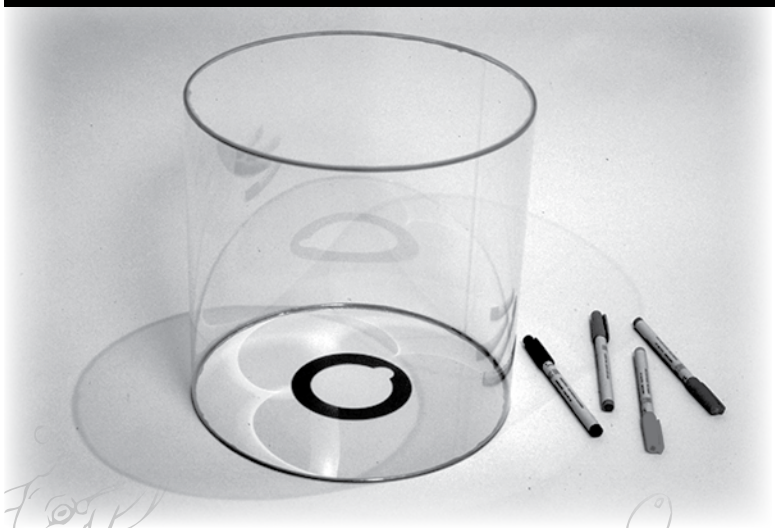


A Collection of Curriculum Ideas for the STARLAB Transparent Cylinder

Including:

Transparent Cylinder Tips by Susan Reynolds Button

The Skies of Gettysburg: July 1-3, 1863 by Scott Beyer

Using Literature, Storytelling and Mythology to Teacher Star Location by Linda K. Johnson

Pond Life by Hamilton County Park District

Nature at Night by Hamilton County Park District

Evolving Solar System by Scott Negley

Other Clever Ideas by Stephen Berr

Curriculum Guide Contents

Transparent Cylinder Tips

from TIPS Booklet #18 edited by Susan Reynolds Button

Note

Cylinder dimensions are height = 10 inches (25.4 cm), diameter of cylinder top = 10 inches (25.4 cm), circumference = 31.5 inches (80.01 cm)

About the Transparent Cylinder

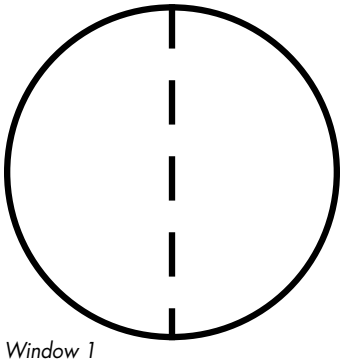
1. You can draw on it. Whatever you draw on the cylinder projects on the dome in reverse — but remember that bright light leaks through areas where there is no drawing. Also make sure that the projector is raised up high enough to project all of the artwork (sometimes the bottom of the artwork is below the horizon).
2. You can make overhead transparencies and tape them together onto the cylinder (apply them in reverse).
3. You can make opaque masks with windows that have drawn or transparent images in the window to be revealed at appropriate moments and changed at will. The top and bottom of the cylinder need to be masked if they have no artwork.

Notes

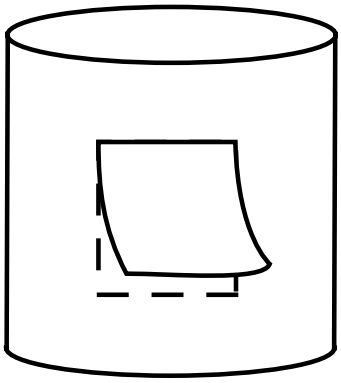
- The images that project the best are drawn in black on white (using bold lines and avoiding tiny details as much as possible — a 2 mm thickness is best). Then use a color copier to make a reverse transparency so that you end up with clear artwork and a black background. (BOCES uses a Xerox® color copier with Thermofax® Infrared Transparencies — IR 111 [3M 520] called "Clear on Black.") The white can then be colored with markers (very lightly because this cuts down on the light and the projection becomes dimmer).
- Vis-a-Vis® markers are very translucent, bright and beautiful but are permanent and must only be used on overhead transparencies which are then applied to the cylinder. Do not use them on the cylinder itself.
- Scotch® "clear" tape is not actually transparent. If you tape the transparencies together along the edges, you can make a sleeve to slide over the cylinder. Tape over "dark" areas so the tape does not show.
- Computer-generated transparencies also project fairly well.
- For drawing directly onto the Transparent Cylinder, use the colored pens that came with it or similar water soluble pens. (Staedtler® Lumocolor AV for Overhead Projection, water soluble — 315 WP4 A6 Non-Permanent Medium).

Window Examples

1. The top of the cylinder has black paper that can fold back to reveal the Transparent Cylinder and can be used like an overhead projector.
2. The sides of the cylinder are wrapped in black paper that has strategic window flaps cut so they can be folded out of the way to reveal an image.



Window 1



Window 2

Possible Applications

There is no limit to the ideas that you can imagine — here are just a few that were brainstormed during the IPS (International Planetarium Society) '96 workshop in Japan!

1. Weather/clouds
2. Differential rotation
3. Sun angles/trigonometry
4. Scene for creative writing/poetry
5. Illustrate poems, stories, music
6. Underwater scene, ocean depths
7. Maps of ethnic groups/historical development of art or costumes
8. Roulette wheel
9. Magma/seismic movement underground
10. Distribution of global vegetation/ecology
11. Merry-go-round
12. Geologic striation
13. Bird migration paths
14. Inside a pyramid
15. Bridge design (with no supports from the center)
16. Inside the earth
17. Inside the mind
18. Holography/3-D effects
19. Another planet environment (may be designed by students as part of a report)
20. Panorama views
21. Single cell or atomic structure
22. Inside parts of the body
23. Satellite orbits
24. Cave art
25. Inside a forest
26. Dinosaurs
27. Animal habitats
28. Evolution of air/space craft
29. Original student art
30. Stage set for a play

Resources

Button, Susan Reynolds, editor. Tips Booklet #18: Tips for Portable and Small Planetarium Users*. Published by the Great Lakes Planetarium Association, 1998.*

The Skies of Gettysburg: July 1-3, 1863

by Scott Beyer

Suggested Grade Levels

Upper elementary through high school

Objective

Give students a basic understanding of the Battle of Gettysburg, Pennsylvania and the associated night skies seen by the combatants during the fighting and maneuvering.

Pre/post Activities

- Watch the movie *Gettysburg* from Turner Home Entertainment
- Read *The Killer Angels* by Michael Shaara
- Watch the Gettysburg segment of *The Civil War* by Ken Burns (PBS Series)
- Engage a local Civil War re-enactor to speak about uniforms and equipment as related to summer campaigns (Gettysburg in particular)
- Review the myths of Hercules, Draco, Mars, and Ophiuchus

Vocabulary

gibbous moon

waxing

waning

Ophiuchus

Mars

General George Gordon Meade

Ganymede

infantry

cavalry

artillery

General Robert E. Lee

Procedure

- Use overhead transparency paper to make overlays of the battle maps on pages 10-12. Color as desired using overhead projection pens (i.e. red for confederate troops, blue for Union troops)
- Tape these overlays to the outside of the Transparent Cylinder.
- In the dome, tell the story of the Battle of Gettysburg on 1-3 July 1863 using the script and the battle map overlays on the Transparent Cylinder. At sunset of each successive day, switch to the Starfield Cylinder and point out the astronomical data from the script.

Script

For three days and nights in July 1863, the Union Army of the Potomac and the Confederate Army of Northern Virginia fought a major battle on the slopes and ridges around the little town of Gettysburg, Pennsylvania. While the battle is remarkable in many ways, one way in particular stands out. Much of the maneuvering and some of the fighting took place at night and many references to the clear skies and astronomical sights exist in the diaries and histories of the war.

It's hard to say exactly where and when the battle began. The bulk of the fighting took place on the 1st, 2nd, and 3rd of July in and around Gettysburg. But these were

MATERIALS

- STARLAB Portable Planetarium
- Northern Starfield Cylinder
- Transparent Cylinder
- Battle map overlays (see pp. 10-12)
- Venus, Mars, Saturn, Jupiter planet projectors
- Civil War era music (optional)
- Battle scene overlay (optional)

three days out of a campaign that lasted more than a month in a war that went on for four years. The Confederates had left the Confederate States and invaded the United States by crossing through Maryland into Pennsylvania and were spread out all the way to Harrisburg and Carlisle. They had been through Gettysburg on more than one occasion and had picked the town quite clean.

The Confederates heard a rumor that Gettysburg had a stash of shoes that they had overlooked. Pettigrew's brigade of Heth's (pronounced "Heath") division went to get them. Late on the day of 30 June they ran into Union troops on the Chambersburg Pike 4 miles northwest of Gettysburg. Convinced that the Union troops were only some local militia, the Confederates camped that night with the idea that they would brush them aside in the morning and get the shoes. Little did they know that the Union troops were really those of Buford's cavalry. Each commander sent word to the rear that he was in contact with the enemy.

While the Confederates believed they faced only a small Union force they could easily sweep aside, Buford had correctly guessed that he faced the entire gathering Army of Northern Virginia. He told his brigade commanders the cavalry would have to "fight like devils" to hold on until the infantry support could arrive.

Troops from both armies were on the march all through the night of the 30th. Union troops wrote of being greeted by entire towns that had turned out under the nearly full moon to see the army go by. People gathered along the road to pass out water and snacks to the soldiers. It seemed to the men to be a grand celebration.

01 July: Battle

At around 4:30 am, just after sunrise, the first shots were fired. Confederate infantry (foot soldiers) engaged dismounted Union cavalry (horse soldiers fighting on foot). There were more Southern troops, but they had to come down a narrow road and then change into fighting lines to attack. That slowed them down and made it easier for the Northern troops who were already in battle lines. The Northern troops also had Sharps carbines. You can load and shoot a Sharps about three times faster than you can the muskets that the Confederates were using.

The Union troops fell back from Herr (pronounce "hair") Ridge to McPherson's Ridge, an even better position, and around 10 a.m. the first of the Union infantry made it to the battle. Both armies continued to grow as troops arrived as fast as they could march. By noon things were going well for the Union.

Shortly after noon, Ewell's corps began attacking the Union positions north of Gettysburg. Howard's corps was sent to stop them, and as they left they posted some reserve troops on Cemetery Hill. Ewell's attack was too much for Howard's men and they started retreating which caused the entire Union position to fall apart and a general retreat through the town began. Some units lost 80% of their men who were killed, wounded, or missing. Union troops fell back to where the reserves posted on Cemetery Hill as the sun was setting.

Procedure

Dim the projection lamp and turn up the side lamps. Replace the Transparency Cylinder with the Starfield Cylinder. Slowly illuminate the starfield.

01 July: Night Sky

Personal diaries confirm clear skies that night. The full moon had occurred at 2 a.m. that morning, so the moon was up nearly all night and in the very early stage of a waning gibbous. Venus was an "evening star" at 17° altitude, 4° to the upper left of Regulus in Leo. It would set about 2 hours after the sun. Jupiter was at 36° altitude and azimuth 219° with Spica about 5° to the lower left, setting around midnight. Saturn was 18° lower and to the right of Jupiter, setting a bit before midnight.

The constellation Hercules was up that night — perhaps some soldiers drew inspiration from his many trials and battles to face their own Herculean tasks. Ophiuchus was also up and his legacy as the first doctor was surely being called upon those ministering to the wounded on both sides.

Troops of both armies streamed into the area all night long. Gen. Meade, the Union Commander, arrived around 2 a.m. on the 2nd and inspected the layout of his troops at 3:30 a.m. by the light of the moon. Mars, the planet of war, had long since set, perhaps resting up for the grisly work that would begin again as the sun rose.

Procedure

Dim the projection lamp and turn up the side lamps. Swap the Starfield Cylinder with the Transparent Cylinder and overlays. Slowly illuminate the battle maps.

02 July: Battle

The Union line formed during the night was in the shape of a fish hook running from Culp's Hill to Cemetery Hill and down Cemetery Ridge until it just trickled out short of Little Round Top. The Confederate line was longer, but roughly the same shape and ran through the town and down Seminary Ridge. Troops of both armies were still arriving after night-long marches.

Gen. Lee had decided to attack near the Round Tops. The Union troops were not concentrated there, in fact, Gen. Sickles left them empty! Longstreet's 1st corps was to make the attack, even though Lee thought Longstreet tended to move too slowly. Lee's method of attack was to strike quickly with Stonewall Jackson's corps, then follow up with Longstreet's more powerful corps. Since Jackson had been killed 2 months earlier, Lee was trying to adapt a new approach.

Longstreet was to attack at an angle up the Emmitsburg Road — the road where Gen. Sickles had just placed his troops because he didn't like the position Meade had assigned him just north of the Round Tops. Sickles left a huge gap in the Union line, the left end of the line dangling, with the Round Tops completely uncovered. All the Confederates had to do was take Little Round Top and they could put cannons there that would be able to ravage the entire Union line from above.

But Longstreet was delayed. He waited for more troops. He marched down the wrong road. He had to turn around and find another road. All in all, it was 4 p.m. before he started the attack. Ewell was supposed to attack the other end of the Union lines at the same time Longstreet was attacking to keep the Union troops busy, but his attack was even later than Longstreet's and the Union was free to move men around as they needed reinforcements.

When Longstreet did attack, he drove Sickles' troops back and nearly overran the Round Tops. But Gen. Gouverneur Warren, who happened to be almost alone on Little Round Top, saw what was happening, and managed to divert troops that had been headed elsewhere. He hurried them to the hill just in time to save it. In fact, some of the troops didn't even have time to load their rifles, they just charged over the hill with empty guns.

The attack was repelled for the most part. The Confederates did manage to break the Union line near Sickles' original position just north of Little Round Top, but they weren't strong enough to stay there and the battle ended on this part of the line.

Ewell finally got the attack going on the north end of the lines by about 7 p.m. Culp's Hill and Cemetery Hill had been stripped to the bare minimum to fight off Longstreet's attack. Ewell's troops outnumbered the Union forces, but the Union troops were so well dug in that the Confederates were forced to withdraw several hours after sunset. Again they had broken the line briefly, but weren't strong enough to hold their position.

Procedure

Change to the Starfield Cylinder.

02 July: Night Sky

Mars, the planet of war, stood as a mute witness to Ewell's attack on Culp's Hill and Cemetery Hill. The fighting there died down just about the time Mars set.

Meanwhile on Little Round Top, Col. Joshua Lawrence Chamberlain and the 20th Maine rested after doing their heroic part to prevent the Confederates from taking that hill. Chamberlain said of his men "some gazed up at the stars and sent wireless messages through them to dear ones far away."

The constellation Aquarius was rising in the east. The hot, thirsty soldiers of both armies would have appreciated a drink of his water. Fighting in the Civil War was very physically strenuous work. It had been a scorching hot July day (90°), both armies wore wool uniforms, and to top it all off, they had to bite open the paper cartridges of gun powder and bullet to load the rifle. Thirst was a constant enemy to all and clean drinking water was always scarce and appreciated. So Ganymede's burden would have been most welcome that night to, as Chamberlain put it, "wash from their throats the nitrous fumes of battle."

Draco, the never sleeping dragon, prowled the night sky much as the pickets, sentries, and ambulance crews prowled the battlefield, ever watchful, always ready to give the alarm. It was a busy night for both armies: men, supplies, and guns were moving, but the worst and biggest job of all was finding and tending to the wounded. As author Shelby Foote put it, "The moonlight glistened on the corpse-strewn valleys and hillsides."

Procedure

Change back to the Transparent Cylinder and finish the script.

03 July: Battle

Culp's Hill was the scene of some early morning action. Each side intended to attack the other, but the Union forces were first to attack at 4:30 a.m. with an artillery bombardment. Confederate troops attacked as soon as the Union cannons ceased firing. The attacks continued back and forth until 10 a.m. when the Confederates were driven out of their positions at the base of Culp's Hill.

As fierce as the fighting was that morning, it was only a prelude to the bigger events to come. Lee spent most of the night planning new attacks on both end of the Union lines — very similar to the nearly-successful day before. However, his orders were too vague and his generals misunderstood them. When Lee went to Longstreet to see why the attack hadn't started, he found out it wasn't nearly ready, or even what he had planned. He canceled the attacks on the ends of the line and decided to attack the center instead.

He opened the attack on the center with an overwhelming artillery barrage, followed by an infantry assault of 13,000 to 15,000 men under Longstreet. Lee lined up nearly 150 cannons almost wheel to wheel in three main groups concentrating on Cemetery Ridge. The Union troops could see this happening, but didn't fire because they were saving their ammunition for the coming attack.

By 11 a.m. everything was fairly calm, even Culp's Hill was quiet by then. At around 1 p.m. all 150 Confederate cannons cut loose with the most intensive bombardment yet seen in the war. By 2:45 p.m. Union guns stopped returning fire. They weren't being very effective and they also wanted to save their ammunition. Since the Union guns were scattered around the field, they didn't get all get the word to quit at the same time, so they fell silent one by one. It looked to the Confederates like the Union guns had run out of ammunition.

Thinking that the artillery attack had done its work, the Confederates ceased firing and began the infantry assault around 3 p.m. It was a sweltering day — about 90° and muggy — and the infantry had almost a mile to go to get to the Union lines. Every inch of it was in the open.

Union artillery fired into the advancing Confederates almost from the time they stepped off. As they attackers drew closer, the infantry added the rifle fire, and the artillery switched to canisters of oversized musketballs that made the cannons into huge shotguns. As the rebels concentrated on one small part of the Union line, the Union troops north and south of that spot swung out 90° and fired into the end of the Confederate lines exposing the rebels to fire from three sides at once. A small number of Confederates made it to the Union lines, even 30 yards beyond them. But Union reserves drove them out and an hour after the infantry assault began, it was over. The Confederates had failed and the battle was over.

That night the grim task of gathering and moving the wounded began again. Over 43,000 soldiers (23,000 Union and 20,000 Confederate) were killed or wounded at Gettysburg. Stretcher bearers worked all night by the light of the moon to help those they could. At one point that night a Union band played softly — yet loudly enough that the melody drifted over to the Confederate lines — a song of victory, not a song of celebration. They played, "Home Sweet Home."

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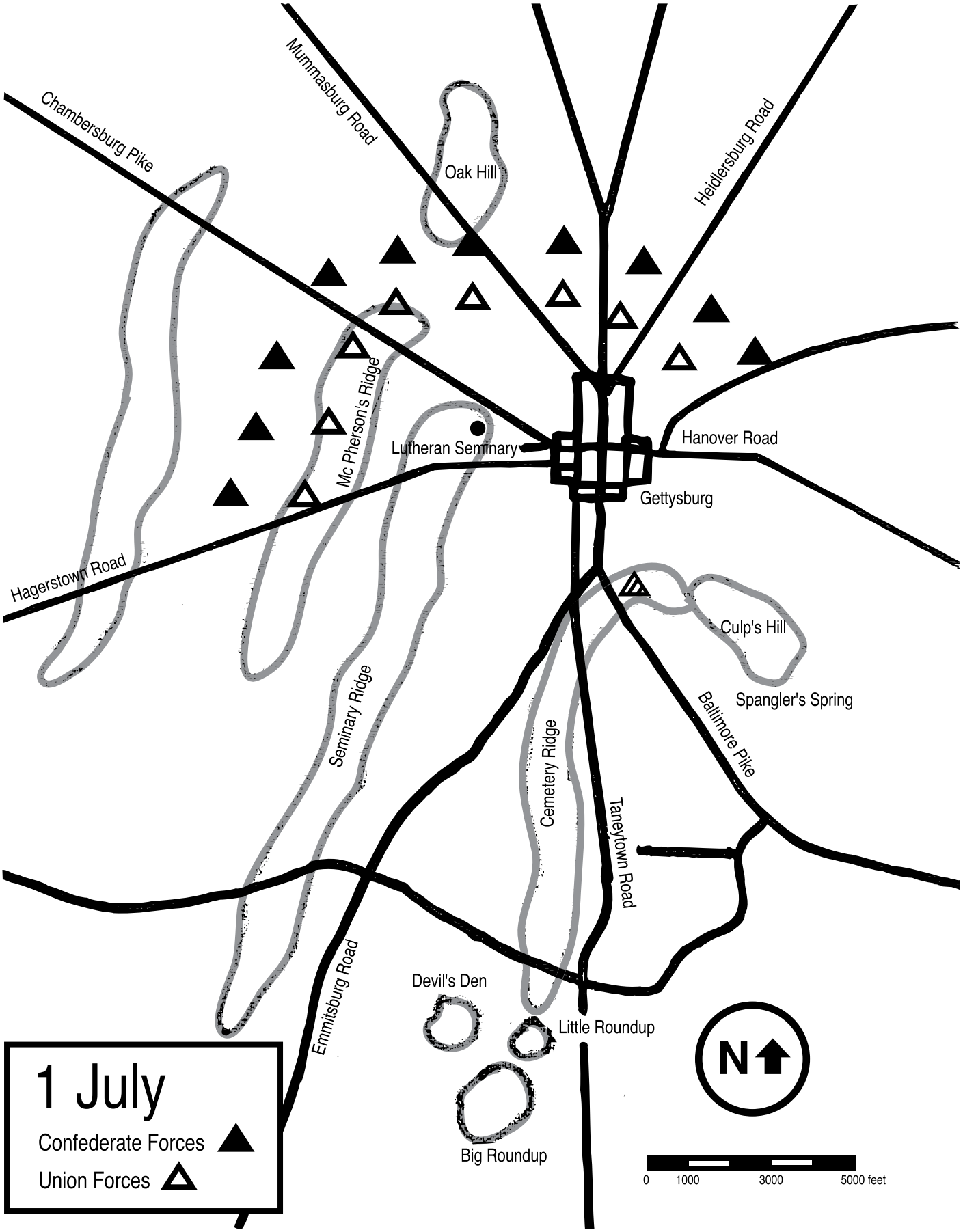
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Lutheran Seminary
Hanover Road
Gettysburg
Hagerstown Road
Culp's Hill
Spangler's Spring
Seminary Ridge
Cemetery Ridge
Baltimore Pike
Taneytown Road
Emmitsburg Road
Devil's Den
Little Roundup
Big Roundup
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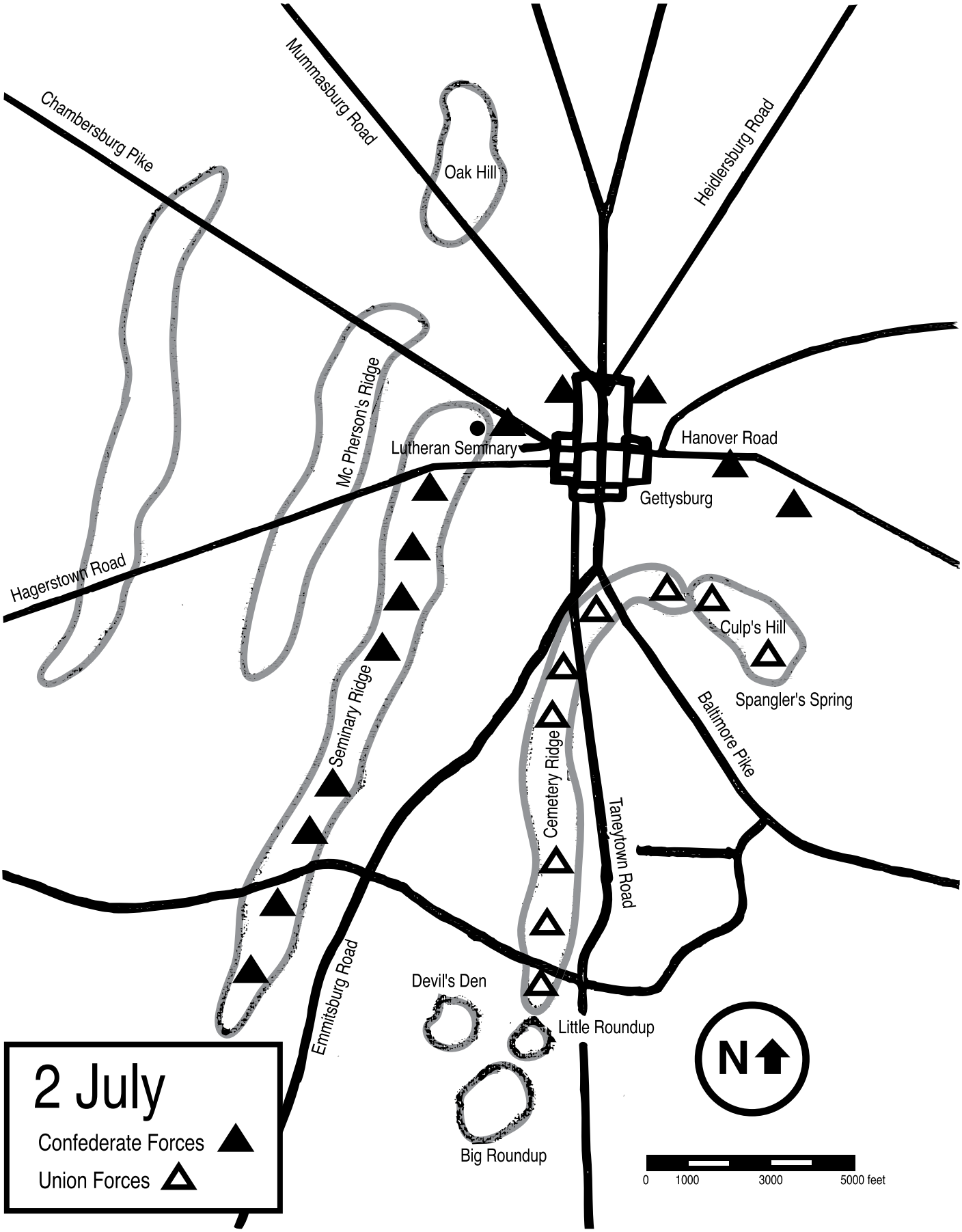
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Baltimore Pike
Cemetery Ridge
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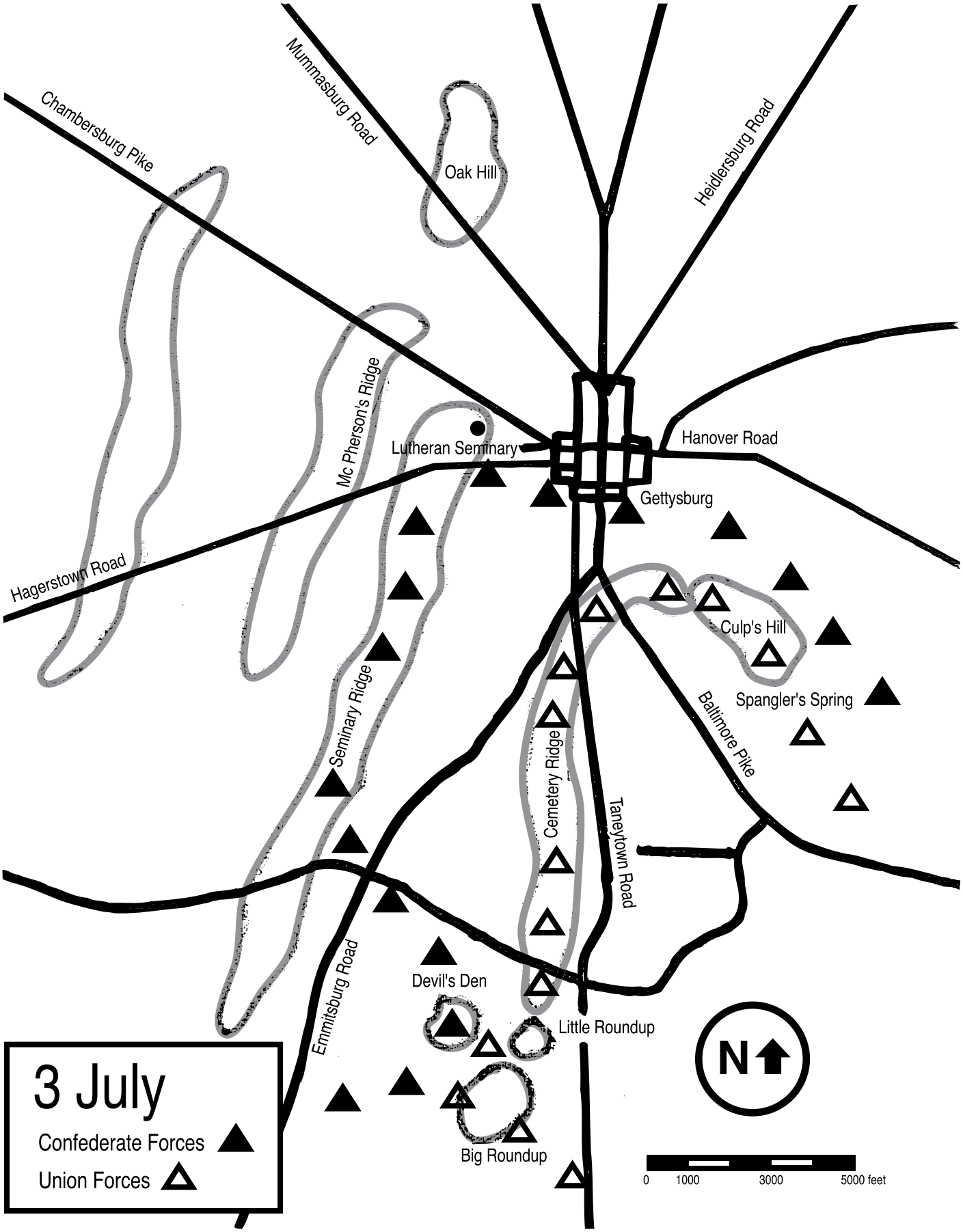
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3 July
Confederate Forces
Union Forces

Using Literature, Storytelling and Mythology to Teach Star Location

by Linda K. Johnson

Objective

Use literature, storytelling, mythology and astronomy to teach star location.

Age Level

K-6

Approximate Time

30 to 40 minutes

Procedure

- In this case the Transparent Cylinder is used to illustrate a story such as the one that follows.
- Sketch your story illustrations (like those at the end of this lesson) onto 8½" x 11" paper.
- Tape the sketches to the inside of the cylinder and trace them onto the cylinder using the colored markers then remove the original sketches or use the suggestions from the "Transparent Cylinder Tips" section by Susan Reynolds Button.
- Using black construction paper, create a cover to go completely around the cylinder (it should be about 10" high by about 32" long for the sides, with a 10" diameter circle for the top). On your black cylinder, cut out a 5 x 8 rectangle (adjust size depending on the size of your illustrations) at the same height as your cylinder sketches. This will serve as a picture frame for the illustrations. As the story is told, rotate the black cover to expose the appropriate illustration for the story.

Rotate the black cover to expose Picture 1.

Many, many years ago, in a far away land, lived a young shepherd boy about your age. You see, in those days boys and girls had to take care of the sheep and goats. They would go far off in the countryside and stay day and night watching the sheep, keeping them safe from wolves and other dangers.

Show Picture 2.

It was a very lonely time. When the sheep were safe there wasn't very much to do. Children at that time didn't know how to read. There were very few books in the world. If they played games, they would have to make them up for just one player because there was no one else around, unless of course the sheep played.

Show Picture 3.

So, mostly the shepherd played a flute or sang songs. The sheep seemed to enjoy the soothing music. It also seemed to keep the wolves away. Days were pleasant enough, but night time was a different story.

Show Picture 4.

Sometimes the young shepherd would hear noises and become frightened because

MATERIALS

- STARLAB Portable Planetarium
- Transparent Cylinder and water soluble markers
- Starfield Cylinder
- Greek Mythology Cylinder
- A Collection of Curricula for the Greek Mythology Cylinder (from Astronomy and More)
- black construction paper
- scissors
- tape
- illustrations

he couldn't see what was there. At times like that, he would pick up his flute and begin to play.

Show Picture 5.

Soon he would settle back and gaze at the stars. He remembered the stories his father and grandfather had told him. There, straight in front of him, was the star group that pointed toward his home.

Show Picture 6 of Constellations

He could never lose Polaris, the North Star. It stayed in the sky all night long and all year long. It was easy to find. Just find the Big Dipper, part of the constellation called Big Bear or Ursa Major. Then use the pointer stars — shoot an arrow straight to the North Star which makes up the handle of the Little Dipper, part of the constellation Little Bear.

Always in between them is that dreadful dragon, Draco.

Read/adapt this text from *A Collection of Curricula for the Greek Mythology Cylinder*:

[Draco is the dragon sent by Juno to guard the golden apples which she had given Jupiter as her wedding present to him. The dragon was a monster with poisonous, fiery breath and an enchanted hide that no arrow could pierce. Ever watchful, he coiled around the tree on which the golden apples hung and would allow no one to come close except Atlas, the giant who held the world on his shoulders.

To get the apples away from the dragon was one of the labors Hercules had to accomplish. He went to Atlas for help and Atlas agreed to get the apples if Hercules would take over the task of holding up the world in the meantime. Atlas enjoyed his freedom so much, he ran away with the apples and left Hercules supporting the earth. Hercules was clever, however, and he asked Atlas to relieve him long enough to place a pad on his shoulder. Atlas fell for the trick and Hercules ran off with the golden apples.To punish the dragon for its failure, Juno placed it as one of the circumpolar constellations where, in the northern heaven, it would never set and would always remain on guard.]

The shepherd boy didn't like to think about the dragon. He wanted to find King Cepheus and his wife Queen Cassiopeia in the sky. He knew it was a straight shot from the Big Dipper, through Polaris. He loved to hear the story of Cassiopeia.

Read/adapt this text from *A Collection of Curricula for the Greek Mythology Cylinder:*

[Cassiopeia was a beautiful woman who was fond of boasting about her beauty. The maidens who attended King Neptune in his underwater kingdom learned that she made a boast that she was far more beautiful than any of them. They demanded Neptune punish her.

Neptune sent a monster sea serpent, Cetus, to terrify all who lived along the coast of the country ruled by King Cepheus and Queen Cassiopeia. The serpent snatched women and children whom he found on the shore. Troubled by this problem in his kingdom, King Cepheus went to an oracle to find out how he could rid his kingdom of this horrible monster. The oracle's answer was that only if he sacrificed his daughter, Andromeda, to the serpent would the maidens feel they had been avenged for the way Cassiopeia had insulted them and ask Neptune to recall the serpent.

Cassiopeia was placed in the heavens to be punished rather than honored. She swings every half night around the North Star. She is upside in the chair in which she is seated, hanging on for dear life in a position most humiliating for a queen of old who was so proud of her beauty.]

But his very favorite of all was the constellation Orion the Hunter which is found in the southern sky.

Read/adapt this text from *A Collection of Curricula for the Greek Mythology Cylinder*:

[Greek legend tells us that Diana, goddess of both the moon and hunting, fell in love with Orion, the bravest hunter of ancient times. She began to neglect her duty of driving the moon chariot across the sky at night which lit the sky so that she could go down to earth to hunt with Orion.

When her brother Apollo heard of this neglect, he decided to do away with Orion. He shone his golden rays so blindingly on Orion one day while he was swimming, that he appeared only as a faint dot in the waves. He then challenged Diana to hit the tiny target with her bow and arrow. Diana, not knowing what the target was, shot so accurately that her arrow hit Orion and killed him. When she found his body on the shore that evening she realized what had happened. After trying in vain to bring Orion back to life, she put his body in her moon chariot and drove high across the sky where it was darkest. She put the body of her beloved Orion in the sky. Suddenly, the sky became bright with stars that outlined his body, jeweled belt and glittering sword. At his foot to keep him company, she placed his two favorite hunting dogs and marked each with a brilliant star. Procyon in the Little Dog (Canis Minor) and Sirius in the Big Dog (Canis Major).]

Dim the projector lamp and remove the Transparent Cylinder. Put on the Greek Mythology Cylinder. Slowly turn up the projection lamp.

As the night grew later, the stars seemed to grow brighter. The stories in his mind seemed to be painted in the sky by the twinkling stars. There was Orion, Draco, and Cassiopeia.

- Review the constellations that were taught. Give students time to see their location — talk about the individual stars in the constellation.
- Once again dim the projection light and change to the Starfield Cylinder as the following is told. Review the constellations and location.

But no, he was just imagining things. He blinked his eyes and rubbed them. Before him were billions of stars. He searched again for his favorites. Can you find them?

Point out Orion and other familiar constellations. Then, slowly turn up the side lamps and dim the projection lamp.

At last the morning light from Apollo was coming. It was time for the shepherd to start his busy day. Tomorrow night he would find his own star pattern and create a story about his own hero.

Picture 1

Picture 2

Picture 3

Picture 4

Picture 5

Picture 6 Constellations (from the Greek Mythology Cylinder)

MATERIALS

For the Classroom

- Water experiments to illustrate properties of water, lifecycle information for insects, amphibians, fish and birds that are adapted to living in/near water

For the Planetarium

- STARLAB Portable Planetarium
- Transparent Cylinder with Pond life sketches
- cassette player and recorded sounds

Pond Life

from the Hamilton County Park District

Description

Ponds may seem peaceful and serene to the casual observer. A closer look reveals an incredible amount of activity which is taking place beneath the surface and along the edges!

Grade Level

Elementary

Content Background

Properties of water that give it a life-supporting role, characteristics of insects, amphibians, fish, and birds that inhabit watery worlds.

Facts & Concepts

communication • vocal sounds • properties of water • defenses • food chain • food web • predator • prey

Vocabulary

characteristics of water surface film • lifecycle • density of water • food chain • heat-holding capacity • food web • transparency • habitat

Objectives

1. Students will be able to understand the conditions of living underwater.
2. Students will be able to describe a pond food web.
3. Students will be able to describe how animals communicate in the underwater world of a pond.

Procedure for the Classroom

- Conduct water experiments as a demonstration or a have the students conduct them to determine the properties of water. How do these properties affect living things?
- Discuss the lifecycle of insects, amphibians, fish and birds that depend on water.

Preparation

- Photocopy the five pond life illustrations onto transparency paper.
- Carefully match up the illustrations (they overlap slightly) and tape them together where the artwork meets — join 1 to 2, 2 to 3, 3 to 4, 4 to 5 and 5 to 1 to make a cylinder with the transparency paper. Trim margins as necessary (including text/titles). Attach this cylinder to the outside of the Transparent Cylinder.
- (Optional.) Color the transparencies using overhead projector pens.

  (Other option: photocopy the illustrations onto regular white paper, tape them together as described above, attach to the inside of the Transparent Cylinder and trace the artwork using colored pens, onto the cylinder.)

Procedure for the Planetarium

- As students are entering the dome, have a tape playing recorded sounds heard at the pond, everything from the splash of a jumping frog to a bird singing.

- Once seated, have the children try to identify the animals making the various sounds.
- Turn down the projector sidelights and turn on the cylinder lights.
- Have the students review what conditions animals must be adapted to for living underwater.
- Begin the lesson by discussing the importance of insects in the food chain.

Water boatmen have long, slender hind legs which are flattened for swimming. They take in air at the surface and it surrounds them when they go underwater. Under the water, if they are not swimming, they must hold on to something in order to stay submerged. The adults are strong flyers and can be found around streetlights. Water boatman eat algae and decaying plant/animal matter.

Giant water bugs are the largest of the true bugs, growing to an impressive 3 inches! They eat other insects, tadpoles and even small fish! Giant water bugs kill their prey with a poison they secrete as they bite.

Water striders are common stream and pond animals that seem to skate on the surface of the water. The bottlebrush-like tips on their legs enable them to stay on the surface of the water where they look for insects that have fallen in to eat. They use the surface of the water much like a spider does its web, locating their food by sensing the vibrations.

Whirligig beetles use short middle and hind legs to swim across the surface of the pond and for diving. Their eyes are divided into two parts so they can see above and below the water at the same time. The larval stages are carnivorous and the adults are scavengers.

Amphibian means double-life. An amphibian's life cycle greatly depends upon clean water. For most species, life begins as the eggs — which have been laid in a vernal pool, pond, stream or lake — hatch. The larval stage looks fish-like and requires gills to exchange oxygen and carbon dioxide. Once metamorphosis is complete, the adult form emerges and continues life on land, either exchanging gases through its skin or breathing via lungs. In some species of frogs, the tadpoles school together in order to protect themselves from predators.

Reptiles have members that are well-suited for life in the water. Many species of turtles call a pond home, including **softshell turtles**. Softshell turtles are quite flat and can grow to be more than twelve inches in length. The carapace or upper shell is covered with a soft, leather-like skin. They are most common in streams and may also be seen in lakes and ponds.

Fish inhabit deeper ponds and lakes. **Bluegill** are widely found, mostly as a result of the stocking of farm ponds. They eat insects, crustaceans, and other small aquatic animals. Females can lay up to 60,000 eggs per spawning, but only a few make it to adulthood. Adults can reach eight to twelve inches and weigh one pound. **Bull-heads**, like other catfish have scaleless skin which is very smooth. Their "whiskers" are called barbels. Barbels are sensory organs which help the fish locate food — mostly small, bottom-dwelling animals.

Many birds nest near the water and forage for food within its depths. The **great blue heron** is a long-legged wader with a sharp bill to catch aquatic animals, mainly frogs and fish. Great blue herons can be almost four feet tall and 70 inches from beak to tail. They stand perfectly still at the water's edge or in the shallows until prey mistakenly comes too close. Then . . . gotcha!

Keeping ponds clean is important to keep these and other aquatic animals healthy and in large numbers. If we become careless, and foul their habitat, we could alter

the environment so quickly, that they cannot make necessary adjustments to survive.

Follow-up Activities

1. Arrange a naturalist-led pond prowl in a local park for your students.
2. Have your students attend a local camp during the school year that provides programming, food, shelter for a two-three day stay.
3. Have the students write a short story about the activity in a pond under the quiet surface.

Evaluation Suggestions

- Have the students discuss the life cycle of a local species of frog.
- Have the students detail a food chain and web present in a pond.

Suggested Resources

Taylor, Barbara, **Look Closer: Pond Life**. *D. K. Publishing, Inc., 1998. 29 pp.*

Lind, Karen, **Water, Stones, and Fossil Bones**. *National Science Teachers Association, 1991.*

Palmer, E. Lawrence and Seymour H. Fowler, **Fieldbook of Natural History**. *Out of print (try www.barnesandnoble.com or www.amazon.com for availability).*

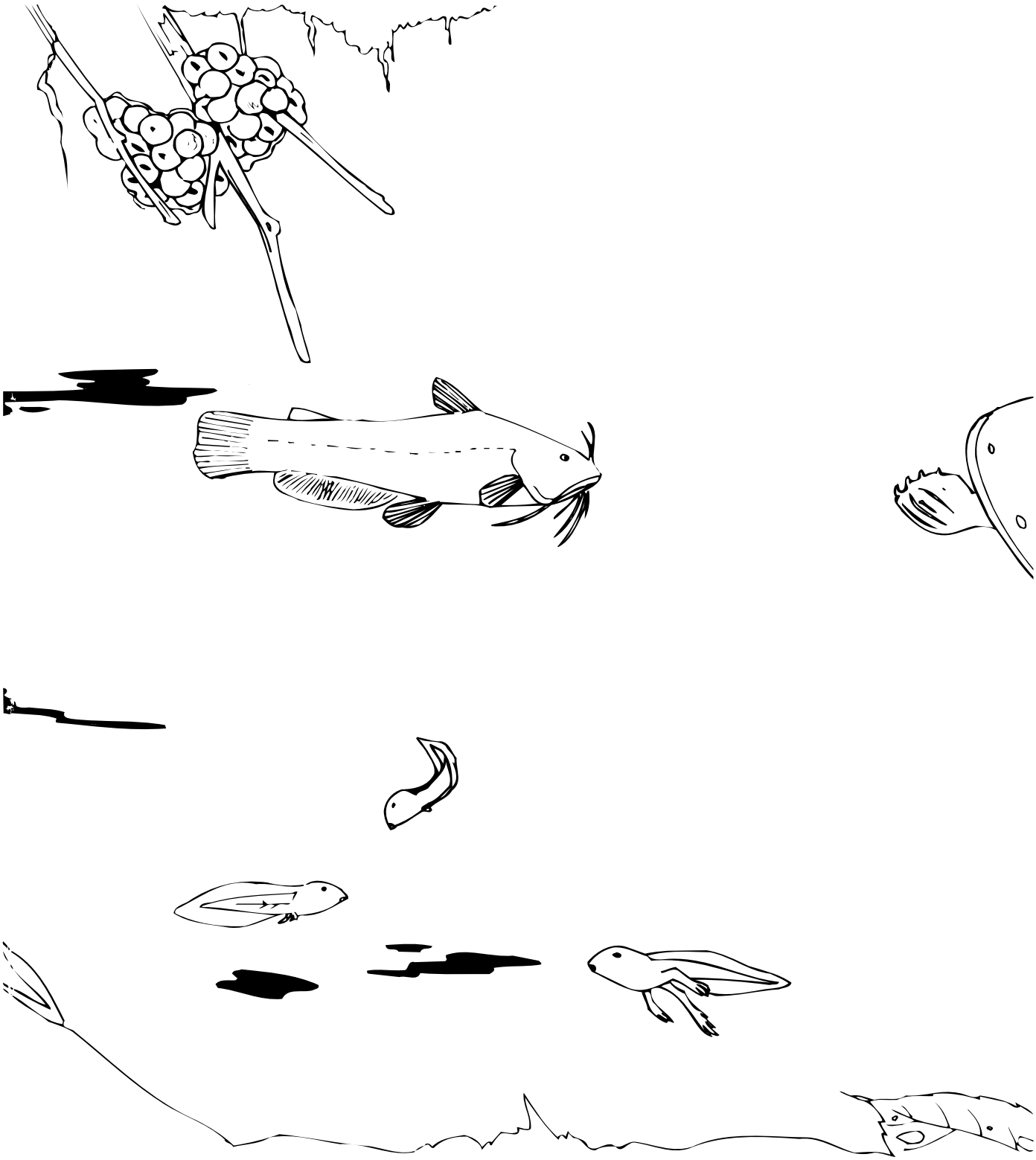
Stokes, Donald, **Stokes Backyard Nature Books**. *Little Brown & Co.*

Pond Life Illustration 1

Join left side of Illustration 1 to right side of Illustration 5. Join the right side of Illustration 1 to left side of Illustration 2.

Pond Life Illustration 2

Join left side of Illustration 2 to right side of Illustration 1. Join the right side of Illustration 2 to left side of Illustration 3.



Pond Life Illustration 3

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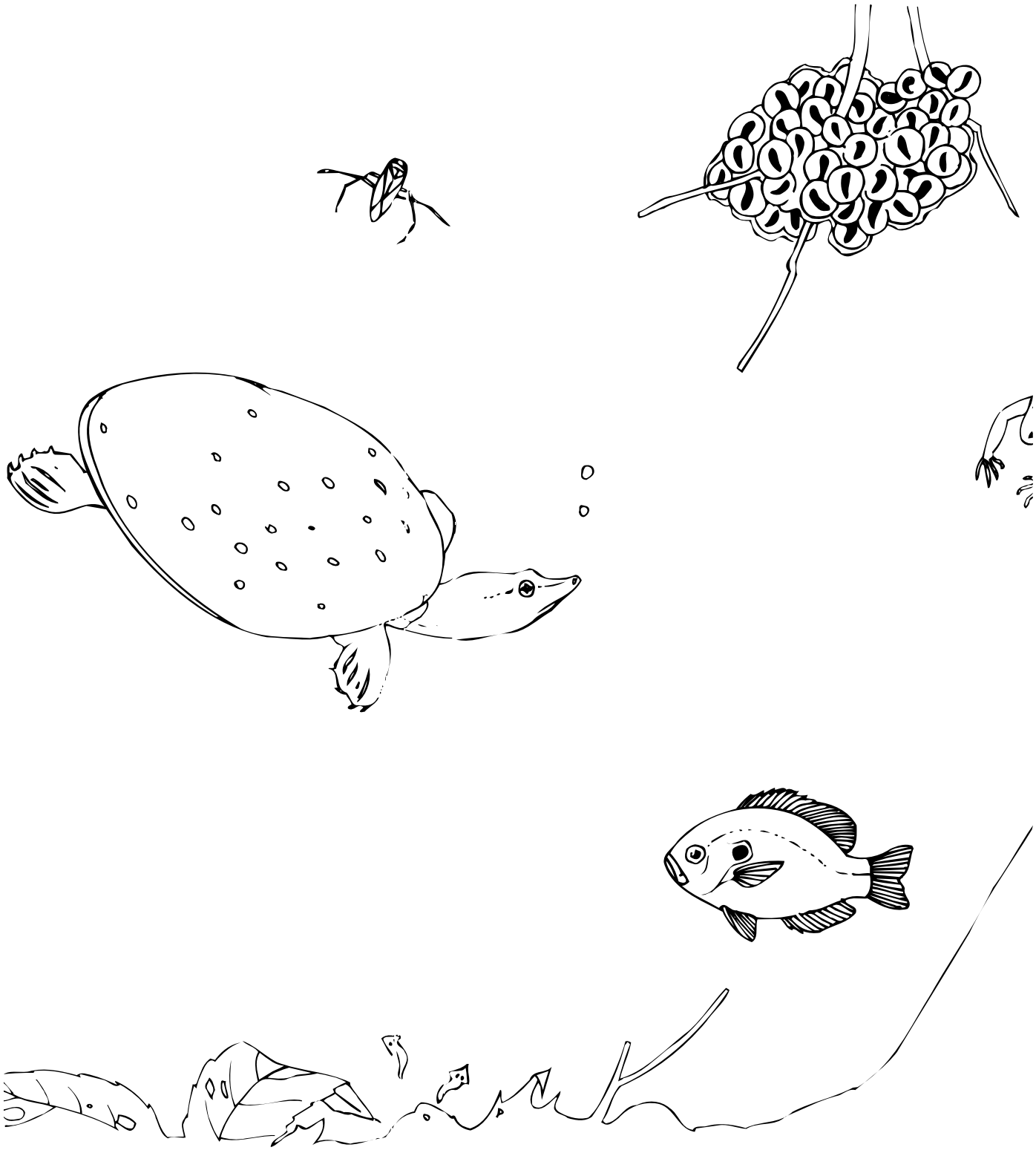

Pond Life Illustration 4

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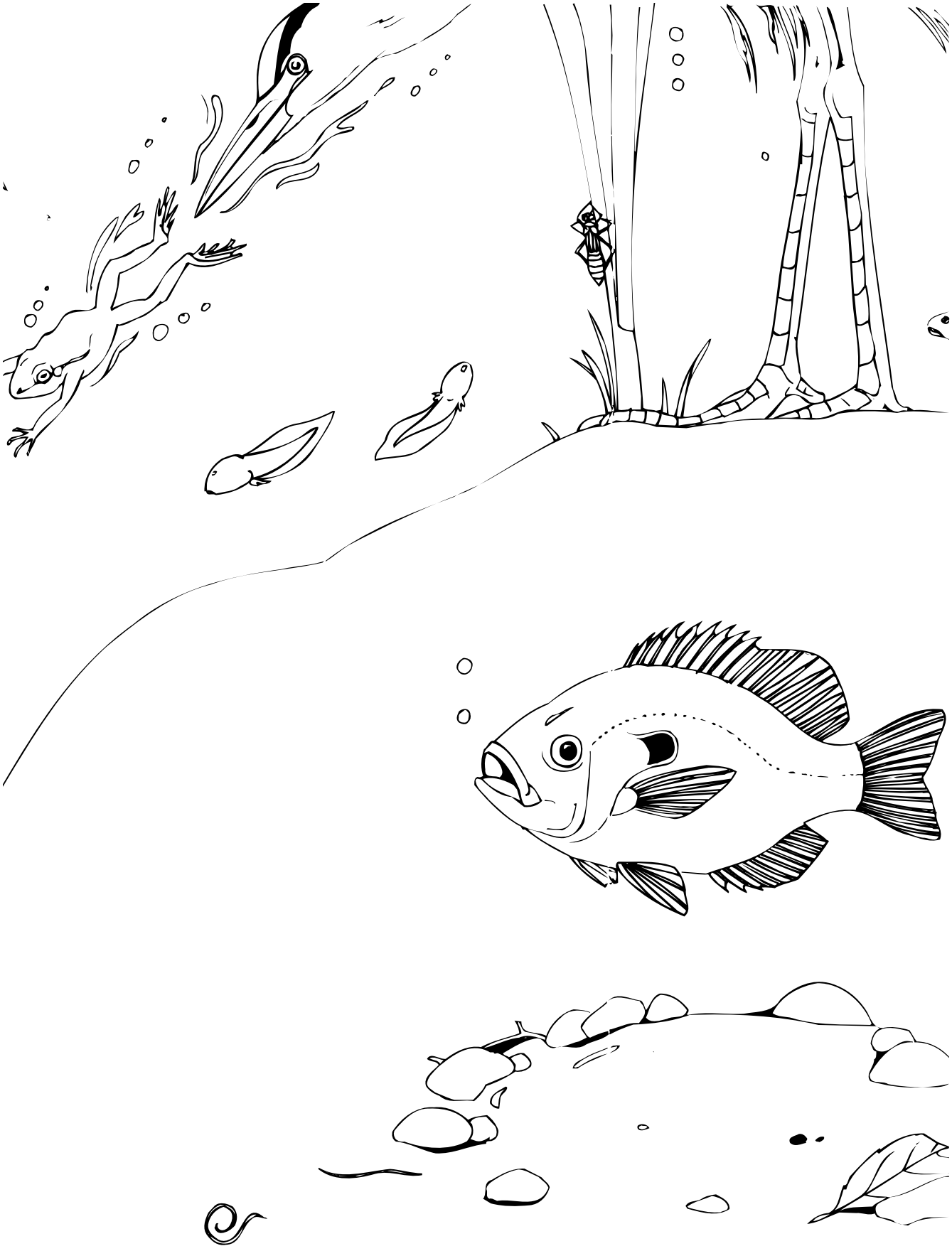

Pond Life Illustration 5

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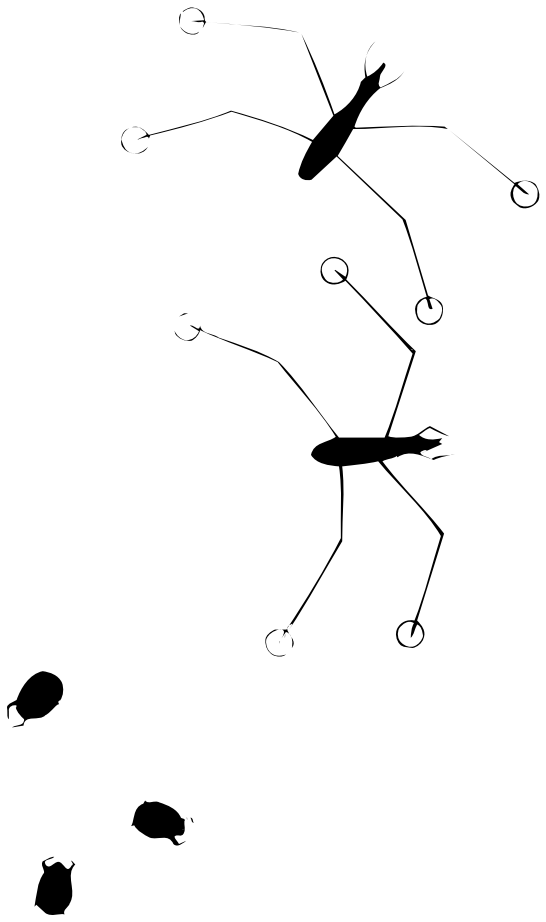
Pond Life Illustration 6 — Cylinder Top



Nature at Night

from the Hamilton County Park District

Description

Under a cover of darkness, the nocturnal world is often described as mysterious or even frightening. It is hard for us to see in low light, so every sound seems amplified and ominous. Typically, we head indoors as night falls, but through this lesson plan, students will hopefully gain an interest in the animals of the night and find the nocturnal world fascinating.

Grade Level

Elementary

Content Background

General understanding of diurnal and nocturnal animals, the characteristics of various groups of animals — mammals, reptiles, amphibians, birds, insects

Facts & Concepts

rods • cones • communication • vocal sounds • senses • food chain • food web • predator • prey

Vocabulary

diurnal • nocturnal • rods • cones

Objectives

1. Students will be able to understand the benefits of being active at night.
2. Students will be able to describe a nocturnal food web.
3. Students will be able to compare the senses of nocturnal animals to their own senses.

Procedure — In the Classroom

Using props to demonstrate the differences in classification of animals, review the senses and what characteristics are programmed for certain functions. Review the terms "diurnal" and "nocturnal" and what characteristics work best in which situation.

Preparation

- Photocopy the five nature at night illustrations onto transparency paper.
- Carefully match up the illustrations (they overlap slightly) and tape them together where the artwork meets — join 1 to 2, 2 to 3, 3 to 4, 4 to 5 and 5 to 1 to make a cylinder with the transparency paper. Trim margins as necessary (including text/titles). Attach this cylinder to the outside of the Transparent Cylinder.
- (Optional.) Color the transparencies using overhead projector pens.

  (Other option: photocopy the illustrations onto regular white paper, tape them together as described above, attach to the inside of the Transparent Cylinder and trace the artwork using water soluble, colored pens, onto the cylinder.)

Procedure — In the Planetarium

- As students are entering the dome, have a tape playing recorded night sounds, everything from frogs to crickets to coyotes. Once seated, have the children try to identify the animals making the various sounds. Turn down the sidelights and turn

MATERIALS

- STARLAB Portable Planetarium
- Transparent Cylinder
- Urban Starfield Cylinder (optional)
- cassette player
- recorded sounds
- (optional for the classroom) props to show differences in classification of animals

on the projector light. Have the students review what characteristics are necessary for survival during the nighttime hours.

- Beginning with insects, play prerecorded sounds while pointing out the following insects and animals.

Katydid. Katydids are in the grasshopper family. They can be found throughout the United States, but mostly east of the Great Plains. Katydids eat the leaves of the bushes or trees in which they are found.

Nighthawks feed entirely on insects caught on the wing, either by day or night. They build no nest, instead they lay eggs on the open ground or on flat, gravelled rooftops. Nighthawks are also known as "bullbats" and reach speeds of 22 m.p.h.

Raccoons are naturally nocturnal. Their level of activity at night depends on the availability of food, the weather, whether the animal is male or female, and if it is a full moon. Some scientists have found that raccoons are less active on full moon nights. Those that live near the ocean adjust their schedules to take advantage of low tides so that they can feed on animals exposed by the low water level.

Flying squirrels glide through the air from higher elevations to the ground using flaps of skin that extend between their fore and hind legs. They can glide 152 feet from a position 60 feet high. They are quick on the ground as well — they are able to cover 75 feet in 12 seconds.

Great horned owls are one of the largest owls found throughout the United States. They are formidable predators, preying on everything from insects to skunks.

Skunks spend the nighttime hours looking for food and investigating burrows. They are omnivorous, and will eat just about anything they come across.

White-tailed deer are found throughout North American except in areas of the southwest. They graze on vegetation at dusk and dawn. They eat large quantities very quickly so that they can go back under cover minimizing the exposure to predators. Once back in a protected area, they can regurgitate the food and rechew it.

Gray tree frogs can be found in the eastern half of the United States. They begin calling in late spring, when nighttime temperatures reach 50°. They have been known to call throughout the day, especially during thunderstorms. They can be found in deciduous forests or mixed deciduous /evergreen woodlands.

Luna moths are beautiful creatures. Their pale green wings spread an impressive five inches. They feed as caterpillars do mostly on the leaves of birch, willow, hickory, walnut, and oak trees.

Little brown bats can be found throughout most of North America, but rarely in large groups. They are efficient predators of insects. An individual bat can eat upwards of 600 mosquitos per hour! They use echolocation, a forerunner of radar, to find their prey.

Procedure

Have the students discover things about their own senses in the dark. Turn down the projection lamp as much as possible or switch over to the Urban Starfield Cylinder. Pretend you and your class are outdoors during a night hike. Have them complete the following activities to explore their own sense of sight.

1. Have the students cover their left eyes with their hands. Turn on a flashlight and have them stare at it with their right eye for one minute (don't use a laser pointer!). Then douse the light and have them alternate opening and closing their eyes and see how much better the left eye (the covered up one) is adapted to darkness.

2. Pass out white index cards and markers whose outside covering is the same color as the marker tip. Have the students write down the color of the marker they believe they have. Once you turn on the lights or exit the dome, you are will be able to see if they were correct. If they have written the word "red" in blue ink, then they know they actually had a blue marker. See if anyone was correct. If more than one person was correct, were the markers from the same color family? Talk about the two components of eyes — rods and cones — and the difference between them. Which do we have more of? Which do nocturnal animals have more of?

Follow-up Activities

1. Arrange a naturalist-led night hike in a local park for your students and their parents.
2. Have your students visit a local camp during the school year that provides programming, food, shelter for a two or three day stay.
3. Have the students write a short story about the adventures of a nocturnal animal.

Evaluation Suggestions

Play various night sounds and have the students identify the maker. Have the students define diurnal and nocturnal and give animal examples of each.

Suggested Resources

Caduto, Michael J. and Jospeh Bruchac, Keepers of the Night: Native American Stories and Nocturnal Activities for Children*. Fulcrum Publishers, 1994. 146 pp.*

Hickman, Pamela, The Night Book: Exploring Nature After Dark with Activities, Experiments and Information*. Kids Can Press, 1999. 48 pp.*

Lawlor, Elizabeth P., Discover Nature at Sundown: Things to Know and Things to Do*. Stackpole Books, 1995. 256 pp.*

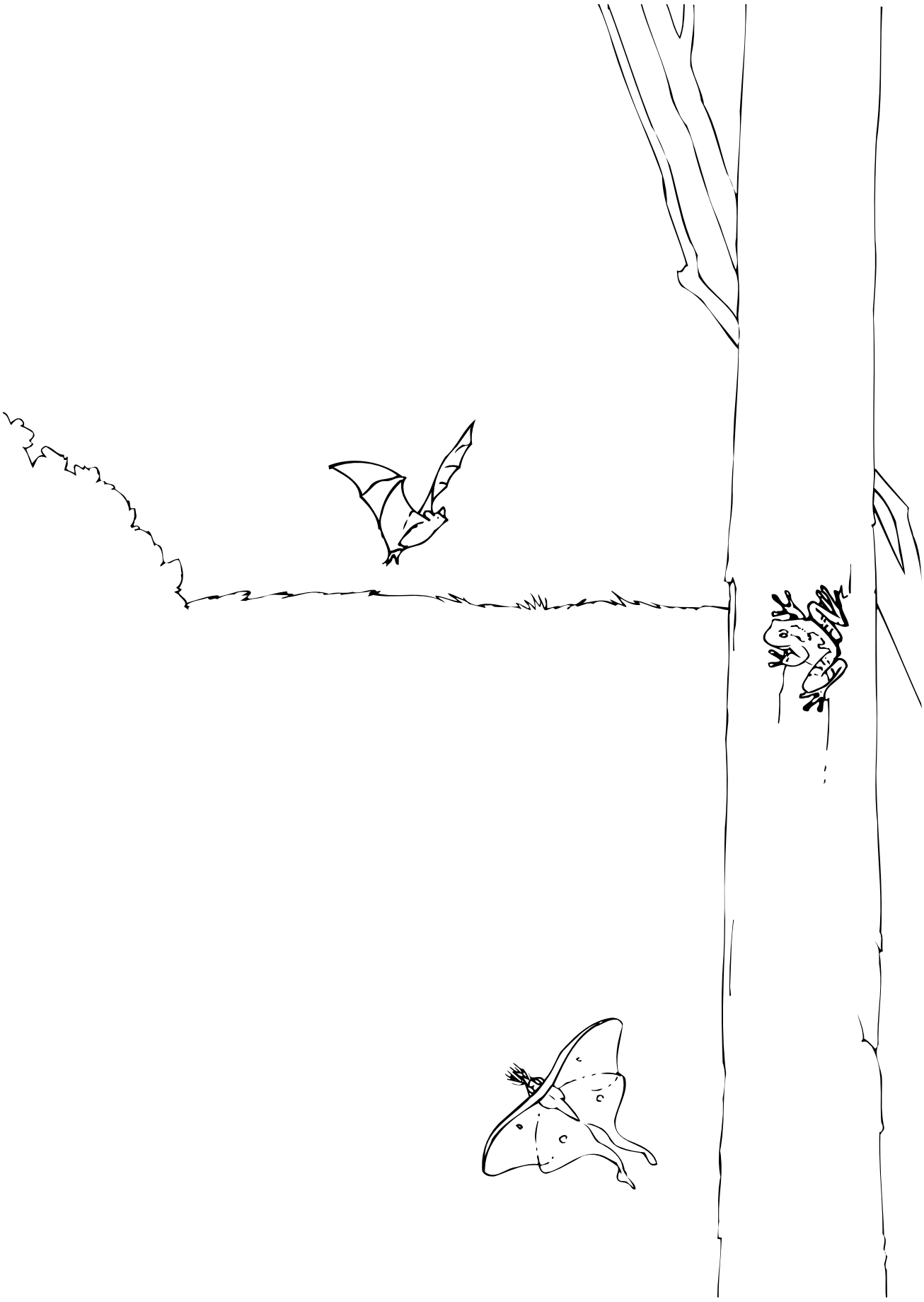
NorthWord Press, Inc., A Guide to Night Sounds *available as a cassette or compact disc.*

Palmer, E. Lawrence and Seymour H. Fowler, Fieldbook of Natural History*. Out of printz (try www.barnesandnoble.com or www.amazon.com for availability).*

Stokes, Donald, Stokes Backyard Nature Books*. Little Brown & Co.*

Nature at Night Illustration 1

Join left side of Illustration 1 to right side of Illustration 5. Join the right side of Illustration 1 to left side of Illustration 2.



Nature at Night Illustration 2

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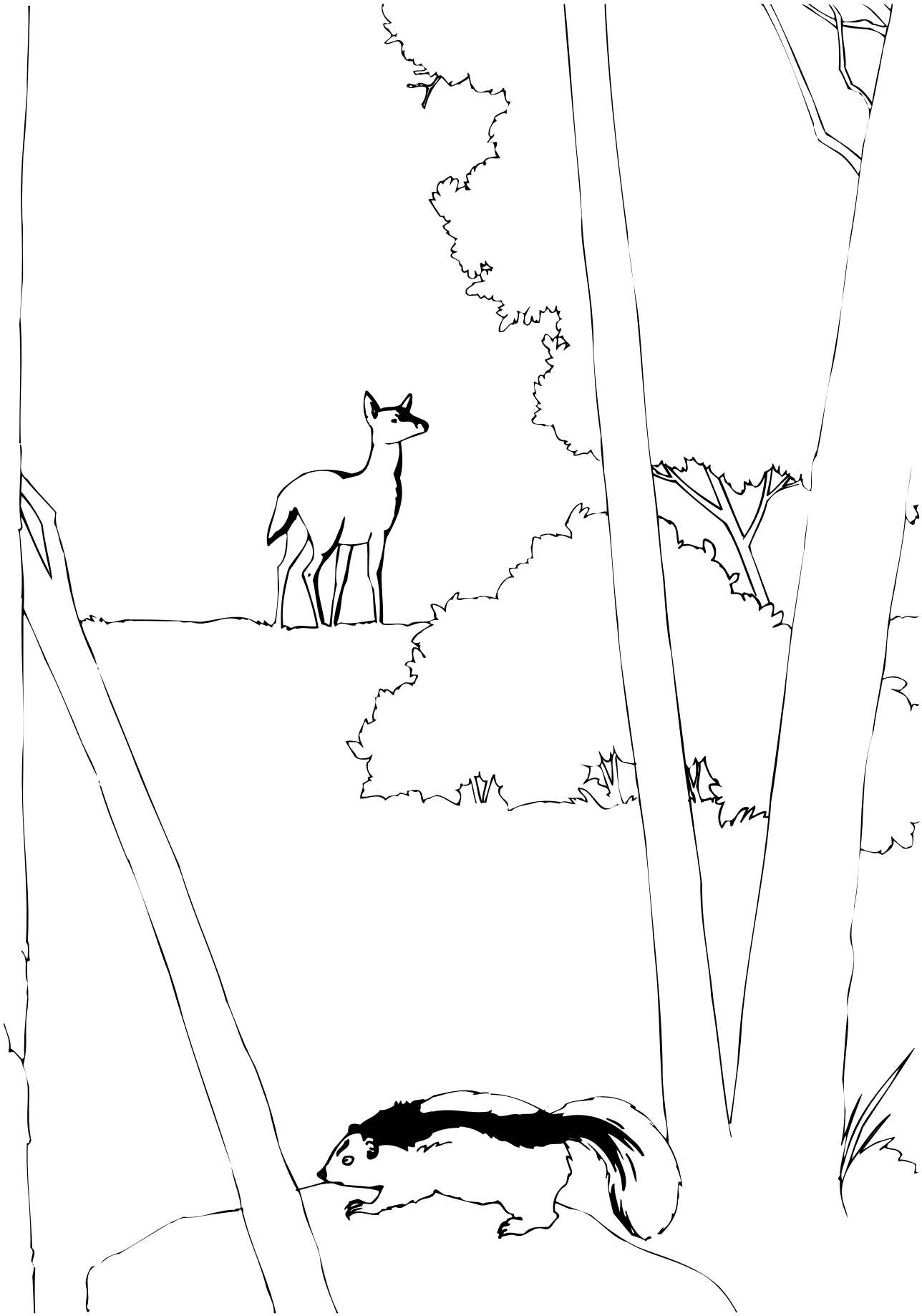

Nature at Night Illustration 3

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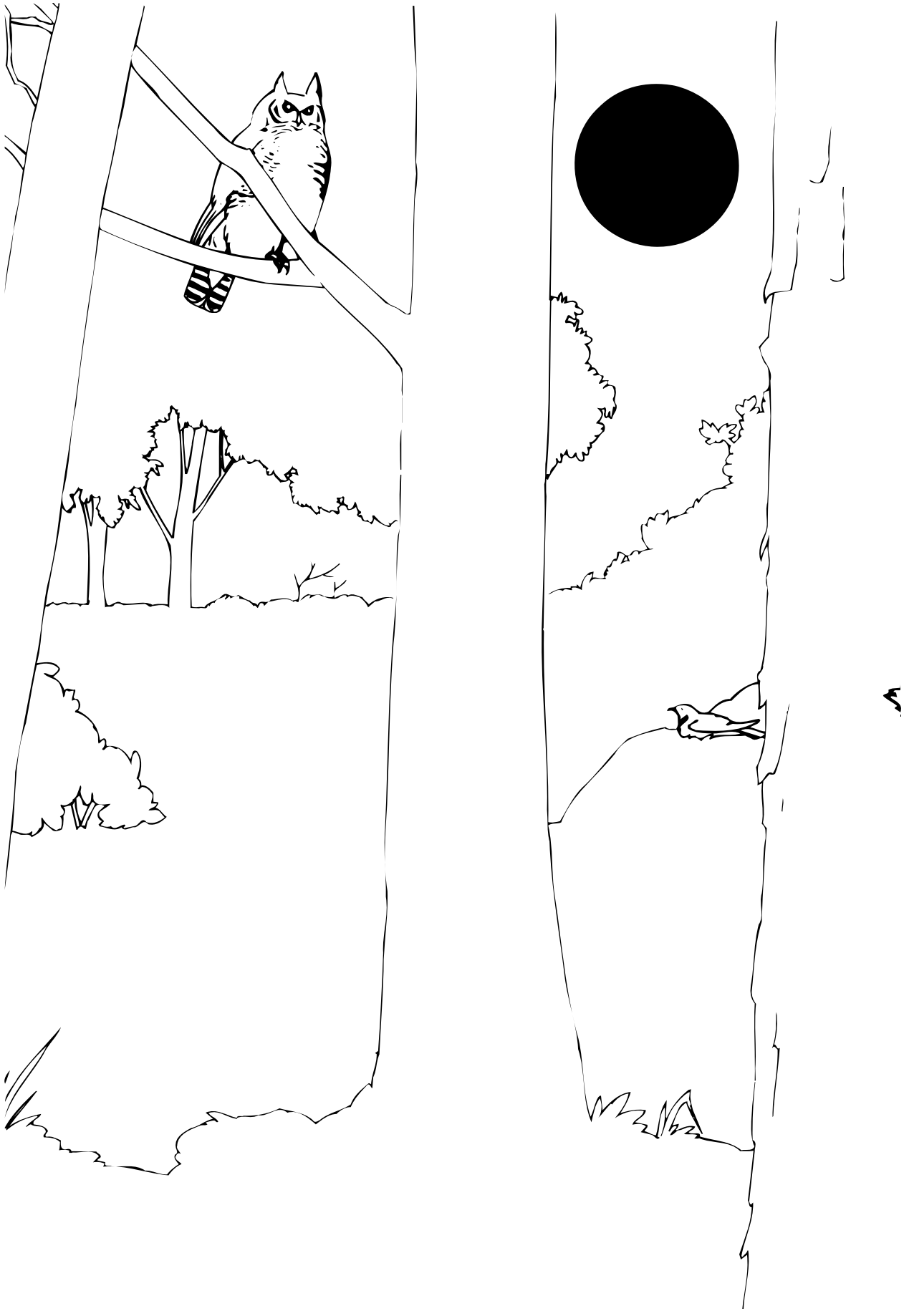

Nature at Night Illustration 4

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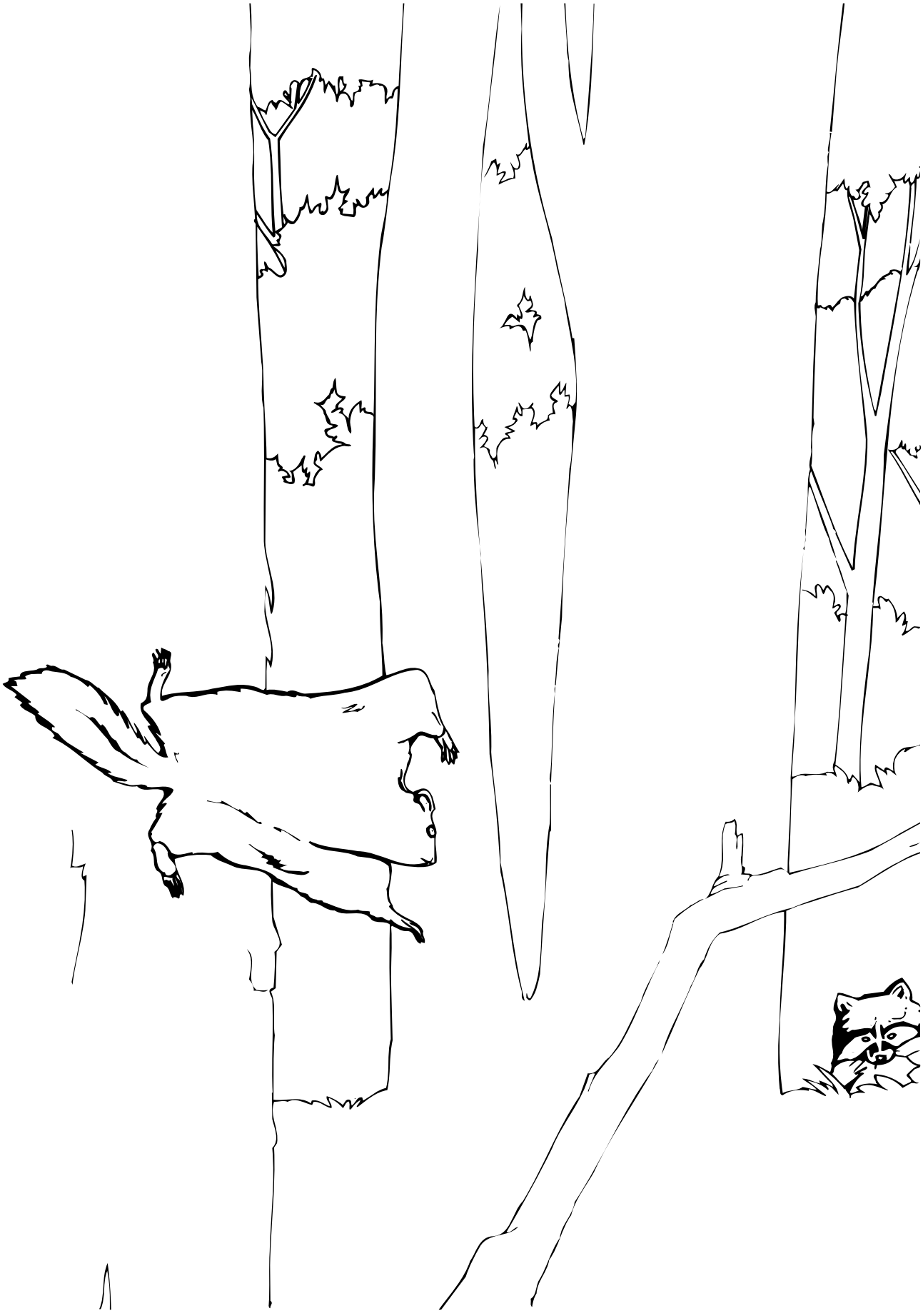


Nature at Night Illustration 5

Join left side of Illustration 5 to right side of Illustration 4. Join the right side of Illustration 5 to left side of Illustration 1.

Evolving Solar System

by Scott Negley

MATERIALS

- STARLAB Portable Planetarium
- Transparent Cylinder
- Evolution drawings
- black construction paper to cover the sides of the cylinder
- Kodalith reversing film

Purpose

To look at stellar evolution with emphasis on the future of our sun

Note

In my 25+ years as a planetarian the subject of stellar evolution with particular focus on our sun's future has captured the attention of audiences from upper elementary grade levels and up. The dramatic changes the sun will experience beginning in 5 billion years as it first swells to a red giant followed by its collapse to a white dwarf is awesome to contemplate for students of any age.

Typically, the main problem in presenting this program in a small planetarium is the inadequate portrayal of the extremes the solar diameter will encounter. The STARLAB Transparent Cylinder offers an excellent vehicle for demonstrating this dramatic effect.

Preparation

- Use the construction paper to form a mask for the sides of the Transparent Cylinder — this will allow projected light only through the top of the cylinder.
- Five Kodalith transparencies are utilized to show the sun's evolution to its final stage as a black dwarf. The six diagrams are shown in half-size scale and, when copied on Kodalith or other type of reversing film, will show the sun as a clear circle with the three inner planets as small dots on their respective orbits.
- Color can be applied to the sun image in each transparency if desired to show its color change from today's white-yellow to red giant. (I would suggest light blue be used for the earth and its orbit to better differentiate it from the other planets. Of course any coloring must be done lightly to minimize loss of brightness in the projections.)

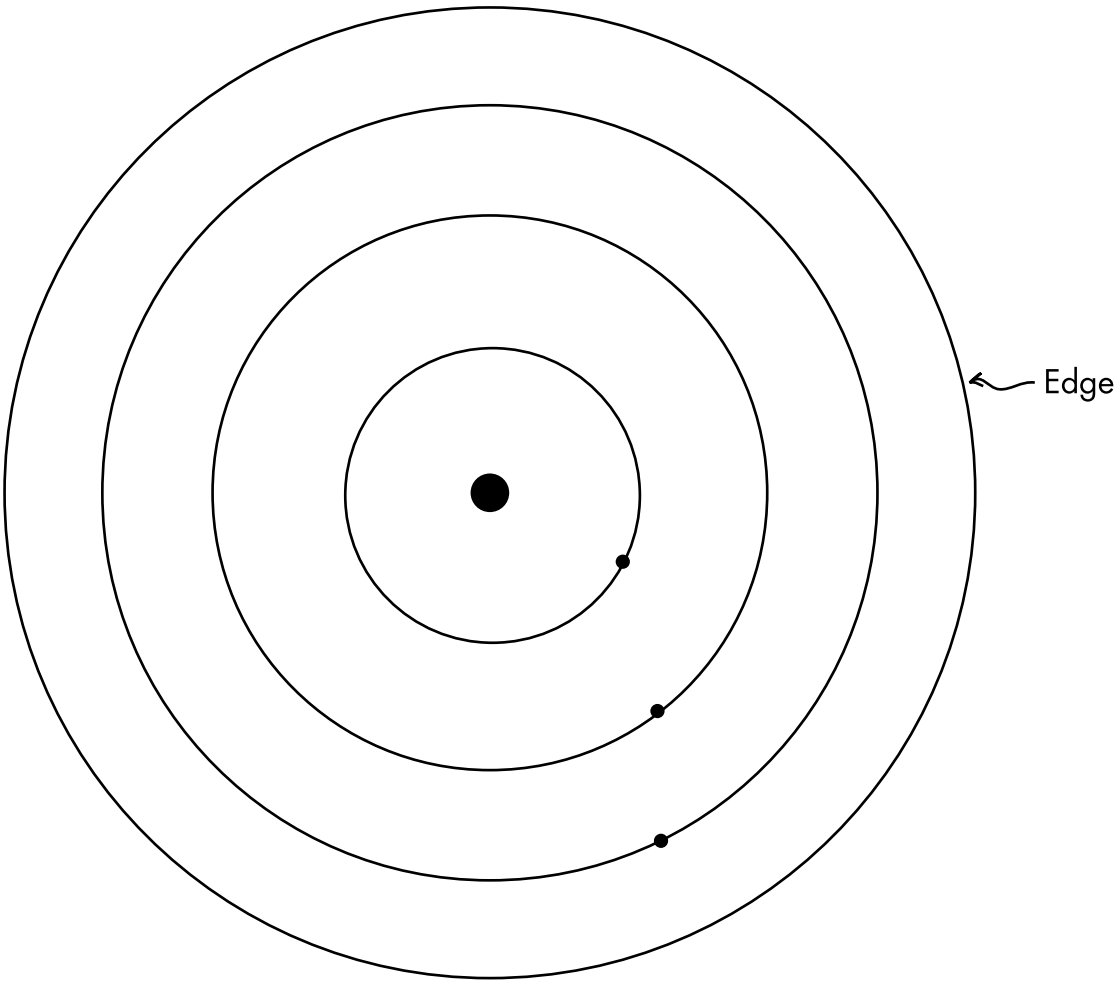
Procedure

Inside the STARLAB with the projector set up and the mask around

1. Display Transparency #1 to show the present sun with the inner planets Mercury, Venus, and Earth.
2. Transparency #2 shows the solar system five billion years from now — the sun will embark on an expansion that will initially threaten Mercury in its orbit.
3. In Transparency #3, the sun continues its expansion, engulfing Mercury and threatening Venus.
4. Transparency #4 shows the sun's expanding diameter as it overtakes the orbit of Venus, finally stopping its expansion short of a (by now) very scorched Earth.
5. After its red giant stage in Step 4, the sun undergoes a dramatic collapse to an extremely dense white dwarf shown in Transparency #5 with a diameter approximately equal to the Earth's. In this view, only the Earth and its orbit are shown as the planets Mercury and Venus have been consumed by the sun.

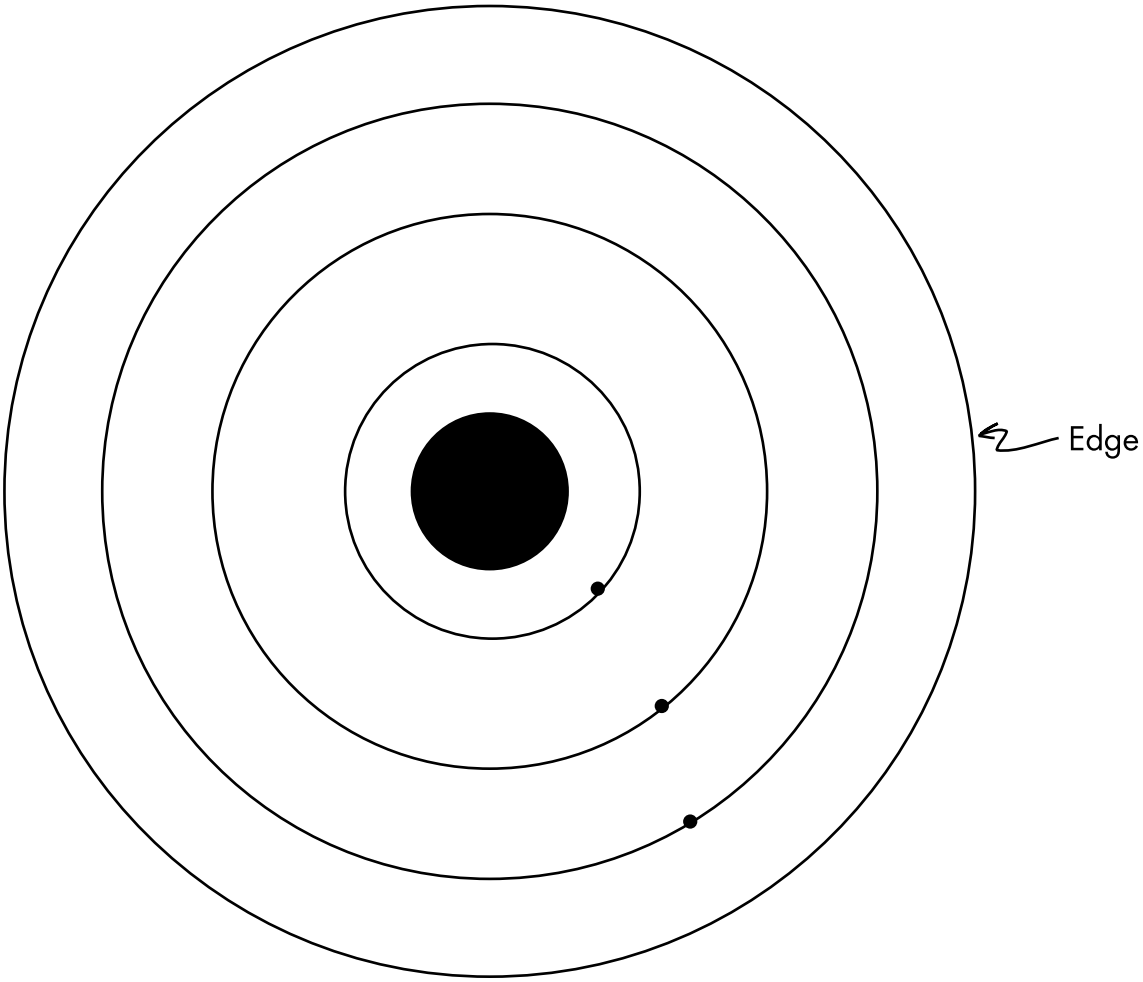
6. After perhaps hundreds of billions of years, the white dwarf sun will cool until no light is emitted, leaving it as a black dwarf dead star with the remaining planets circling it. This effect is achieved by placing a coin or other small opaque object over the white dwarf dot in Transparency #5.
7. Summary — To show the relative sizes of the current sun with its red giant and white dwarf stages use Transparency #6. In reality, the diameter expansion and reduction ratios from the current sun to its extremes are even greater but the size of the red giant was limited by the cylinder's diameter. Likewise, the white dwarf dot should be smaller but its projection then would probably not be visible. Still, I believe the sizes shown will give a reasonable impression of the sun's dramatic changes.

In recent years I have seen a variety of sizes suggested for the sun's red giant stage resulting in one, two or three planets being consumed by the sun. It appears that the general consensus is for the middle viewpoint (two planets, Mercury and Venus, gone with the Earth remaining but scorched) which is the position depicted in these transparencies.



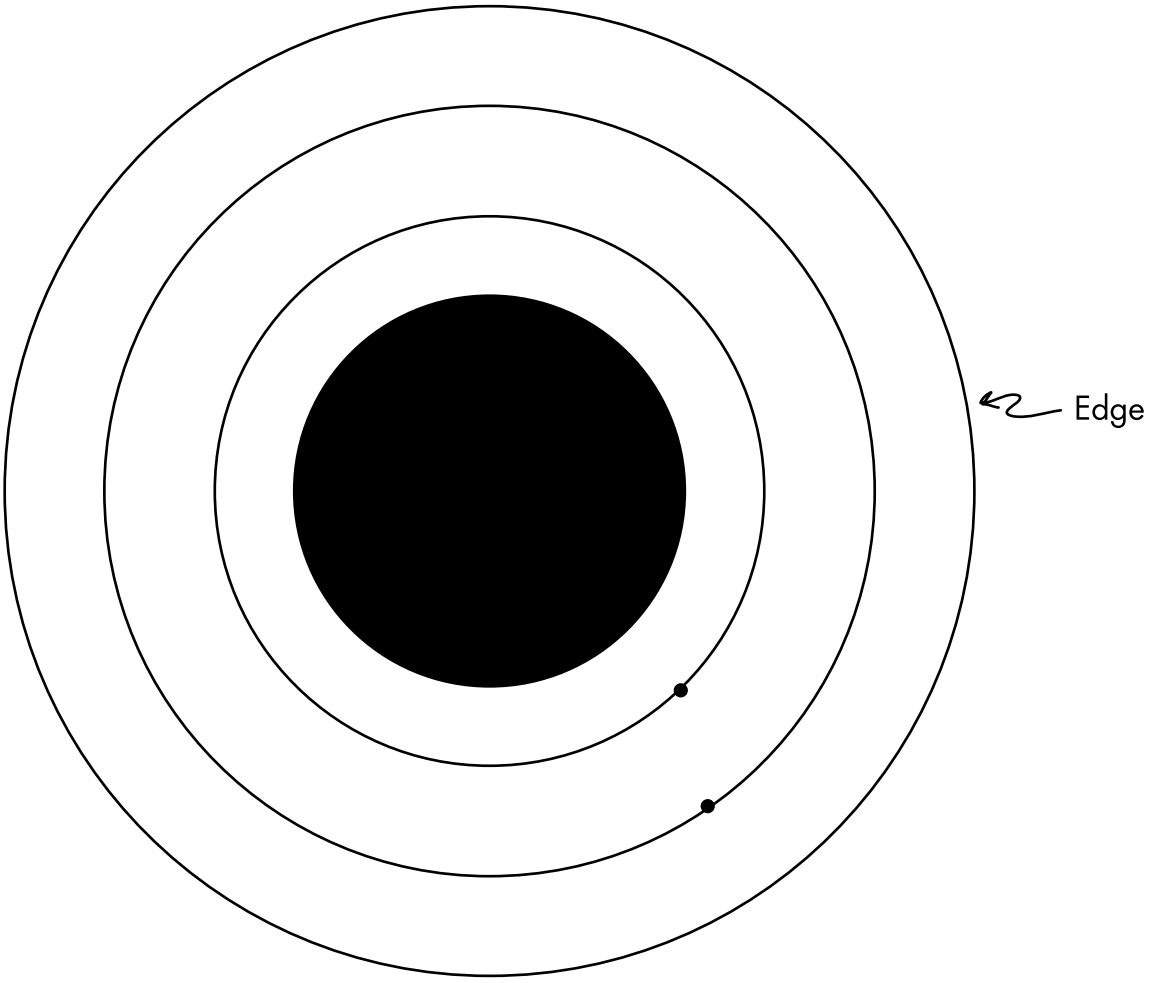
Transparency #1

The effect begins with the present sun with the inner planets Mercury, Venus, and Earth.



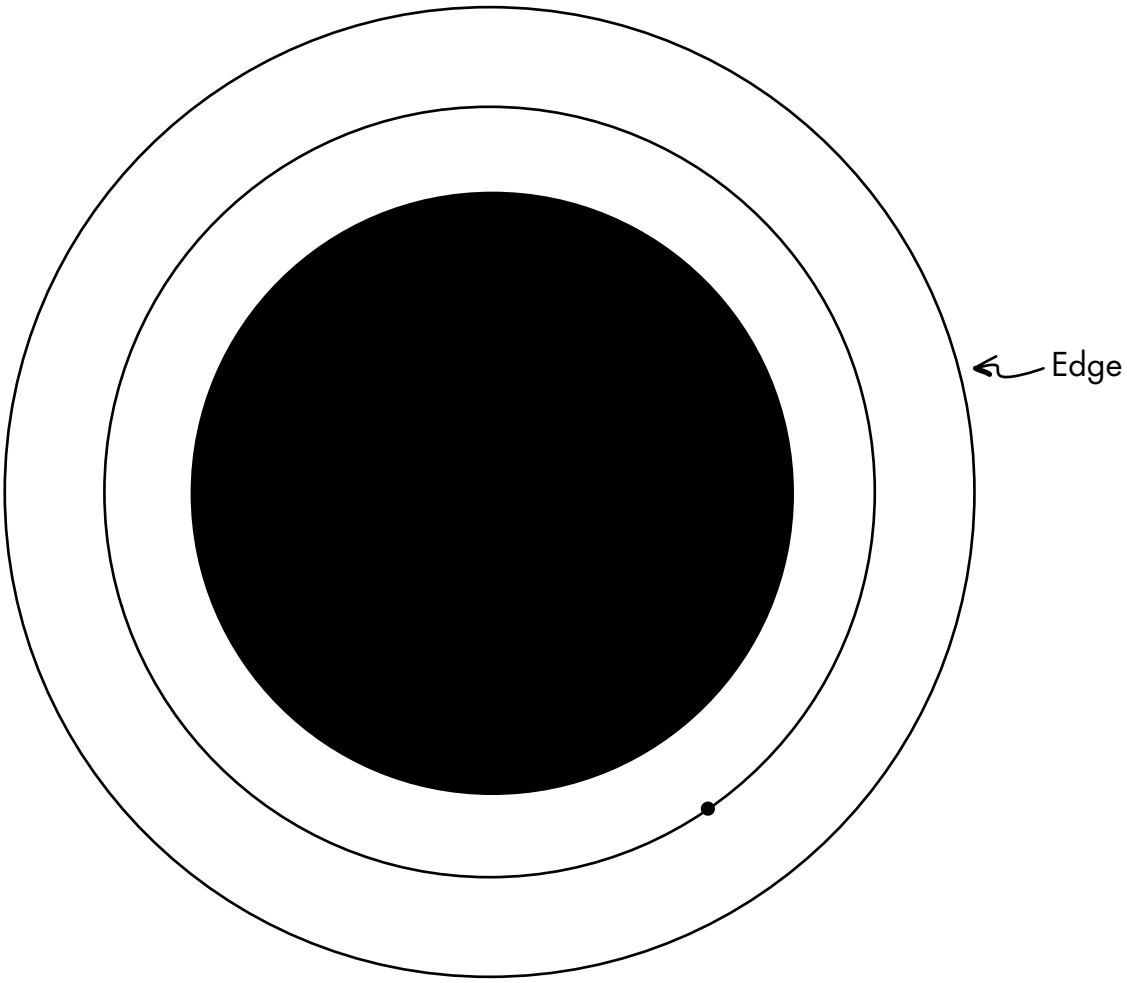
Transparency #2

The solar system five billion years from now — the sun will embark on an expansion that will initially threaten Mercury in its orbit.



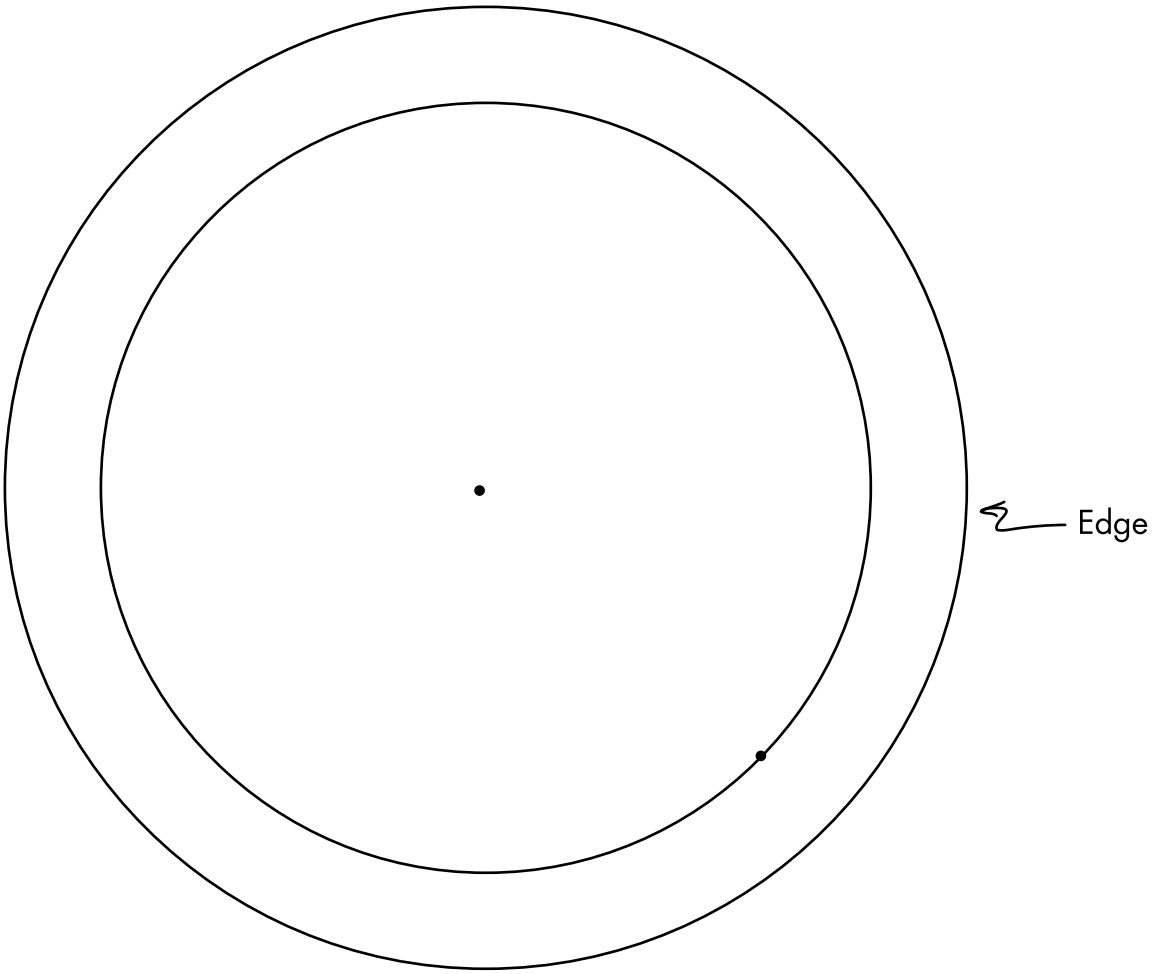
Transparency #3

The sun continues its expansion, engulfing Mercury and threatening Venus.



Transparency #4

The sun's expanding diameter as it overtakes the orbit of Venus, finally stopping its expansion short of a (by now) very scorched Earth.

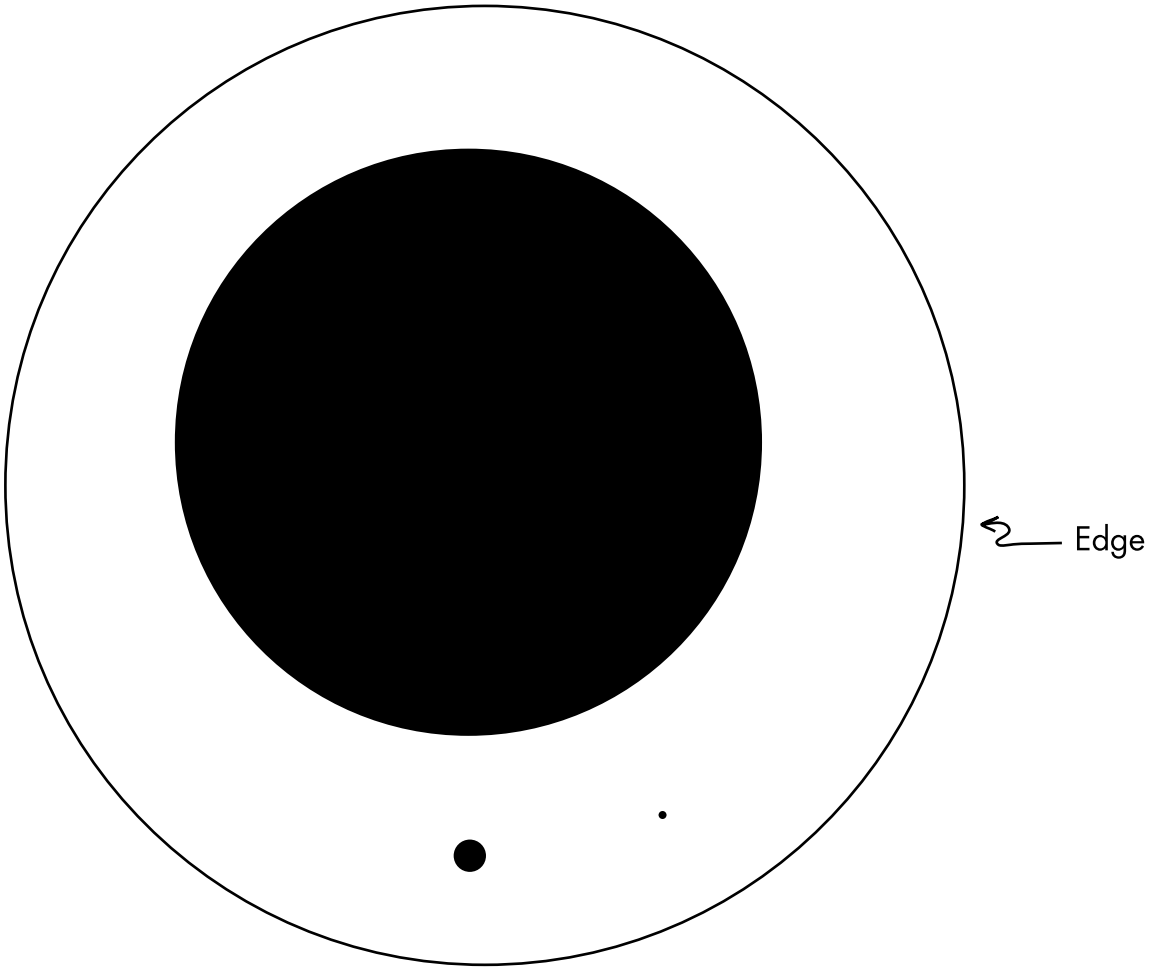


Transparency #5

After its red giant stage in Step 4, the sun undergoes a dramatic collapse to an extremely dense white dwarf shown here with a diameter approximately equal to the Earth's. In this view, only the Earth and its orbit are shown as the planets.

Mercury and Venus have been consumed by the sun.

After perhaps hundreds of billions of years, the white dwarf sun will cool until no light is emitted, leaving it as a black dwarf dead star with the remaining planets circling it. This effect is achieved by placing a coin or other small opaque object over the white dwarf dot.



Transparency #6

The relative sizes of the current sun in its red giant and white dwarf stages.

(In reality, the diameter expansion and reduction ratios from the current sun to its extremes are even greater but the size of the red giant is limited by the cylinder's diameter. Likewise, the white dwarf dot should be smaller but its projection then would probably not be visible. The sizes shown should give a reasonable impression of the sun's dramatic changes.)

Other Clever Ideas

by Stephen Berr

Art and Science

- The thing I like to do with the Transparent Cylinder involves art and science. As you know, 4 sheets of 8.5 x 11 paper taped vertically together go around the cylinder rather neatly. I copy appropriate pages from a coloring book. (Talented kids, ages 8-12, might be able to draw the pictures themselves.) The pages should be related to something being studied. For example, copy pages from a coloring book about dinosaurs, or undersea life, or the rain forest.
- These pictures are then copied onto transparency film, and (depending on budget) shared or given individually. A good way to work individually might be to divide the class into groups of four, with each group given a complete set of transparencies for one "cylinder go-around." If you are working with coloring books, different sets from the same book can be used so that all the groups are not working on the same thing. The coloring should be done with strong colored transparency markers that don't "crawl." Some colors work better than others. The children then either draw and color the pictures on the film, or color in the coloring book pictures. They must learn what is in their picture.
- Select 4 pictures and tape them together and then tape them around the cylinder. A piece of plain paper can be cut out in a circle and placed on top to shade the top of the dome, or another circular "sky pattern" or "overhead pattern" can be used. It is also best to experiment with a small (6 inch high or so) collar that can be placed around the bottom of the cylinder, with the colored transparencies sitting on top, and projected a bit above the cylinder. The paper circle top is then sort of a "hat" over all. The reason for raising the transparencies is to make them project better, and more fully. You want the lamp to be above the bottom edge of the transparency.
- These are then used in the dome, with the students who made the particular section of the transparency describing what they did, and what is represented in their picture. You can have several "shows" made up of different sets of 4 transparencies taped together. In this manner you have a new way of involving students in studying environments like rain forests, or undersea life or dinosaurs, or anything you can imagine. This kind of activity is probably best suited for a summation activity, or can even be used as an evaluation activity.

Cave Silhouettes

- I also have heard of a teacher who tapes silhouettes of stalagmites, stalagtites, bats, etc. all around the cylinder, and turns the dome into a cave. Sounds neat, and might even be a great Halloween activity!

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Thanks!

LTI would like to thank everyone listed above for their outstanding contributions to this collection of ideas for the Transparent Cylinder. Several of our contributors were winners of our Transparent Cylinder Contest held in 1997.