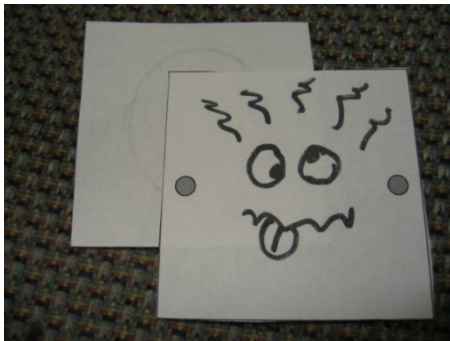
How to build a thaumatrope using the face template:



STEP 1: Lay the blank square on top of the face template square and line up the holes.



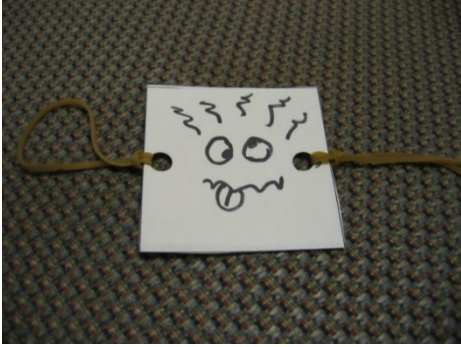
STEP 2: Using the outline of the face on the bottom square as a guide, draw the eyes, nose, mouth, hair, and any other features you want on the blank square. **You don't need to trace the outline of the face.**



STEP 3: Turn the face template square over so that the drawings are back to back, with both pictures visible. Turn one picture upside down, so that when the thaumatrope is spun, both pictures will appear right side up.



STEP 4: When done drawing, make sure again that the two squares are lined up, and then punch two holes through the gray circles.



STEP 5: Tie the two squares together by slip knotting a rubber band through each punched hole.

This same process can be used to build thaumatropes with the tree template or with two blank templates, where the visitors make up their own design.

Using the thaumatrope

- Hold rubber bands between thumb and index finger.
- Twist rubber bands by rubbing between the thumb and index finger. The thaumatrope will begin to spin. You can vary the speed of the spin by increasing the twisting of the rubber band between the fingers. It may take a little practice to spin it fast enough.

Clean Up

- Collect all the unused squares and organize them.
- Recycle leftover thaumatropes.
- Return all materials to the activity box.

Explanation

History of the Thaumatrope

The earliest forms of animation were optical toys or animation toys. The first of these was the thaumatrope, introduced in 1826. Examples of common thaumatrope pictures include a bare tree on one side of the disk, with its leaves on the other, or a bird on one side and a cage on the other. They often also included riddles or short poems, with one line on each side. The invention of the thaumatrope is usually credited to John Ayrton Paris, an English doctor.

Why does a thaumatrope work?

Early scholars were interested in the thaumatrope because they thought that it helped to explain the illusion of motion in an animation or motion picture. According to the “persistence

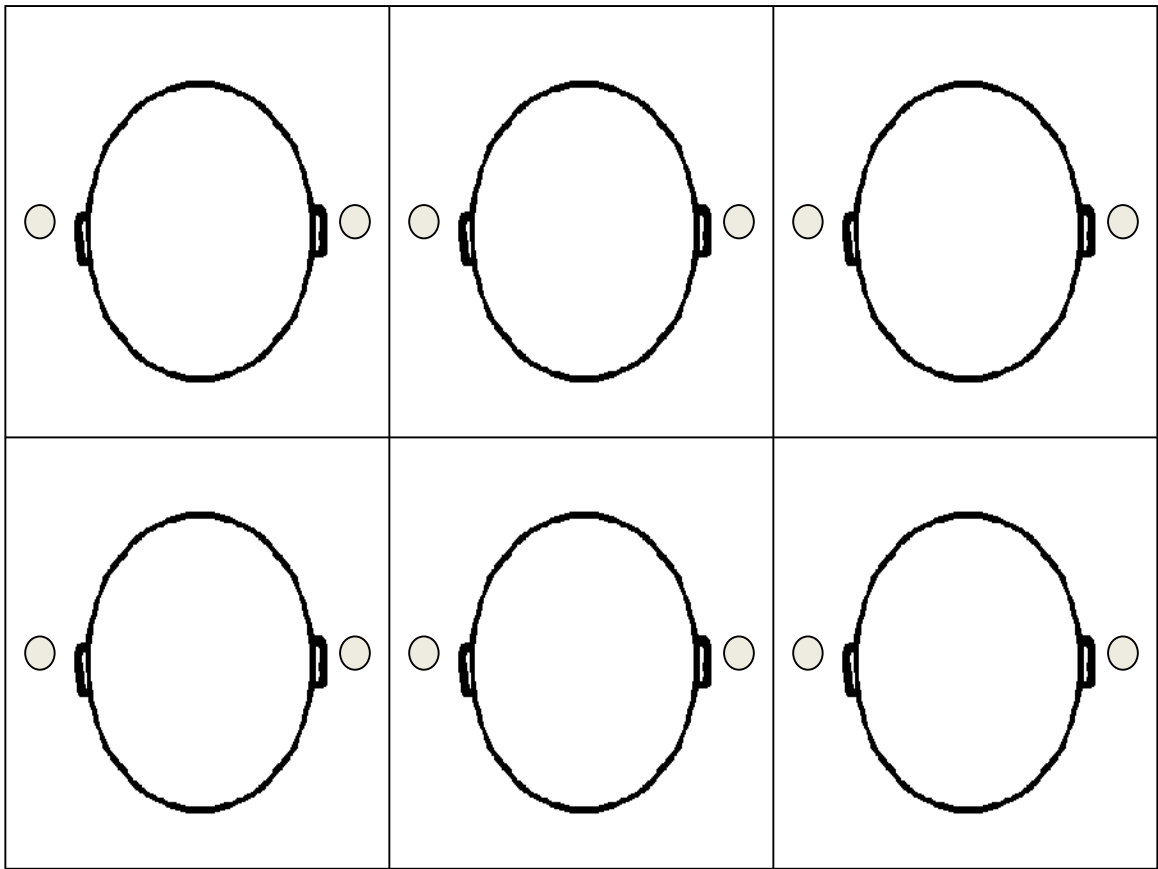
of vision” theory, developed in 1833, the human eye blends a series of rapidly moving images into a single moving image. Scientists of the 19th century believed that this occurred because of the eye’s tendency to retain images on the retina briefly after they are viewed.

As it turns out, the theory was completely wrong in its explanation of motion pictures, but it did help partially to explain the thaumatrope illusion. Images do not “persist” on our retina, but we do see an “after-image.” In fact, when a bright image is flashed in front of our eyes, we actually see a succession of after-images. These after-images are responsible for such illusions as the lines and shapes we see when we wave a burning stick in the air at night, the multiple hands we see if we move our arm quickly in front of our face, and the blended images we see when we twirl a thaumatrope. So, although the thaumatrope helped spur on the research and innovation that eventually led to animation and motion pictures, it actually had very little to do with these two technologies.

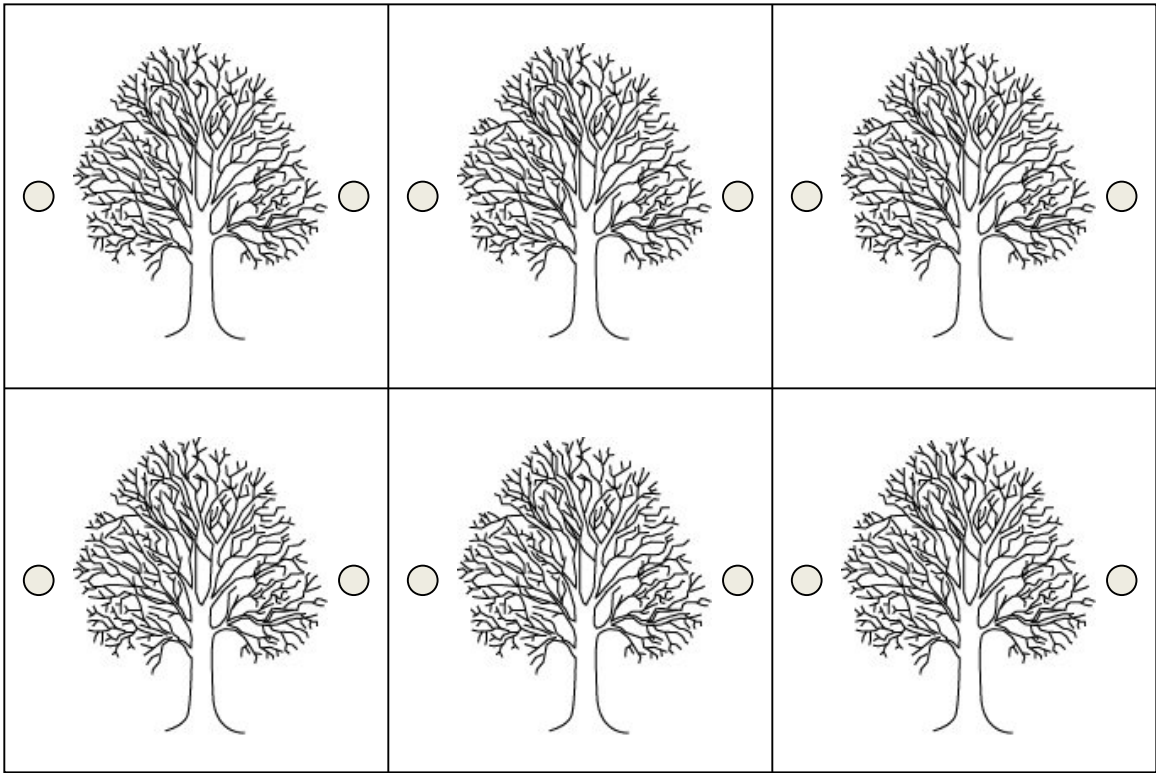
Optional Extensions

- ❑ Using craft trays or lunch trays will give visitors their own “designated area” to create their thaumatrope.
- ❑ Store activity materials in a large container, clearly labeled for easy access.
- ❑ Reduce paper use by laminating cut and hole-punched copies of Master C. Visitors can then use dry erase markers to design a reusable thaumatrope.













Master A



Master B



Master C

ANIMATIONLAND

Create Your Own Foley Sound Effects

Visitors create different Foley sounds and learn about the history of sound effects in animation and motion pictures.

Science Topics

Processes

Process Skills

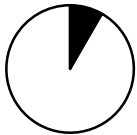
Assessing
Testing

Grade Levels

1-8

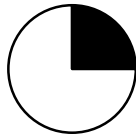
Time Required

Advance Preparation



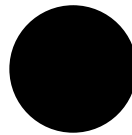
5 minutes

Set Up



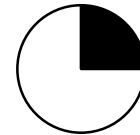
15 minutes

Activity



60 minutes

Clean Up



15 minutes

Supplies Needed

- “Create Your Own Foley Sound Effects” Activity Table Sign (see Master C)
- 2 small hand brooms
- 2 oven liners
- 2 coconut shell halves
- 2 pieces of cellophane
- 1 pair of gloves
- 16 oz. box corn starch
- Wooden container (recommended size: 10”x20”)
- 10 cups various sizes of rocks
- 2 cups assorted birdseed mix

- ❑ 1 bag 7- bean mix
- ❑ 3 cups cat litter
- ❑ 4 yogurt containers, 8 oz. size
- ❑ 4 large plastic mixing spoons
- ❑ 13 cup tin can (coffee can) with lid
- ❑ 4 small balls (golf or ping-pong sized)
- ❑ 1/4" audio tape
- ❑ 1 roll aluminum foil
- ❑ Optional: Flubber (See Master A)
- ❑ Optional: Additional open-ended sound effects (See Master B)

Advance Preparation

- ❑ Ensure all materials are present and functioning properly
- ❑ Replace any nonfunctioning or overused materials

Set Up

- ❑ Set-up activity table sign
- ❑ Display 5-10 Foley sound props (cellophane, coconut shells, oven liners, small brooms, rock box, gloves, etc.), in activity area. Make sure to be familiar with each item's "sound description" prior to setup. (See Master B)

Introducing the Activity

Goals:

- ❑ Visitors try out different commonly used *Foley sound effects*.
- ❑ Visitors explore how everyday objects create sounds intended to portray or exaggerate the actions in animation.
- ❑ Visitors understand the history of animation sound effects.
- ❑ Visitors invent their own sound effects using everyday objects.

Introducing the activity:

- ❑ Welcome! Have you ever heard of Foley effects?
- ❑ Foley effects are the sound effects used in animation such as footsteps, glass shattering, or wings flapping. These effects are added to make the animation sound more realistic.

- ❑ All of these sounds are created by **Foley artists** using everyday objects, like the ones we have here (gesture toward the commonly used Foley effects).
- ❑ Would you like to try?

Activity

Creating the Foley Effects:

- ❑ Encourage visitors to explore examples of commonly used Foley effects.
- ❑ Pick up an object and demonstrate the sound it produces (See Master B)
- ❑ What do you think this sound is used for?
Before revealing the answer, have visitors brainstorm some ideas. If they're struggling with the answer, try repeating the sound while they close their eyes.
- ❑ Next, encourage visitors to create their own Foley effects using the props provided (See Master C).
- ❑ How many different sounds can you make? Can you think of how these sounds might be used in animation? (*Great time to suggest the Be a Foley Artist exhibit*)

Explanation

What are Foley effects?

Foley effects are the sound effects added to a film or animation after completion. They are responsible for every sound we hear in a film besides the character voices.

Who creates these effects?

Foley artists create these effects by matching live sound effects with the action of the animation.

History of Foley Effects

Sound effects have been used since the 1920s to enhance radio, but it wasn't until Jack Foley burst onto the scene that sound effects were fully recognized and utilized in films. Jack Foley is accredited with inventing the "art of Foley" in the 1930s. In his 30 years at Universal Studios, Jack took sound effects to new levels. His revolutionary technique, using everyday objects to create sounds in prerecorded films, was both cheap and practical. While pre-Foley sound effects were often drowned out by character voices, Jack's technique enabled the motion pictures to sound and feel more realistic. Since his death in 1967, other Foley artists have followed in the footsteps of their profession's founder. Today, every audible film and animation available utilizes Foley effects to improve its quality.

Websites:

<http://www.marblehead.net/foley/>

<http://www.filmsound.org/foley/reel-sound.htm>

<http://www.filmsound.org/foley/>

<http://www.exploratorium.edu/bts/>

Optional Extensions

- ❑ Once the visitor has mastered creating sound effects, encourage them to develop a “sound scene”...one that you can hear but not see! (For instance, rain mixed with footsteps on gravel, followed by a bird flying, and finishing with roaring thunder—is an **instant storm scene.**)
- ❑ Captivate visitors by questioning, “What will your ‘sound scene’ be like? Will it be a comedy, a drama, or a horror scene? How would the sound effects be different for each?”
- ❑ Have available large pieces of paper and a few pencils or markers in order to get visitors involved in writing down their sound effect ideas or sound scene ideas.
- ❑ With a small group of visitors, try playing “Name That Foley Effect.” First, give each visitor/contestant a piece of paper and a pencil or pen. Next, have them close their eyes while you create a common Foley sound effect using one of the props. Finally, have them open their eyes and silently write down what they think the effect is most often used for in animation. Repeat this process with as many sound effects as you like. Once you’re finished, reveal the answers and compare results. Whoever has the most correct answers wins! For an additional twist to the game, the winner could be the one who comes up with the most ideas about what the sound could be used for.
- ❑ Add more open-ended sound props to promote dynamic sound scenes. Other suggested props include a musical triangle, wooden blocks, whistles, newspaper, cheese grater, baby rattle, water soaked hinge, empty aerosol can, spray bottle, watering can, balloons, kitchen utensils, kazoos, frozen lettuce, celery, fabric, cardboard tubes, sandpaper, and rubber bands.

Master A

Flubber Recipe:

Bowl #1—Large Container

1-1/2 cups very warm water

2 cups Elmers white glue or all-purpose washable clear glue*

A few drops of food coloring and/or glitter if using clear glue

Mix this combination thoroughly.

AND

Bowl #2—Small Container

1-1/3 cups very warm water

2 level tsp. 20 Mule Team Borax

Mix this combination thoroughly.

Directions

- Use your hands to mix the contents of Bowl #2 into Bowl #1.
- Lift and turn the mixture until it is fully blended. Discard any leftover liquid.
- If kept in an airtight container, the Flubber will keep for up to two weeks.
- Keep the Flubber away from your carpet and hair, as it will stick! Use white vinegar as a solvent.
- This recipe makes enough Flubber for six children.

*Available by the gallon at Discount School Supply: (800) 627-2829 or www.earlychildhood.com

Master B

Common Foley Sounds

OBJECT	PRODUCING THE SOUND	USE IN ANIMATION
Hand Brooms	Hold broom at handle and swish the broom up and down as if swatting a fly with a fly swatter.	Wind, bird wings flapping
Oven liner	Hold up with hands on either side and shake gently.	Thunder, loud crash
Coconut Shells	Hold half-shells in either hand. Gently hit the shells front-to-back onto a flat surface, one after the other.	Horse hooves
Cellophane	Gently crinkle cellophane with your hands so that it makes a light crackling sound.	Leaves blowing in the wind, footsteps on leaves, crackling fire
Gloves	Take gloves by the opening and flap them together as if pretending to clap with them.	Bird wing flaps
Corn Starch	Squeeze the box until you hear a crunching sound.	Snow crunching
Rocks, Cat litter, Birdseed	Cover the bottom of the wooden box with each item. Use a flat-bottomed object (plastic cup) to crunch onto each surface.	Footsteps
Flubber	Put Flubber in a yogurt container and push down on it using a mixing spoon.	Wet squishy sounds



Create Your Own Foley Effects!

Idea 1

Recreate Foley sound effects.

Idea 2

Make your own sound effects.

Idea 3

Create a sound scene.

Appendix C

Classroom Activities

ANIMATIONLAND

Seeing Spots—The Illusion of Color

Students observe cartoons through a magnifying lens to discover the illusion of many colors is made from tiny dots of only four colors.

Science Topics

Light and color
Color theory
Perception
Technology

Process Skills

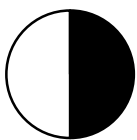
Classifying
Collecting data
Comparing/
Contrasting
Hypothesizing
Investigating
Observing

Grade levels

K-4

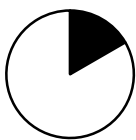
Time Required

Advance Preparation



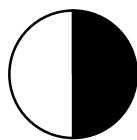
30 minutes

Set Up



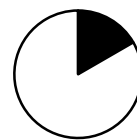
10 minutes

Activity



30 minutes

Clean Up



10 minutes

Supplies Needed

- ❑ 1 or 2 large coffee filters
- ❑ Several plastic eyedroppers (or straws)
- ❑ Watercolors—suggested colors are magenta, yellow, and cyan (magenta is a bright pink and cyan is a light blue)

- ❑ Water
- ❑ Jar or cup for water
- ❑ Small containers for paint, e.g., lids or yogurt cups, 3–5 for the teacher plus 3 for each table group. Note: If you use Bingo paint daubers, you will not need paint containers for the groups.
- ❑ Marker
- ❑ Masking tape
- ❑ Hand magnifying glasses (at least 8x magnification), 1 per student
- ❑ Cutout color newspaper cartoons (or color magazine photos) for each student
- ❑ Cotton swabs with tempera paint (suggested colors are magenta, yellow, and cyan) or Bingo paint daubers with tempera paints— enough for each group of 3–4 students to have one set
- ❑ Optional: TV or computer screen
- ❑ Optional: microscopes of 10x power or more

Advance Preparation

- ❑ Week before activity: Ask students to find a color cartoon (from a newspaper, magazine, or printed from the internet), cut it out, and bring it to class.
- ❑ Gather the following materials:
 - Set of 3 colors of bingo paint daubers or cotton swabs and 3 colors of tempera paints in small containers **for each group of students**
 - Hand magnifying lens (can be shared if there are not enough for each student)
 - Large piece of white construction paper **for each student**
 - Markers (one for each group)
 - Masking tape

Set Up

- ❑ Set out the following for color mixing demonstration:
 - Watercolor paints
 - 3–5 paint containers (portion cups, jar lids, etc.)
 - 3–5 eyedroppers or straws
 - Water in a jar or cup
 - Paint brush
 - Coffee filter
 - Marker
 - Masking tape

Introducing the Activity

Explain to students that they are going to talk about colors and how animators use colors when they make a cartoon. Ask the students the following questions in **bold**. Possible student answers are in *italics*. After the discussion, begin the color mixing demonstration below.

- **What are some names of different colors?**
- **What colors do you see in cartoons or TV shows?**
- **What types of colors do you use when you draw?**

Let students speculate before offering answers to any questions. The answers at the right are provided primarily for the teacher's benefit.

Students will name many different colors.

What happens when you mix colors?

You get new colors, the colors change, the colors get darker, etc.

Are there different ways to mix colors?

This question may be hard for students. Encourage the class to think of different times that you would mix colors, such as while using crayons or paints, with different colored lights, or dyeing your hair different colors.

Color Mixing Demonstration:

Gather students where they can watch your demonstration.

This activity is an exciting way to remind students of how colors mix to form new colors. Magenta, cyan, and yellow are suggested because these are the colors used by most printers (including the ones that print the newspaper comic strips).

1. Explain that scientists always label their work so they don't mix things up or forget what they are doing.
2. Using a marker and masking tape, model the labeling process for your students. Label three small containers as follows: M for magenta, C for cyan, and Y for yellow (alternatively label them R, B, and Y for red, blue, and yellow).
3. Put a few drops of water in each of three small containers.
4. Using a paintbrush, mix magenta watercolor paint into the water in the container labeled "M" (substitute red if magenta is not available). Continue until the water is dark magenta.
5. Repeat step 4 for yellow and then for cyan (or blue).
6. Using eyedroppers or straws, put small dabs of watercolor on the coffee filter. Watch the colors mix as the different paint splotches expand and bleed into each other. Ask the students to predict which new colors will form.
7. As a class, make a color-mixing chart (see below for an example). Encourage students to be descriptive. For example, depending on the type of paints and how much was used, mixing magenta and yellow might create a "light orange," "sunset red," or a "pinkish yellow." Include room for student observations. Did it make a difference how much of each color was used? What happened when three or four colors were mixed together?

Sample Color Chart:

	Magenta	Cyan	Yellow
Magenta	<i>Really bright magenta</i>	<i>Reddish purple</i>	<i>Pinkish orange</i>
Cyan		<i>Dark cyan</i>	<i>Ocean green</i>
Yellow			<i>Bright yellow</i>

Let students know that we do not always have to mix colors to create new colors because the brain can do this for us. Printers use dots to create colors in magazines, books, and newspapers. We can see these dots by looking at printed pictures with a magnifying glass or a microscope. A TV also uses tiny dots of three different colors to make all the colors that we see on the screen.

Activity

Part 1

Using magnifying glasses to look at comic strips, students can discover how color printers work.

1. Review with the class how to use their magnifying glasses.
2. Ask students to use their magnifying glasses to study their comic strips. What do they notice? Are the pictures made up of solid colors or are they composed of tiny dots? What colors are the dots?
3. Optional: While some students are examining their comic strips, other students may use their magnifying glasses to look at a TV or computer screen. If the teacher has a microscope, students can also look at their comic strips under higher magnification. NOTE: Despite a commonly held belief, it is not dangerous to look at a TV or computer screen up close for short periods of time.

Part 2

Students create pictures by using dots of color, just like a printer or a TV.

1. Give each student a piece of white construction paper.
2. For each group, pass out a set of Bingo paint daubers or a set of cotton swabs and three containers of tempera paint (3 colors).
3. Ask the students to create a picture using dots of colors. Encourage them to keep the dots separate. Can they make new colors by putting dots of different colors next to each other?
4. After the students have finished their pictures, post them on the wall. Do their pictures look different when viewed from far away?

Class Discussion

Part 1

Ask students what they have discovered about their comic strips.

What were some of the colors you saw in your comic strips without using the magnifying glasses?

The students will name many colors. Almost any color can be shown in a comic strip, even when the printer only uses dots of three different colors.

What did you find out about the comic strips by using the magnifying glasses? Were your comic strips made of solid colors or tiny dots?

Comic strips are printed using tiny dots of only three colors (magenta, cyan, and yellow) as well as black dots.

Were any of the tiny dots the same as the colors you saw without the magnifying glasses?

Answers will vary.

Ask for student observations. There is no correct answer. Let students guide the discussion and present their hypotheses before

Part 2

Is using dots of color different than using a paintbrush? Why?

Students may say that it was easier or harder, that they could create different textures, designs, types of pictures, etc.

What colors did you use? Did you make any new colors by combining different colored dots? What new colors did you make?

Students may name many colors. If students say that they could not make any new colors, suggest that they look at their pictures from far away.

Did the dots appear to blend together when you looked at your picture up close? How about when you looked at it from far away?

Although the paint dauber (or cotton swab) dots are large, students may notice that they blend together only when they look at the picture from far away.

Why do you think printers and TVs use dots of only a few colors?

It would be very expensive to make a printer with many different colors of ink or to make a TV screen that could produce many colors of light. Using dots of only a few colors (and letting our brains do all the work of mixing the colors) is one way to save money.

Explanation

Printers use many dots to make color pictures. It would be very expensive to have a different color of ink for every color you wanted to print. To save money, printers use small dots of only

a few colors. Most printers use magenta, yellow, cyan, and black because these four colors can be combined to produce most other colors.

Our brain actually combines the small dots of colors into a single new color. There are four different kinds of cells in the retina of the eye that are sensitive to different colors. Rods are one kind of cell that is very sensitive to dim light. Cones are color-sensing cells because there are three kinds of cells, each sensitive to different colors. One kind of cone is especially sensitive to blue light, one to red light, and one is most sensitive to a greenish-yellow. Each of these cells sends information into the brain, which combines it into our experience of color.

When we watch a cartoon on television, we see thousands of different colors. Our TV screen, however, is made up of tiny dots of only three different colors—red, green, and blue. Our brain combines these dots of color to make the many different colors we see.

Optional Extensions

- Mixing different colors of light is different than mixing different colors of paint or ink. Students can study how light mixes by using several flashlights, each with a different color of plastic covering the front end. The basic colors of light used in a TV screen are blue, green, and red. These colors can be mixed to form most other colors.

Cross-curricular Connections

ART	Study the use of color and dots of color in art, e.g., pointillism.
MATH	Make a chart of how colors mix and look for patterns.
BIOLOGY	Learn about how the human eye perceives color and draw a model of the human eye.

ANIMATIONLAND

Fooling the Brain—The Illusion of Motion

This activity introduces one of the important optical illusions that make animation possible.

Science Topics

The brain
The eye
Perception
Motion
Technology

Process Skills

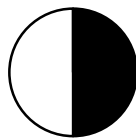
Following instructions
Observing
Analyzing

Grade Levels

5–8

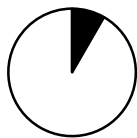
Time Required

Advance Preparation



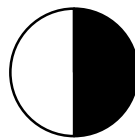
30 minutes

Set Up



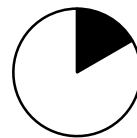
5 minutes

Activity



30 minutes

Clean Up



10 minutes

Supplies Needed

- Spiral disk template, 1 per student (see master)
- Compact discs (CDs), 1 per student
- One knife or scissors
- Highlighter markers, 1 per student
- Tape, 1 roll per group
- Brightly colored ball or other noticeable object, 1 for pre-activity

Advance Preparation

- ❑ Make copies of the spiral disk template (Master A) on cardstock.
- ❑ Make a hole in the center of each spiral disk the size of the hole in the CD. It should be large enough to fit the tip of the marker through, but small enough so the whole marker does not fit. The disk will spin on the marker.

Introducing the Activity

An optical illusion is anything that tricks our eye and brain into seeing something other than what's there. TV and film animations are made from a series of many pictures, each picture a little different from the previous one. If the pictures are shown fast enough, the brain connects the movement together and we see an animated picture, or moving image.

Explain to students that they are going to be studying how animation is created and why it works. Suggest to students that when we watch an animation, we are actually seeing an optical illusion. Then ask the students the following questions in **bold**. Possible student answers are shown in *italics*.

What types of animations have you seen before? What are your favorite cartoons?

Students will give examples.

What is an optical illusion? Are cartoons an optical illusion?

An optical illusion is something that tricks your brain or eye. Students may give examples of optical illusions. Students can discuss their initial ideas about why cartoons are or are not optical illusions.

Explain the following, or, if students have demonstrated good background knowledge, summarize 'what we know' with the following:

- Animators draw pictures to create animation.
- Animators draw many pictures, each one slightly different from the one before.
- Animators use computers or puppets or clay characters to create different types of animation.
- Animators take pictures and put them on film to create animation.
- Scientists study why our brains are tricked by optical illusions and why the illusion of motion in animation works.
- Scientists can use optical illusion to study how the brain and eye work.

Let students speculate before offering answers to any questions. The answers at the right are provided primarily for the teacher's benefit.

In the activity we will experiment with an optical illusion to find out something about how the brain works.

Background information about the brain:

1. Scientists generally have background knowledge before conducting an experiment. Scientists apply ‘what they know’ to their observations in the real world. Ask students, “What do you know about the brain?”
2. Summarize what we know:
 - The eye is a sensor that picks up light bouncing off objects around us.
 - The brain “decodes” information picked up by the eye so that we can perceive our world.
 - Some parts of the brain look at color, some look at shape, some at depth, and some at motion, etc.

Demonstration:

Divide the class into two groups. Each group represents a specific part of the brain:

- Brain Group #1 can only ‘see’ objects moving up.
- Brain Group #2 can only ‘see’ objects moving down.

Explain that these jobs are similar to the jobs performed by different sections of the brain. Students now represent specific nerve cells in the brain designed to detect either upwards or downwards motion information coming from the eye.

Use a brightly colored ball or other noticeable object. Explain that when the class sees the object move up, Brain Group #1 should shout “UP” continuously until it stops moving up. When the class sees the object move down, the Brain Group #2 should shout “down” continuously until the object stops moving down. Move the object up and down and have the class practice. This is a simple version of how the brain sees motion!

The part of the brain that detects motion is active even when there is no motion, but the brain signals are “loudest” when motion is present. To demonstrate this, have Brain Group #1 whisper “up” whenever the object is not moving up, but shout “up” when the object is moving upward. For example, when Brain Group #1 sees the object moving up, they shout “up, up, up” continuously. When the object is not moving or is moving in a direction other than up, the group should whisper “up, up, up”. Group #2 does the same, but with the word ‘down’ in response to downward movement. Move the object up and down and have the class practice.

This is a more realistic version of how the brain sees motion. The brain can tell the difference between the “shout” and the “whisper” and can figure out which direction an object is moving. Notice that when an object is standing still, both groups are still whispering. The double whispering is interpreted by the brain as meaning an object is standing still.

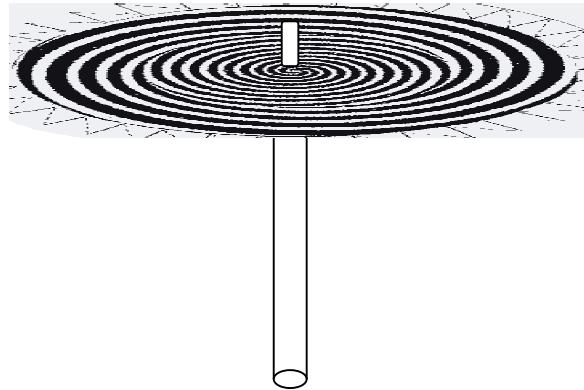
Activity

Students work in groups of two.

Some optical illusions trick our brains into seeing motion when nothing is actually moving. These illusions are useful because they can help scientists understand how we perceive motion. We will use the “waterfall illusion” to test how the brain sees motion.

1. Building the waterfall illusion:

- Cut out the spiral disk template
- Use tape to attach the CD to the back of the spiral illusion disk. Make sure that the CD is in the center of the spiral illusion.
- Take the cap off the highlighter.
- Put the disk on the highlighter so it can spin freely.



Waterfall Illusion

2. Using the Spiral Illusion

- Each student takes turns spinning the waterfall illusion and staring at the spiral.
- One student spins the disk with one hand while holding onto the pen with the other hand.
- Students should try to spin the spiral at a constant rate.
- The other student stares at the center of the spiral while trying not to blink or look away.
- After 30 seconds of staring at the spiral, the students should turn and look at something stationary nearby such as a picture on their desk or their hand held up in front of them. What do the students see?
- Have the partners in each group switch roles and repeat the steps above.

Class Discussion

Review with the students the model of the brain that you introduced at the beginning of the lesson. Do they remember how the brain processed motion? Next, ask the students to talk about their observations and findings during the experiment.

What did you observe while staring at the spiral?

Different people will see different things when watching the spiral. Some students may see strange line patterns of color patterns. Others may only see the black and white spiral.

What happened after you stared at the disk?

For most people, after staring at the spiral, objects will appear to move in the opposite direction that the spiral was moving. If the spiral appeared to be twisting outward, objects will momentarily twist inward and vice versa.

What variables affected how you saw the optical illusion, e.g., direction, speed, or time?

Direction and speed can change the direction and the magnitude of the optical illusion. Time can also change the persistence of the illusion.

Ask for student observations. There is no correct answer. Let students guide the discussion and present their hypotheses before discussing

Does this optical illusion make sense with our model of how the brain sees motion? Can you make a hypothesis for why this optical illusion works (see post-activity below)?

Have students discuss possible explanations of their own before offering the post- activity explanation.

Optional post-activity:

Let students discuss whether their experimental findings fit the model of the brain presented earlier. Then explain that scientists have an idea of why this illusion may work. To demonstrate this idea, lead the class through the following activity:

1. Remind class of the pre-activity and practice a few times.
2. Tell the class that the brain listens to the motion-sensitive brain cells to determine what direction objects are moving. When, for example, the left group “shouts” and the right group “whispers,” the brain knows that the object is moving left. When both groups are whispering, the brain cancels both signals out and decides that the object is standing still.
3. Ask the students what they think would happen if some of the brain cells were “quiet.” Would the brain be confused?
4. Explain that the class, acting as the brain, has just been staring at the waterfall illusion and that the spiral has been spinning to the right. The effect of this is that one group, the “right” group, has become very tired and no longer “whispers” or “shouts” no matter what direction objects are moving. Now move the object to the left and right and have the class practice with these new directions. Only the “left” group should be making any noise. What happens when the object is standing still? Without the right group whispering, the brain only hears the “whispers” of the left group and perceives that the object is moving to the left. This is the optical illusion! In the case of the spiral illusion, there are actually different cells that detect motion in a spiral direction. Try the same experiment, but with the “left” group silent this time.

Discuss how this optical illusion relates to the illusion of motion seen in a movie or in an animated cartoon (see below for explanation).

Explanation

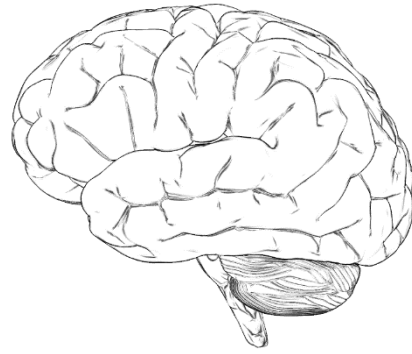
How do we see?

Seeing is a complex process, in which our eyes are only the first step. Our eyes are sensors that detect light and create nerve signals. The nerve signal passes to the back of the brain to an area called the primary visual cortex, which begins to make sense of what our eyes have seen.

Different nerve areas specialize in recognizing lines and shapes, processing movement, discerning color, combining information from both eyes, etc. In this activity, it was the motion-sensitive nerve cells that were being activated. As the image is processed, more complex functions begin, such as recognizing objects and faces. All this activity goes on without any conscious effort!

Why Does Animation Work?

TV and film animations are made from a series of many pictures, each a little different from the previous one. If the pictures are shown fast enough, the brain connects the movement together and we see an animated picture, or moving image.



The images must be viewed fast enough for the illusion to work. Through the years, filmmakers and animators found that, at 24 frames per second or greater, the moving image appeared to flow smoothly with no interruptions. Modern motion pictures show 24 frames per second and TV shows 30 frames per second.

In 1833, French scientist Joseph Plateau came up with a theory called persistence of vision to explain why the human eye blends a series of rapidly moving images with regular interruptions into a single moving image. According to the theory, the eye retains images on the retina briefly after they are viewed, allowing for different images in a series to blend together into a single moving picture. This theory remained the prevalent explanation of the phenomenon for the rest of the 19th century.

At the beginning of the 20th century, however, scientists found that although the human eye does briefly retain images, this effect could not create motion. If the images were retained long enough for persistence of vision to work, we would actually end up seeing images stacked one on top of the other rather than a blended moving image. Scientists realized that animation works because of the brain rather than the eyes, and because of an illusion called apparent motion. The human brain is wired to see motion, sometimes even where no motion exists. When we watch a film of an object moving, the same cells that detect real motion are activated. In other words, our brain cannot and does not distinguish between illusory motion and real motion. To the visual system, the movement in a motion picture is real motion!

Optional Extensions

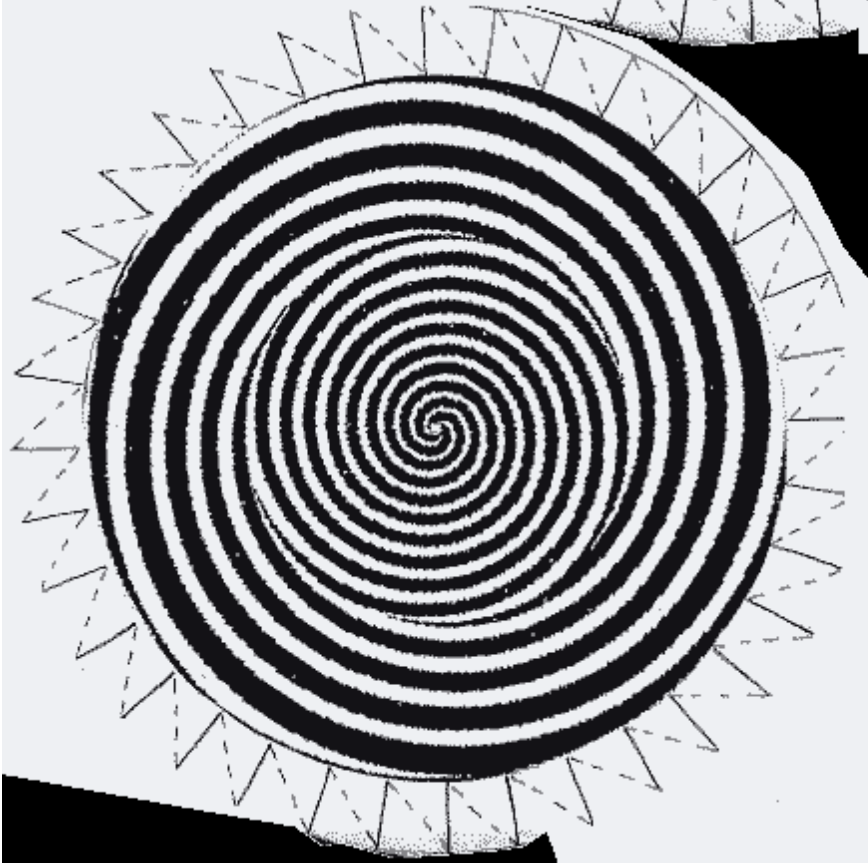
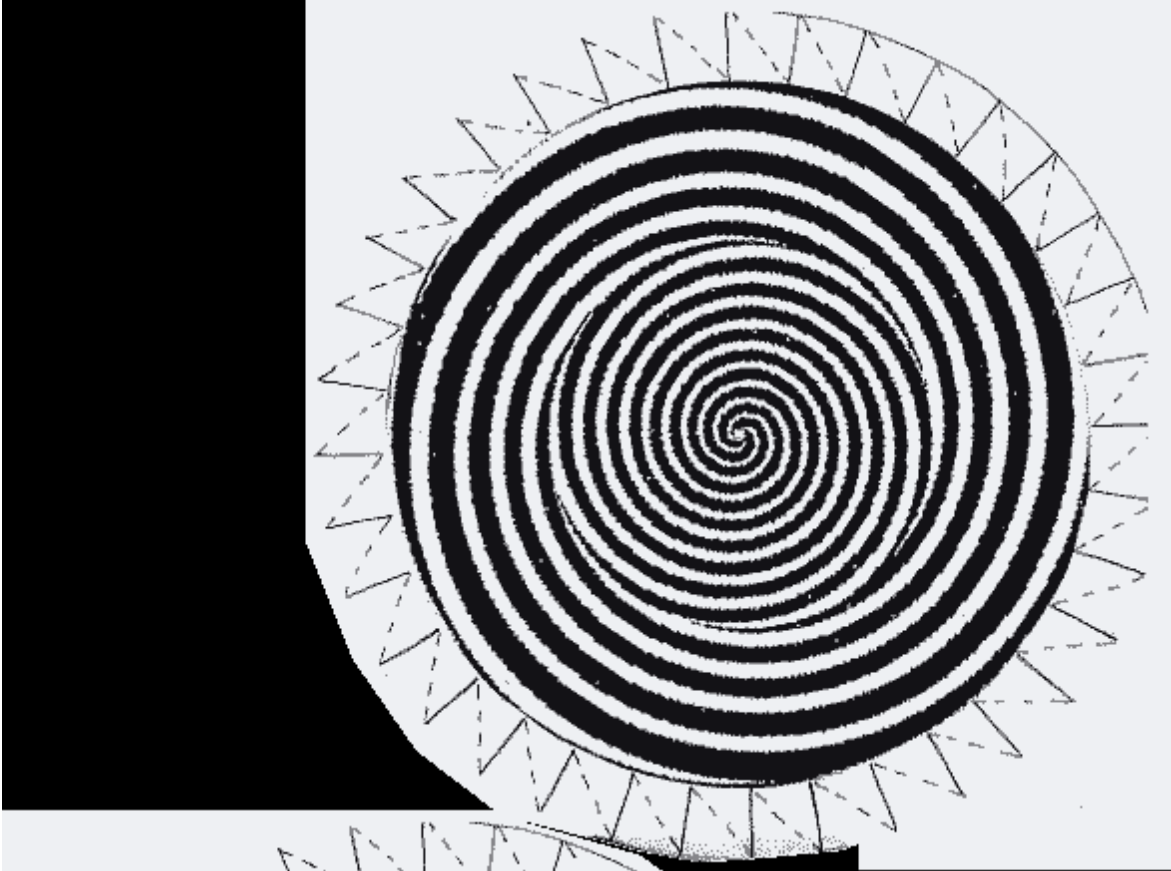
- ❑ Have students create an experiment to test a variable, e.g., disk spinning speed, distance from disk, etc. Make sure that the group makes a hypothesis before they perform the experiment.
- ❑ Have students research other optical illusions and how illusions help us understand how our brain and eye perceive the world.

Cross-curricular Connections

BIOLOGY

Have students research the biology of the eye. Look at the structure of the cornea, lens, and retina. Learn the difference between rods and cones. Use optical illusions to explore the blind spot where the optic nerve attaches to the retina.

Master—Spiral Disk Template



ANIMATIONLAND

Build Your Own Zoetrope

Students learn about the history of animation and the science of apparent motion by creating an animation toy.

Science Topics

Animation
Apparent Motion
History
Processes

Process Skills

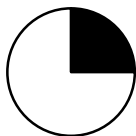
Drawing
Construction
Measuring
Following Instructions
Designing

Grade Levels

3-12

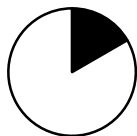
Time Required

Advance Preparation



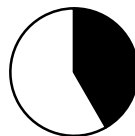
15 minutes

Set Up



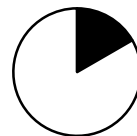
10 minutes

Activity



25 minutes

Clean Up



10 minutes

Supplies Needed

- Compact disc (any old CD), 1 per student
Optional alternative: cottage cheese container lids with center holes precut by the teacher
- Zoetrope Template, 1 per student (see master)
- Scissors, several per group
- Tape, 1 per group
- Pens and pencils, several per group
- Highlighter markers, 1 per student

Advance Preparation

- ❑ Copy the Zoetrope Template (Master A), one per student.
- ❑ Gather one compact disc for each student.
- ❑ Gather **for each group of students**:
 - Highlighter markers
 - Pencils and pens
 - Scissors
 - Tape
- ❑ Before doing the activity with the class, practice the activity procedure below.

Set Up

- ❑ Have all materials gathered and organized for the students.
- ❑ Make a copy of the Zoetrope Template (Master A) for each student.

Introducing the Activity

Ask the students the following questions in **bold**. Possible student answers are shown in *italics*.

What are some of your favorite animated movies and TV shows?
Any animated Disney movies, Charlie Brown, Cartoon Network shows, Tom and Jerry, Scooby Doo, Shrek, A Bug's Life, Robots, Finding Nemo, or many other possible answers.

TV and film animations are made from a series of many pictures, each picture a little different from the previous one. If the pictures are shown fast enough, the brain connects the movement together and we see an animated picture, or moving image.

Before the invention of movies and TV, people could make animations with simple toys. Today in class, students are going to create a simple version of a zoetrope, an early animation toy from the 19th century. Zoetropes were popular toys for animating short clips of drawings or pictures, making the pictures “come to life.”

Let students speculate before offering answers to any questions. The answers at the right are provided primarily for the teacher's benefit.

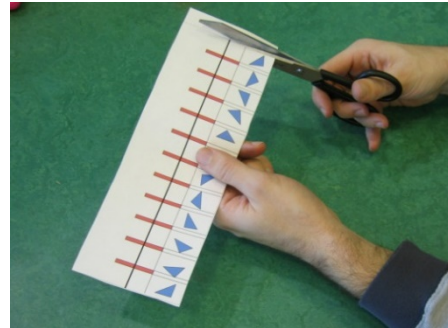
Activity

Students should work individually, sharing resources and sharing their zoetrope animations with each other.

Procedures for this activity were adapted from the zoetrope activity kit that can be purchased on howtoons.com (recommended for ages 7–12, not recommended for children under 3).
<https://howtoons.com/collections/single-kits/products/zoetrope>

1 Distribute one Zoetrope Template (Master A) to each student.

- Have students cut out the two zoetrope strips along the dashed lines.



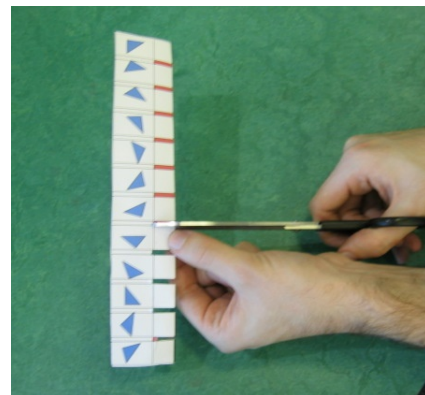
2 Fold the strip with triangles in half lengthwise.

- Crease along the thick black line, with all graphics to the outside and the blank side facing in.



3 Cut out the red rectangles.

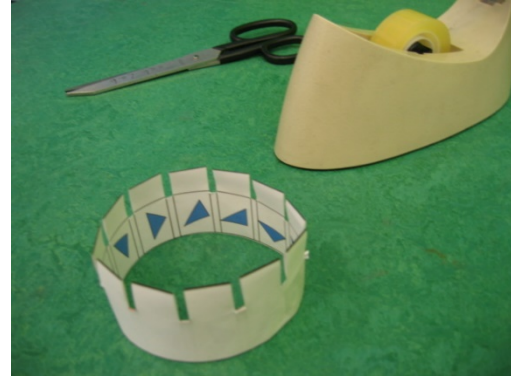
- Cut out each of the red rectangles.



4

Tape the ends of the zoetrope strip together to make a circle.

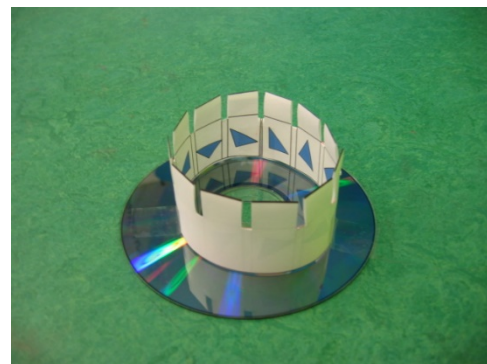
- Have triangles facing inward, inside the circle.



5

Tape the strip circle onto the CD.

- Use three or four pieces of tape to attach the circle onto the CD, centered over the hole in the CD.



6

Attach to the marker and spin the CD.

- Take off the highlighter cap, and stick the CD over the pen end. Replace the cap on the highlighter.
- Hold the zoetrope up to your eye-level and spin the CD with your fingers.
- Look through the slits of the zoetrope to the graphic on the other side of the circle.
- Adjust the speed at which the CD spins to find the best animation effect.



7

Have students create their own graphics for a zoetrope.

- Students can use the blank zoetrope strip to create their own animation sequence.
- Students should draw one graphic per square, simulating some motion of the graphic.
- Emphasize the concept of making small changes from one frame to the next. If the motion is too large, the animation will appear disjointed.
- Repeat steps 2 through 6 for the new zoetrope strip.

Class Discussion

How did changes in the spinning speed affect the animation?

Depending on the image being animated, the rate will vary somewhat. It all depends on how joined, or smooth, the animation appears, which depends on the amount of movement the character makes from one frame to the next.

Most modern movie projectors and animation clips show 24 frames per second. For the 12-frame zoetrope template, that would be two rotations per second.

What kinds of images work best in a zoetrope? What kinds of images would not work as well?

Tumbling triangles, walking people, horses, dogs, flying birds, or bouncing balls.

Images of a looped motion (the end frame can be connected back to the beginning frame) work best. The tumbling triangle was designed so that the last triangle in the strip would be a small movement away from the orientation of the first triangle.

Ask for student observations. There is no correct answer. Let students guide the discussion and present their hypotheses before discussing explanations.

Explanation

When was the zoetrope invented?

George Horner invented the zoetrope in 1834. It was called a “daedalum” or “daedatelum” originally, which meant “wheel of the devil.” It became a popular animation toy around the 1860s.

How does the zoetrope work?

The zoetrope is a cylinder that sits horizontally, with vertical slits along the top of the cylinder. The user briefly sees one of a series of pictures on the inside of the cylinder by looking through the vertical slits. The space in between the slits acts as a shutter, separating the images. As the zoetrope spins, the user sees the series of images one after another, just like a modern movie camera shows films, one frame at a time. Small changes in the image, one frame to the next, are interpreted by the brain as movement.

Is what we see an illusion?

The brain processes information about motion in a different fashion than other visual information, such as color, shape, or depth. Certain areas in the visual cortex, a region of the brain, are responsible for processing information about motion. Cells in this region are responsible for processing different kinds of motion. For instance, certain groups of cells are active when watching an object move from right to left in front of our eyes. Scientists have discovered that the same cells are active when a person is watching a real motion, e.g., a person walking from left to right in front of them, or when a person is watching an illusory motion, e.g., a film of a person walking from left to right. This has led scientists to believe that the brain cannot distinguish between real motion and illusory motion. This is called the theory of apparent motion.

The zoetrope uses the theory of apparent motion to animate a series of images. The images flicker before the user's eye and the brain connects the images, giving the illusion of fluid motion.

Optional Extensions

More complicated version of a zoetrope:

<http://www.groeg.de/puzzles/zoetrope.html>

This site, created by Georg Eggers, has directions and a template to build an entire zoetrope.

Cross-curricular Connections

LANGUAGE ARTS/SOCIAL STUDIES

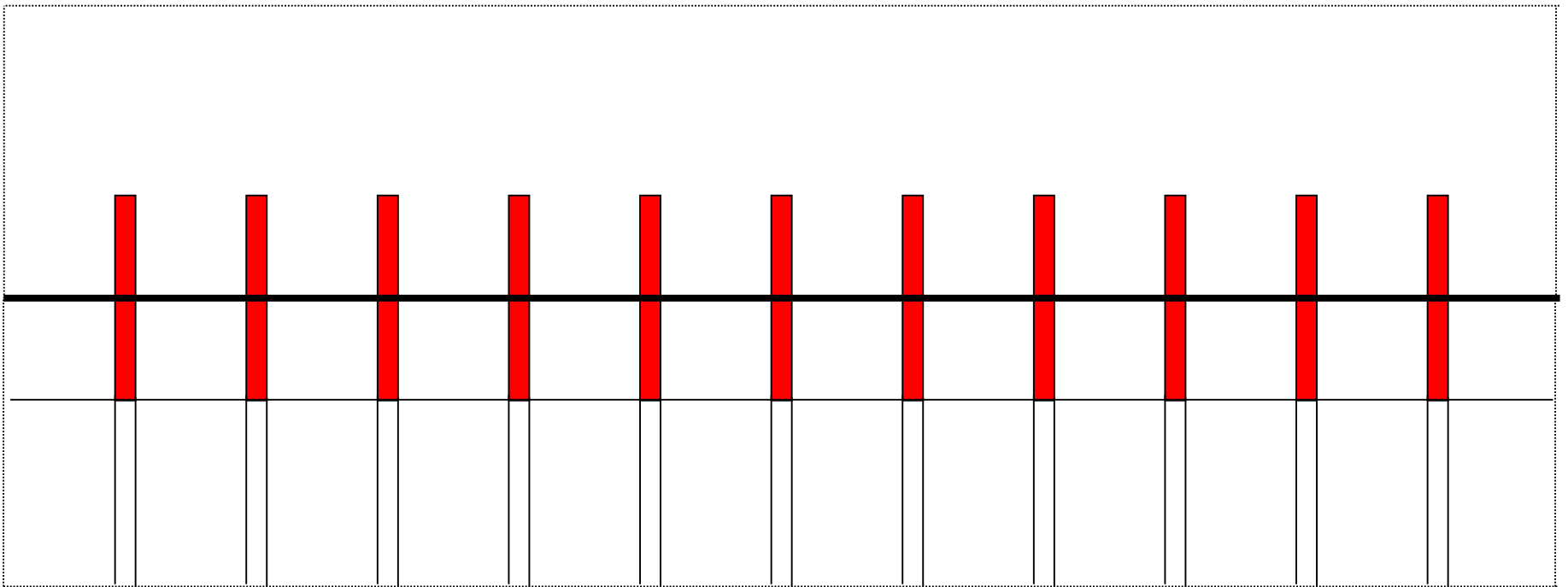
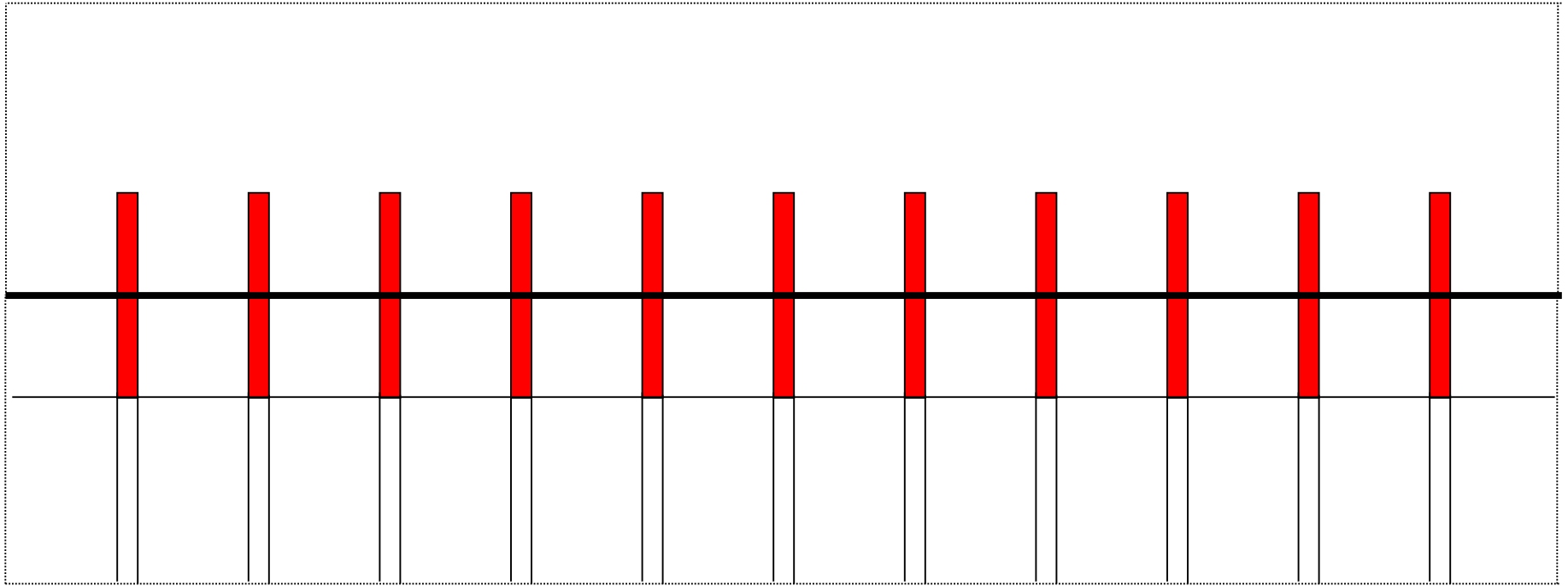
Read the class a story by Mark Twain, who lived around the time the zoetrope was invented. Talk about what people did for entertainment before the invention of movies.

MATH

Look at the ratios that emerge with 24 frames/second. If there are 24 frames per second, then 12 frames are $\frac{1}{2}$ second, 8 frames are $\frac{1}{3}$ second, etc. You can extend this by looking at how many pictures are needed for one minute or one hour of animation.

MUSIC

Listen to music from the 1830s.



ANIMATIONLAND

Plan of Action

Students make a storyboard and act it out.

Science Topics

Planning

Process Skills

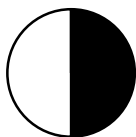
Comparing/contrasting
Investigating
Observing

Grade Levels

3-12

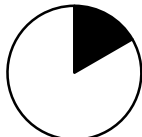
Time Required

Advance Preparation



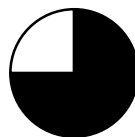
30 minutes

Set Up



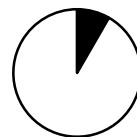
10 minutes

Activity



45 minutes

Clean Up



5 minutes

Supplies Needed

- Sticky notes (or blank notecards and pushpins), 10 per student
- Black markers, 1 per student
- Sheets of cardboard (or bulletin boards), 1 per group
- Easels, 1 per group

Advance Preparation

- ❑ Gather supplies.
- ❑ Make an example storyboard or enlarge a comic strip for an example.

Set Up

- ❑ Set out the supplies.
- ❑ Put the bulletin boards on easels to display the storyboards.

Introducing the Activity

Ask students if they have a favorite animated cartoon. Explain that when animations are made, animators make a script with pictures called a storyboard. Just like a play has a script, a storyboard is the plan for animators to follow when doing all the work of creating the final story for the animation.

After a rough draft storyboard has been created, animators pitch the story to the director. Everyone gathers around the board and the animators act out the story, with silly voices and simple sound effects.

Activity

Students work in groups of 4 or 5.

Making the storyboard

- Have students choose a legend or fairy tale they are familiar with, such as *Paul Bunyan* or the *Three Bears*. The students will use the characters from the legend or fairy tale they choose to create a storyboard that tells a new story. For example, the *Three Little Pigs* could go to the grocery store to buy milk.
- Have each group of students work together to create a new story and draw what the main characters will look like.
- Once the story is developed, students should decide what parts of the story are the most important. Have each student draw at least three key moments in the new story.

- Once all the drawings are done, each group should put their images in order on their bulletin board.
- Each group should discuss their story and make any necessary changes to the story. For example, some scenes may change order, some scenes might need to go away, and new scenes may need to be added.
- Once their storyboard is finished, each group should choose group members to voice each of the characters when presenting to the class.

Pitching the story

Each group shares their storyboard with the class:

- Set up a bulletin board where the whole class can see it.
- Students act out the story, making silly voices and sound effects.

Class Discussion

The storyboard is one of the first steps in creating animation. Once the basic outline of a story is written, animators sketch the key moments of the story onto cards, and then put the cards on a board in a sequence that resembles a comic strip. The animators act out the story for each other, making sounds and voices for all the characters. They then share ideas for how to make the story better, change the storyboard, and pitch the story again.

After the script is finalized, actors record the voices for all the characters. The **key frames** are illustrated next. All the pictures in between the key frames are then made by people called **in-betweeners**. All these pictures are filmed at a rate of 24 pictures per second, adding up to 14,400 pictures an hour!

Music and sound effects are recorded, the animation is edited together, and the animation is complete!

Optional Extensions

Film Scores

Most movies and TV shows use music to tell us how to feel about what we are watching. The Darth Vader theme that plays when he appears tells us he is a bad guy. We would feel differently if he entered the spaceship to the sound of Pachelbel's Canon. Play the students different pieces of music and have students describe how the music makes them feel.

Some examples of standard emotional music:

- "O Fortuna" from *Carmina Burana* by Carl Orff and "In the Hall of the Mountain King" from *Peer Gynt* by Edvard Grieg feel suspenseful.
- "Morning" from *Peer Gynt* by Grieg feels light and happy.

- “Entry of the Gladiators” by Julius Fucik, the “Hallelujah Chorus” from *Messiah* by George Frideric Handel, and *Sabre Dance* by Aram Khachaturian feel excited.

Show the students a clip from a popular movie with famous music, play the video again with the sound off, and then play it again with different music on a CD player.

Sound Effects

Have students make sound effects with various household objects. Use tinfoil or wax paper to make a crackling fire, coconuts to make horse hoof sounds, etc. (see Foley Artist activity).

Cross-curricular Connections

Read a play as a class.

Look at similarities between comic books and movies. The opening credits of *Spider-man 2* show a storyboard of the movie *Spider-man*