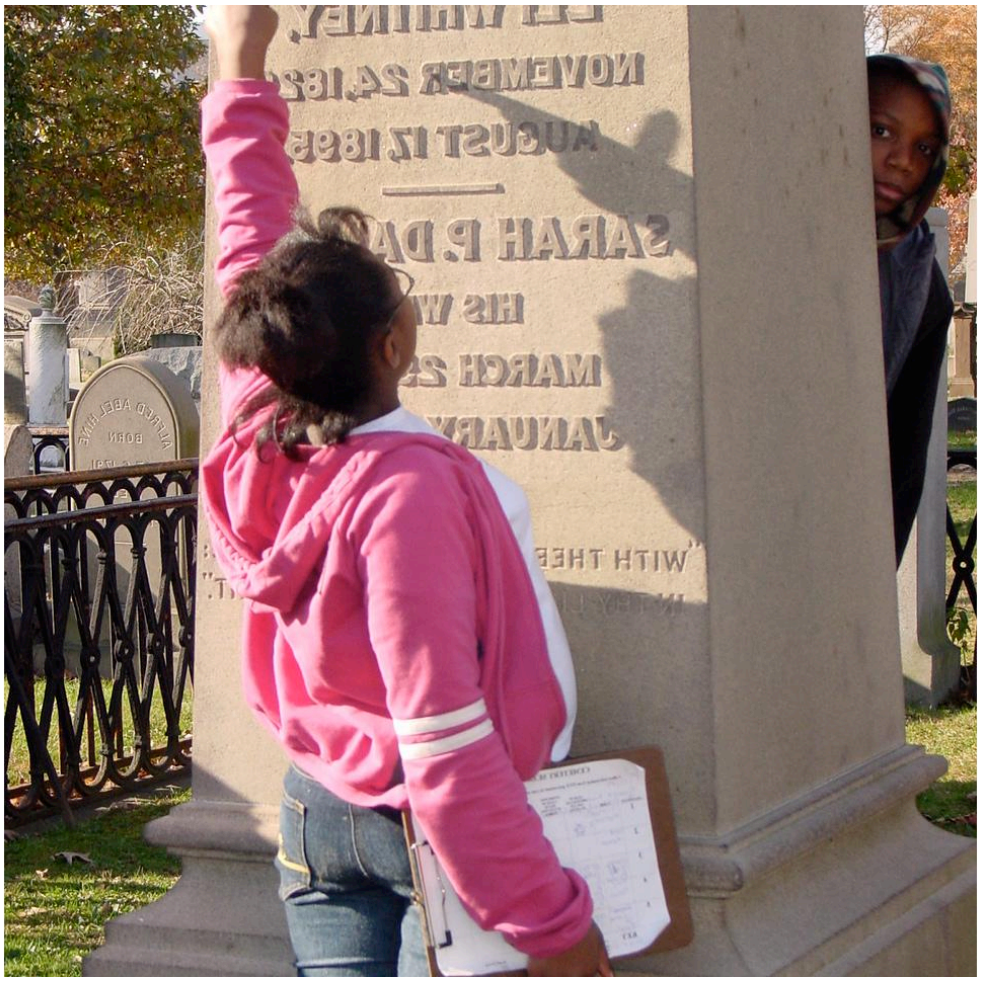
Open Spaces as Learning Places
CEMETERY UNIT



THE "OPEN SPACES AS LEARNING PLACES" PROGRAM

PROGRAM STRUCTURE

The Open Spaces as Learning Places program teaches environmental science through six curriculum units focused New Haven open spaces. The program takes place over 9 weeks in both the spring and fall semesters. Each year, we teach approximately 27 hours of science education to 200 New Haven 6th grade students. In addition, through teacher training workshops and on-going support, we provide professional guidance to New Haven public school teachers.

In the **Schoolyard Unit** students learn that even the schoolyard is part of the natural world. By studying New Haven's history and creating a wildlife enhancement project in their schoolyard, students recognize the role humans and nature play in shaping the landscape.

The **Greenspace Unit** raises student awareness of open space at the neighborhood level. Children learn about local stewardship efforts of neighborhood residents to restore open space by transforming vacant lots into greenspace sites, landscaping yards, and maintaining curb strips. Students note the effects of natural change on the neighborhood environment and examine the special adaptations that allow flora and fauna to thrive in their neighborhood habitats.

The **Park Unit** takes an ecological approach to open space by focusing on a nearby city park to teach students about natural communities and ecosystems within their local park. Students begin to appreciate the ecological significance of open space. They become aware of the dynamic state of nature as they observe materials cycling through the forest environment and learn about successional change.

The **River Unit** makes regional connections, showing how watersheds join together urban communities and suburban towns to open space areas. Students study stream dynamics to see how water shapes the Earth's surface. After learning that water is a limited resource, students identify sources of pollution that threaten local rivers. After a canoe trip on a nearby river, the children explore adjacent wetland habitats rich with wildlife.

The **Pond Unit** ties together concepts from previous lessons and uses the example of a local pond for the study. The children use physical, chemical and biological measurements to analyze water quality. As they sample pond life, students observe food webs, metamorphosis and adaptations to different pond habitats. The students see successional change and learn how overlapping ecosystems provide valuable edge habitat for wildlife.

The **Cemetery Unit** provides a geological overview of landscape change. Students discover that the Earth's crust, composed of rocks and minerals, moves slightly every day. At a local historic cemetery, students look for change over time on gravestones, noting differences in resistance to weathering among rock types. They also learn that cemeteries serve as wonderful habitat for urban wildlife.

To download any of these teaching materials for free, please visit www.urbanresourcesinitiative.org.

CEMETERY UNIT: SUMMARY

The cemetery unit provides a geological overview of landscape change. Students discover that the Earth's crust, composed of rocks and minerals, is reshaped slightly every day. Plate tectonics builds up the crust while weathering and erosion break it down. At a local cemetery, students look for change over time on gravestones, noting differences in resistance to decay among rock types. As the children use the markers to gather historical, social and environmental evidence about their community, they learn that cemeteries served as models for urban parks. The unit concludes with a look at seasonal change and lessons in wildlife tracking that encourage students to enjoy nature year-round.

CEMETERY UNIT: LEARNING OBJECTIVES

Journal

- Students demonstrate strategic writing skills by utilizing alternative reference sources. For example, they will locate a reference person who can give them information on changes in the city of New Haven over time and accurately record their responses to interview questions.

- Students demonstrate strategic speaking skills to plan and carry out an interview with an elderly member of the community.

- Students demonstrate strategic listening skills by writing down questions prior to a scheduled interview, and summarizing the essential information given by the interviewee.

- Students investigate the social life of people in New Haven thought time by performing an interview of an elderly long-term resident of their neighborhood.

Test/Worksheets

- Students can identify the components of the Earth's layer: a crust; a hot convecting mantel; and a dense metallic core.
  Review Sheet 6.1-Cemetery Review

- Students demonstrate an understanding of the types organisms that utilize cemeteries as their habitat.
  Worksheet 6.1-Cemetery Search

- Students investigate the social, political and economic life of people in New Haven thought time by performing an analysis of the gravestones in a cemetery.
  Worksheet 6.1-Cemetery Search

- Students can describe the regular and predictable motion of the Earth system and its relation to phenomena such as a day, a year, and the seasons.
  Review Sheet 6.2-Reasons for Seasons

- Students demonstrate an understanding of the characteristics of organisms by learning to identify and interpret various animal tracks.
  Review Sheet 6.1-Cemetery Review and Worksheet 6.2-Track Story

- Students observe similarities and differences in animal tracks.
  Review Sheet 6.1-Cemetery Review and Worksheet 6.2-Track Story

Classroom Performance

- Students simulate tectonic plate movement in relation to Connecticut's landforms and geology.

- Students are exposed to the history of cemeteries and develop an understanding of how New Haven pioneered the modern cemetery movement (that served as a model for public parks).

- Students classify and identify properties of different rocks and minerals.

- Students understand and describe the process through which igneous, metamorphic and sedimentary rocks are formed.

- Students construct a simple classification system for distinguishing rocks and minerals and name the properties used for this classification.

- Students observe similarities and differences in rocks and minerals.

- Students listen and respond to presentations by looking at the speaker and asking relevant questions.

- Students understand visual arts in relation to history and cultures through an examination of the monuments and gravestones in a New Haven Cemetery.

- Students demonstrate an understanding of the uses of natural resources, including the use of various types of rocks to create monuments and gravestones in cemeteries.

- Students work cooperatively in groups; e.g., share materials and help team members to explore the cemetery

- Students interpret the relationship between the signs and symbols on the gravestones and the diversity of culture and religion in New Haven.

- Students demonstrate competency in many movement forms through the imitation of various animal movements.

- Students demonstrate understanding and respect for the physical and performance limitations of others.

- Students demonstrate mental multiplication skills

- Students gain an understanding of principles of the reproduction of organisms in the context of conservation.

- Students work cooperatively as a member of a team on solving natural resource management issues.

- Students will identify and classify the geometric shapes that they see on track patterns.

- Students demonstrate an understanding of the sun as a powerful source of energy for all living things on the planet.

- Students demonstrate an understanding of the trade-offs or consequences of technology and development on the open spaces of New Haven through a classroom discussion**.**

CEMETERY UNIT

Science Curriculum Standards and - Grade 6		Classroom Activities									Outdoor Activities			Focus Activities					Journal
Content Standards	**Expected Performances**	Hardboiled Earth	Graham Cracker Tectonics	Connecticut Geology	Seeds on the Move	Worn Down	Building Blocks	Rock Candy	Rock and Mineral Sort		Cemetery Synopsis	Cemetery Search Overview	Cemetery Search	Reasons for the Seasons	Winter Survival	Animal Tracks	Track Stories	Resource Management	Recollections of New Haven
Scientific Inquiry, literacy, numeracy	**C INQ.1** Identify questions that can be answered through scientific investigation.												x						
	C INQ. 3 Design and conduct appropriate types of scientific investigations to answer different questions		x				x	x	x				x	x			x	x	
	C INQ. 5 Use appropriate tools and techniques to make observations and gather data												x						
	C INQ. 8 Draw conclusions and identify sources of errors		x				x	x	x				x	x			x	x	
	C INQ. 9 Provide explanations to investigated problems or questions		x				x	x	x				x	x	x	x	x	x	
	C INQ. 10 Communicate about science in different formats, using relevant science vocabulary, supporting evidence and clear logic		x				x	x	x				x	x	x	x	x	x	
6.2 Matter and Energy in Ecosystems	**C 5.** Explain how populations are affected by predator-prey relationships																	x	
	C 6. Describe common food webs in different Connecticut ecosystems																	x	
6.3 Energy in the Earth's Systems	**C 7.** Describe the effect of heating on the movement of molecules in solids liquids and gasses.	x																	
	C 9. Explain how the uneven heating of the Earth's surface causes winds and affects the seasons.													x					
6.4 Science and Technology in Society	**C 11.** Explain how human activity may impact water resources in Connecticut, such as ponds, rivers and the Long Island Sound ecosystem					x													

CEMETARY UNIT

English Language Arts Standards and Curriculum Framework - Grade 6		Classroom Activities								Outdoor Activities			Focus Activities				Journal
Content Standards	Expected Performances	Hardboiled Earth	Graham Cracker Tectonics	Connecticut Geology	Worm Down	Building Blocks	Rock Candy	Rock and Mineral Sort	Cemetery Synopsis	Cemetery Search Overview	Cemetery Search	Reasons for the Seasons	Winter Survival	Animal Tracks	Track Stories	Resource Management	Recollections of New Haven
1.1 Students use appropriate stategies before, during, and after reading in order to construct meaning	**a.** Activate prior knowledge, establish purposes for reading and adjust the purposes while reading.														X		
	c. Select and organize relevant information from text to summarize.														X		
1.2 Students interpret, analyze, and evaluate text in order to extend understanding and appreciation	**a.** Generate and respond to questions.		X														
	e. Discuss and respond to texts by making text to-self, text-to-texy and text-to-world connections.										X						
1.3 Students select and apply strategies to facilitate word recognition and develop vocabulary in order to comprehend text.	**d.** Develop vocabulary through listening, speaking, reading and writing.	X	X		X	X	X		X					X			
	e. use content vocabulary appropriately and accurately (math, music, science, social studies, etc).							X			X				X		
1.4 Students communicate with others to create interpretations of written, oral, and visual texts.	**a.** respond to the ideas of others and recognize the validity of differing views																X
3.1 Students use descriptive, narrative, expository, persuasive, and poetic modes.	**a.** use oral language with clarity, voice and fluency to communicate a message.		X														X
	c. use the appropriate features of persuasive, narrative, expository or poetic writing.																X
3.2 Students prepare, publish and/or present work appropriate to audience, purpose, and task.	**d.** research information from multiple sources for a specific purpose.										X						X
	f. publish and/or present final products in a mynad of ways, including the use of the arts and technology.																X
4.2 Students seek and write using standard language structures and diction appropriate to audience and task.	**a.** use sentence patterns typical of spoken and written language to produce text.																X

CEMETERY UNIT

Math Curriculum Standards and Framework - Grade 6		Classroom Activities							Outdoor Activities			Focus Activities					Journal
Content Standard	**Expected Performances**	Hardboiled Earth	Graham Cracker Tectonics	Connecticut Geology	Worn Down	Building Blocks	Rock Candy	Rock and Mineral Sort	Cemetery Synopsis	Cemetery Search Overview	Cemetery Search	Reasons for the Seasons	Winter Survival	Animal Tracks	Track Stories	Resource Management	Recollections of New Haven
1.1. Understand and describe patterns and functional relationships.	a. (1) Describe, analyze and extend numeric geometric and statistical patterns and use them to identify trends and justify predictions.															x	
2.2. Use numbers and their properties to compute flexibly and fluently, and to reasonably estimate measures and quantities.	a. (1) Estimate and predict reasonable answers and recognize and explain when an estimate will be more or less than an exact answer.		x														

CEMETERY UNIT:
BACKGROUND INFORMATION

The cemetery unit provides a geological overview of landscape change using hands-on activities and field study. Students learn that change occurs every day through plate tectonics. Children use models to recreate geologic events and examine rocks and minerals that make up the Earth's crust. A visit to a local cemetery takes students full circle, back to the beginning of the program, when they learned about the history of New Haven. Students search for direct evidence of change over time by gathering historical, social and environmental information from gravestones to gain a better understanding of their community. The unit ends with a look at the seasons for a year-round perspective on environmental change. Students learn about winter survival strategies and develop wildlife tracking skills that enhance environmental awareness and encourage nature exploration.

Classroom geology lessons teach students that the Earth consists of three layers: (1) **crust**—a thin rocky skin that covers the planet; (2) **mantle**—a thicker layer underneath the crust that is hotter and denser than the crust and is made up mostly of rock; and, (3) **core—**a mass of heavy metals at the center of the Earth that is much hotter and denser than the mantle.

There are two kinds of crust: **continental crust** and **oceanic crust**. The continental crust that makes up the continental landmasses is lighter than the dense oceanic crust that lies under the oceans. The crust and the uppermost layer of the mantle combine to form a rigid zone called the **lithosphere** that floats on top of the molten rock of the lower mantle (the **asthenosphere**). The lithosphere is split up into separate pieces called **plates**. There are six major plates and seven smaller ones that drift around like icebergs on the molten lower mantle. The plates carry the continents and oceans as they float about, coming together (**converging**) and moving apart (**diverging**). The movement of the plates is called **plate tectonics**. Even though the plates move very slowly (about as fast as fingernails grow), over millions of years they have moved enough to create seven continents separated by oceans from one supercontinent, and they continue to change the landscape.

Most geological activity occurs where two plates meet. A **transform boundary** is where two plates slide sideways past each other, creating **earthquakes** with the slipping motion. There is also earthquake activity along cracks in a single plate. The place where two different plates or two parts of a single plate come together and move against each other is called a **fault line**. As the plates slowly move together and apart, volcanoes are produced when the molten rock or **magma** from the mantle is exposed. Magma that reaches the surface is called **lava**. When the molten rock cools, it forms new crust, often in the shape of mountains. In places where continental crust meets oceanic crust, the dense oceanic crust slides under or **subducts** the edge of the other. The oceanic crust and the water that covers it heat up with pressure building as it dips down toward the mantle, creating explosive volcanoes. When continental crust meets continental crust, mountains are formed as the crusts crumple or **fold**.

Five hundred million years ago, the Earth looked very different with oceans and landmasses in different shapes and locations. Approximately 250 million years ago, there was a **Great Collision**. Plates moved together to form a huge landmass or super continent called **Pangea**. The area that would later be called Connecticut was at the heart of this Great Collision. It was crumpled and folded. About 200 million years ago, Pangea cracked and broke apart. As the super continent split into the continents we see today, Connecticut cracked but it did not break apart. As the land mass pulled apart, a trench fault formed, causing a huge block of crust from the Connecticut shoreline to Massachusetts to sink down below the level of the surrounding area. In this way, the twenty mile wide central valley lowland was created. Volcanic lava came up through the cracks of the original fault, cooling to form a layer of **basalt**. Rain washed sand, clay and gravel over the basalt and then the process repeated itself. As time passed, slippage along the fault caused the sides of the valley to press inward towards one another. This movement broke up layers of basalt (also known as **traprock**) into sections, and caused them to tilt. West Rock and East Rock are traprock segments that were forced upward through the Earth's surface when the valley sides pushed together. The geologic history of Connecticut can be easily summarized using three words: crunch, crack and squeeze.

The Earth is changing all the time. Plate tectonics builds up and recycles the Earth's crust while **erosion** and **weathering** wear it down. Physical and chemical weathering causes rocks to fragment, crack, crumble or break down. Water can force a rock to split when it seeps into cracks and freezes. Plants can also break up rocks when they grow in cracks. Chemical reactions with air and water break down rocks as well. Some minerals produce weak acids when they mix with rainwater. These acids slowly dissolve rocks. The mixing of emissions from factories and automobiles with water in the atmosphere creates **acid rain**. When acid rain falls to the Earth's surface it also decomposes rocks. Materials are worn away further by erosion that loosens and carries away the rock debris caused by weathering. Water, wind and ice are important agents of erosion. The sediment they move is deposited elsewhere, creating new landforms. Over time, erosion and weathering change the shape of the landscape.

Over 100,000 years ago, all of Connecticut was covered with ice by a **glacier** that was 1200-1500 feet thick. As the glacier advanced, rocks were pushed along, scouring the landscape. The glacier also compressed materials into hills and ridges. When the glacier started to retreat, melting ice produced great rivers of water that cut the Connecticut valley more deeply. Large quantities of clay, sand and gravel were deposited as water flowed down toward the ocean. Remnants of the glacier can be seen today. Judges' Cave at the top of West Rock is a formation of erratic boulders left behind by the retreating glacier, and Long Island was created by glacial debris.

Minerals are the building blocks of the Earth. Minerals are inorganic solids that do not form from living things. There are many different types of minerals, each with its own physical properties, chemical composition and characteristic crystal shape. Minerals occur naturally and are the same through and through. Minerals combine to form **rocks** that make up the Earth's crust, mantle and core. Rocks contain more than one substance and can include organic materials. They are formed in three different ways. When molten rock or magma hardens, **igneous** rock is made. Another way rock is formed is through layering. **Sedimentary** rocks are created when weathered and eroded materials are deposited in layers and compressed. When plants and animals get trapped and

preserved between layers of sedimentary rock, fossils are formed. Fossils are clues to the past that help us date rocks, act as environmental indicators and provide valuable information about patterns of evolution. When igneous or sedimentary rock changes form through heat or pressure, it becomes **metamorphic rock**.

A visit to a cemetery offers a glimpse of the past and traces change over time that reinforces and expands student understanding of geological concepts. Students discover that even though cemeteries are burial grounds for the dead, they also offer a park-like atmosphere for passive nature recreation and provide important habitat for wildlife. Graveyards are social and historical landmarks as well as valuable open space. In fact, the **cemetery movement** laid the groundwork for the public park movement with graveyards serving as models for urban parks. Cemeteries provide important information about disasters, epidemics, wars, occupations, lifespan, family structure and economic status. In addition, a close look at gravestones reveals environmental and geologic evidence of long-term weathering and erosion. The date on the marker shows how long the stone has been exposed to the elements. Gravestones are made of igneous, metamorphic and sedimentary rocks with granite (an igneous rock) showing more resistance to decay than sandstone, slate and marble (sedimentary and metamorphic rocks). Vegetation (tree roots, moss and lichens), wildlife tunneling, graveyard maintenance (weed whacking, mowing, digging etc.) can hasten the deterioration of cemetery monuments, sometimes causing gravestones to tilt or even split.

Unit activities give students a global perspective on change over time. Final lessons teach students about seasonal change by showing them how the Earth's tilt on its axis creates different **seasons** as it orbits around the sun. The Earth moves in two distinct ways. In a 24-hour period or one **day**, the Earth makes one full **rotation** on its axis. This movement accounts for daytime and nighttime. The Earth is tilted to one side at a 23 degree angle. Summer in the Northern Hemisphere is when the North Pole is tilting towards the sun. The sun is shining more directly on the Northern Hemisphere and there are more hours of sunlight. When the North Pole is tilted away from the sun, it is winter in the Northern Hemisphere with less direct sunlight and fewer hours of daylight. The Earth **orbits** around the Sun in 365 1/4 days or one **year**. The sun warms and lights up the Earth from 93 million miles away. It provides energy for all living things on the planet. Seasonal variations in heat and sunlight have a profound impact on living things on the planet.

Winter showcases nature's amazing ability to adapt to changing conditions. Northern animals have different adaptations for coping with winter as temperatures drop and snow makes travel more difficult. Food and water are harder to find because plants have shut down and water is locked up in frozen soil. In response to these seasonal changes, some animals **migrate** to areas with less severe conditions, and others become **dormant** (inactive during particularly harsh times) or they **hibernate** (remain inactive for an extended period of time) to wait out the coldest times of the season. But there are many animals that remain **active**, working hard to find food and water and to stay warm. Each winter strategy is a gamble with many animals unable to survive to spring. An animal's physical and behavioral characteristics determine its winter survival strategy.

Wildlife tracking is a wonderful way to enjoy nature year-round. **Tracks** are evidence that wildlife has been around even when animals have not been seen. They help

identify wildlife and provide valuable information about ecosystem interactions, habits and behavior.

It is important to remember the three P's when animal tracking: **pattern**, **print** and **place**. A motto among animal trackers is, "When in doubt, follow it out!" The first step in tracking wildlife is to determine the movement pattern. Body and movement features revealed by tracks make it possible to separate an animal into one of four movement pattern categories: **walkers** (hoofed animals and members of the dog and cat families), **waddlers** (heavy bodied, short-legged animals such as muskrat, beaver, opossum, raccoon, skunk, porcupine, woodchuck and bear), **hoppers** (most members of the rodent family and the lagomorphs – hare and rabbit) and **bounders** (most members of the weasel family). Next, the focus is on differences among groups of animals in each category to try to narrow down the species by measuring the size of the track, the **stride** (the distance between two prints or between sets of prints) and the **straddle** (the width of the tracks from the outer edge of one print to the outer edge of the next print or across the set of tracks). These measurements help estimate the approximate size of an animal. Finally, a tracker relates the location of the tracks to habitat preferences for a more accurate identification of wildlife species. Tracking recreates the story of what an animal was doing, where it was going, how fast it was moving, when it was there and how many other animals were around. Tracking skills encourage students to continue their search for nature past the *Open Spaces As Learning Places* program.

CEMETERY UNIT:
CLASSROOM ACTIVITIES

CLASSROOM ACTIVITY ONE

Title: Hardboiled Earth
Objectives: Students will learn about the Earth's structure and the relationship between the planet's crust and its other layers.
Time: 10 minutes
Materials: Pot, water, stove, eggs and a knife
Preparation: Hard boil eggs and let cool before class.
Procedure:

- Students work in pairs. Give each group a hardboiled egg. Explain that the egg is a model of the planet, Earth. The different parts of an egg (shell, white and yolk) correspond to the Earth's three layers: 1) a thin outer crust; 2) a thicker mantle; and, 3) a core. Crack open a demonstration hardboiled egg to show the inside structure.
  1) Crust – the layer that the students walk on is a thin rocky skin that covers the planet. There are two types of crust: continental crust and oceanic crust. The continental crust that makes up the continental landmasses is lighter than the dense oceanic crust that lies under the oceans.
  2) Mantle – the layer underneath the crust is hotter and denser than the crust and is made up mostly of rock. The part of the mantle lying directly beneath the crust is cooler and more rigid than the lower parts of the mantle that are hot, weak and actually flow at a very slow rate even though they are solid. The crust and the uppermost layer of the mantle combine to form a rigid zone called the lithosphere that floats on top of the molten rock of the lower mantle (the asthenosphere).
  3) Core – in the center of the Earth is a mass of heavy metals that is much hotter and denser than the mantle. The outer core is molten and the inner core is solid. The heat from deep within the Earth triggers convection currents in the mantle causing hot materials to rise, spread out, cool and then sink.
- Ask the students to break the shell of their egg by gently tapping it on their desk and rotating it to create cracks all the way around the egg. Explain that the lithosphere (the crust and the uppermost layer of the mantle) is not a single sheet of solid rock. Just as the shell of the egg is cracked, the lithosphere is divided into separate pieces called plates. There are six major plates and seven smaller ones that drift around like icebergs on the molten lower mantle. These plates carry the continents and oceans as they float about, coming together (converging) and moving apart (diverging). Ask the students to push together pieces of the eggshell and pull apart others. Describe how the Earth is moving and changing all the time. The movement of the plates is called plate tectonics. Even though the plates move very slowly (about as fast as finger nails grow), over millions of years they have moved enough to create seven continents separated by oceans and continue to change the landscape.

Adapted from Stone Wall Secrets Teacher's Guide, pp. 49-50 and NatureScope's Geology: The Active Earth, pp. 3-4

CLASSROOM ACTIVITY TWO

Title: Graham Cracker Tectonics

Objectives: Students will see the landscape changes that take place when the plates move.

Time: 10 minutes

Materials: Plate boundary handouts (Worksheet 6.1), wax paper, plastic knives, chocolate frosting, graham crackers, plastic cups and water

Preparation: Wrap one half cup frosting in wax paper for each pair of students.

Procedure:

- Students work in pairs. Give each group wax paper with frosting, a plastic knife, and four graham cracker halves. Tell them that the materials will be used to study plate tectonics. Ask them if they can guess what the different items represent (graham crackers – plates, frosting – molten rock from the mantle called magma). They will create geologic events with their graham cracker plate tectonic models. Explain that the most geological activity occurs where plates meet. Point to the plate boundaries on the handout and locate Connecticut on the map to show that it is not near a plate boundary.
- Have the students spread the frosting with a knife and lay down two crackers side by side with the long edges almost touching each other.
- Ask them to push the crackers together without pressing down. Have them scrape the crackers against each other, up and down. The students should hear a crunching noise as the crackers catch and scrape. Explain that they have created a transform boundary where two plates slide sideways past each other. See if they can guess what happens as a result of the slipping motion (earthquakes). A large crack in a single plate or the place where two different plates come together and move against each other is called a fault line. Describe how the Pacific and North American Plates are sliding past each other in California at the San Andreas Fault. Show them the location on the handout. Tell them that in 1906, there was an earthquake so large along this fault line that the earth moved 20 feet in less than one minute. Have them imagine what it would be like to have the special tree that they had been watching at their house end up in their neighbor's yard after an earthquake. Tell them that because Connecticut is in the middle of a plate, there is not the same level of geological activity as on the West Coast of North America where two plates meet.
- Ask the students to separate the crackers slowly so that an inch of frosting is exposed. When magma reaches the surface of the Earth, it is called lava. Have them guess where they might expect to find lava (volcanoes). Tell them that when the hot, molten rock is exposed, it cools to form new crust. In the middle of oceans, plates pull apart or diverge and new oceanic crust is formed at these oceanic rifts. The magma that flows out of divergent cracks is a very liquid type of lava that cools to form basalt. Explain that this is what is happening in the Atlantic Ocean and locate it

on the handout. At the Mid-Atlantic Ridge, the North American plate is moving away from the Eurasian plate. Europe is being pushed away from North America as the Atlantic Ocean widens. If the students flew to Europe every year from Connecticut, their trip would be a little bit longer each year.

- Ask the students to push the crackers together, pressing down slightly. As they watch frosting ooze up between the crackers, see if they can guess what they just created (volcanoes). Ask them what forms after the lava cools (crust in the shape of mountains). Describe how the type of eruption determines the shape of the mountain. A more powerful explosion produces a cone-shaped mountain while a less severe eruption creates one that is dome-shaped. Explain that they have simulated converging plates. Tell them that when plates converge one of two things can happen depending on the substrate: subduction or folding.
- Have them continue to push the crackers together, pressing down a little harder on one cracker than the other. Tell them that in cases where two plates converge and oceanic crust meets continental crust, the denser oceanic crust slides under or subducts the edge of the other. The oceanic crust heats up as it dips down towards the mantle. Pressure builds up until a powerful eruption of thick lava and other material explodes as at Mt. St. Helens in 1980. That explosion was so strong that hot mud and ash flowed down at 100 miles per hour. Show them the Cascade Range in the Pacific Northwest on the handout.
- Ask the students to remove the two crackers. Come around to each group and have them dunk one edge of each of the two remaining crackers in a cup of water for a few seconds. Have them place the crackers on the frosting with the soggy sides just touching each other. Ask the students to gently push the crackers together so they can see both crackers fold as they resist subduction. Have them guess what they have just made (mountains and/or hills). Explain that when continental crust collides with continental crust, there is a crumpling as both crusts deform into mountain ranges. Find India on the handout and explain that this process is going on today in the Himalayan Mountains. India is converging with Asia, creating a folding of land that continues to build the Himalayas, home to the world's highest continental mountain, Mt. Everest.
- Be sure the students understand that volcanic eruptions in the ocean can create islands with huge mountains. It is believed that a hot spot under the plate in the Pacific Ocean formed the Hawaiian Islands. Mauna Kea on the island of Hawaii is the tallest oceanic mountain in the world. Point out the Hawaiian Islands on the handout.

Adapted from Stonewall Secrets Teacher's Guide, pp. 50-52 and Geology Rocks!, pp. 50-51

CLASSROOM ACTIVITY THREE

Title: Connecticut Geology

Objectives: Students will recreate Connecticut's geologic past for a deeper awareness of New Haven's landscape.

Time: 10 minutes

Materials: Convergent model with folded terrain from the graham cracker activity, plastic world map placemats, Connecticut map and scissors

Preparation: Cut out the continents from one of the placemats. Follow the procedure from the graham cracker activity.

Procedure:

- Explain to the students that 500 million years ago, the Earth looked very different with oceans and landmasses in different shapes and locations. Approximately 250 million years ago, there was a Great Collision. Plates moved together to form a huge landmass, or super continent called Pangea. Use the cut out continents to show the students how the continents fit together like puzzle pieces in a jigsaw puzzle. The area that would later be called Connecticut was at the heart of this Great Collision. It was crumpled and folded. Refer to the model with folded graham crackers to help the students envision Connecticut's landscape at that time.
- About 200 million years ago, Pangea cracked and broke apart. As the super-continent split into the continents we see today, Connecticut cracked but it did not break apart. Ask the students to pull apart the folded graham crackers until there is a one-inch gap between the folded portions. As the landmass pulled apart, a trench fault formed causing a huge block of crust from the Connecticut shoreline to Massachusetts to sink down below the level of the surrounding area. In this way, the 20 mile wide central valley lowland was created. Check the students' models to be sure they all have created a valley. Show the students a map of Connecticut and point out the highlands and the lowlands.
- Volcanic lava came up through the cracks of the original fault, cooling to form a layer of basalt. Rain washed sand, clay and gravel over the basalt. Then the process repeated itself. As time passed, slippage along the fault caused the sides of the valley to press inward towards one another. This movement broke up layers of basalt (also known as traprock) into sections, and caused them to tilt. West Rock and East Rock are traprock segments that were forced upward through the Earth's surface when the valley sides pushed together.
- Tell the students that the geologic history of Connecticut can be easily summarized using three words: crunch, crack and squeeze. Have them hold their fists together to demonstrate the process. Ask the students to firmly push their fists together (crunch!), slightly pull apart their fists (crack!) and gently squeeze together their fists (squeeze!).

CLASSROOM ACTIVITY FOUR

Title: Worn Down
Objectives: Students will learn how the landscape is shaped by erosion and weathering.
Time: 10 minutes
Materials: None
Preparation: None
Procedure:

- Discuss how the Earth is changing all the time. Plate tectonics builds up and recycles the Earth's crust while erosion and weathering wear it down.
- Physical and chemical weathering causes rocks to fragment, crack, crumble or break down. Describe how water can force a rock to split when it seeps into cracks and freezes. Plants can break up rocks too when they grow in cracks. Plant roots force the crack to widen and deepen as they grow. Eventually the roots apply enough pressure to split apart the rock. Chemical reactions with air and water break down rocks as well. When iron is exposed to oxygen in the atmosphere, it changes to rust. Explain to the students that East and West Rocks are reddish in color because of this same chemical reaction. Some minerals produce weak acids when they mix with rainwater. These acids slowly dissolve rocks. Remind the students about acid rain. The mixing of emissions from factories and automobiles with water in the atmosphere creates acid rain. When acid rain falls to the Earth's surface it also decomposes rocks. Describe how acid rain and other types of weathering destroy historic monuments.
- Talk about materials being worn away further by erosion that loosens and carries away the rock debris caused by weathering. Water, wind and ice are important agents of erosion. The sediment that they move is deposited elsewhere creating new landforms. Over time, erosion and weathering change the shape of the landscape.
- Explain to the students that over 100,000 years ago, all of Connecticut was covered with ice by a glacier that was 1200-1500 feet thick. As the glacier advanced, rocks were pushed along, scouring the landscape. The glacier also compressed materials into hills and ridges. When the glacier started to retreat, melting ice produced great rivers of water that cut the Connecticut valley deeper. Large quantities of clay, sand and gravel were deposited as water flowed down toward the ocean. Remnants of the glacier can be seen today. Judges' Cave at the top of West Rock is a formation of erratic boulders left behind by the retreating glacier and Long Island was created by glacial debris.
- Discuss how people change the natural patterns of weathering, erosion and deposition. Humans speed up erosion by clearing land, blast through rock to make highways and change the course of rivers by building dams and creating channels. Geological and human forces shape landscape features.

CLASSROOM ACTIVITY FIVE

Title: Building Blocks
Objectives: Students will learn about the characteristics of rocks and minerals and how they are formed.
Time: 10 minutes
Materials: Snow, sand and dirt
Preparation:
Procedure:

- Remind the students how the Earth is constantly changing, building up and wearing away. Tell them that minerals are the building blocks of the Earth. Minerals are inorganic solids that do not form from living things. There are many different types of minerals, each with its own physical properties, chemical composition and characteristic crystal shape. Minerals occur naturally and are the same through and through. Show them mica and quartz.
- Describe how minerals combine to form rocks that make up the Earth's crust, mantle and core. Rocks are formed in three different ways. When molten rock or magma hardens, igneous rock is made. Compare the process to fudge cooking on the stove that hardens into candy. Show them granite and basalt. Another way rock is formed is through layering. Sedimentary rocks are created when weathered and eroded materials are deposited in layers and compressed. Use snow, sand and dirt to demonstrate by layering them and then shaping them gently into a snowball. Metamorphic rock is igneous or sedimentary rock that has changed form through heat or pressure. Use the snowball to show the process by pressing very hard on the snowball with your hands for a minute or so. Explain that the heat and pressure from your hands has changed the snowball into a hard, icy mass.
- Be sure the students understand the difference between a rock and a mineral. Minerals are composed of a single substance while rocks contain more than one substance. Minerals are the same throughout and are inorganic. Rocks contain different minerals and can be composed of organic materials.

CLASSROOM ACTIVITY SIX

Title: Rock Candy
Objectives: Candy models will show students how to differentiate between rocks and minerals.
Time: 10 minutes
Materials: Ziploc bags and assorted candy (plain and peanut M&M's, plain and almond Hershey's Kisses, gummy bears, Nestles' Bunch a Crunch, etc.)
Preparation: Create individual bags of assorted candies by placing one sample of each of the different types of candies in Ziploc bags.
Procedure:

- Distribute bags of candy to the students. Ask them to pretend the different candies are rocks and minerals. They are geologists who must classify whether the assorted

candies are rocks or minerals. Explain to the students that as scientists they will have to analyze the contents of the candy very carefully. They will be asked to remove the candy one piece at a time. They will be told to bite the candy in half and then to look closely at the cross section of the candy. If the candy looks the same throughout than it represents a mineral but if there is more than one substance, it represents a rock. Ask if any students have nut allergies. Some of the candy contains nuts and it is very important to warn the children with allergies which candies should be avoided.

- Start with the plain Hershey's Kiss. Ask the students to remove the sample from the bag, bite it in half, observe the candy closely and then classify it as a rock or a mineral. Mineral is the correct answer because it is one substance, the same through and through. Tell the students that they may now eat their mineral. Repeat with the almond Hershey's Kiss. The correct answer is rock because there is more than one substance. Tell them they now can eat their rock.
- Continue with the rest of the samples, leaving the M&M's for last. Have them classify the peanut M&M as a rock first and then, ask them to analyze the plain M&M. Most students will identify it as a mineral but challenge them to look more closely. Why do M&M's melt in your mouth not in your hand? The candy coating on the outside! Plain M&M's represent rocks because they are composed of more than one substance.
- Congratulate them on being expert geologists!

Adapted From Stone Wall Secrets, pp 41-42

CLASSROOM ACTIVITY SEVEN

Title: Rock And Mineral Sort
Objectives: Students will classify rocks and minerals.
Time: 10 minutes
Materials: Fossils, rocks and minerals, Ziploc bags, labels, index cards, magnet and a pen
Preparation: Pair up each rock with a mineral that it contains and place the matching sets in numbered Ziploc bags. Prepare an answer sheet for the rock/mineral pairs.
Procedure:

- Distribute bags of rocks and minerals to pairs of students. Tell the students that they are geologists with real rocks and minerals. Ask the students to examine the samples closely to identify which is a rock and which is a mineral. Remind them that a mineral is composed of a single substance and is the same throughout. A rock contains minerals and is made up of more than one substance. Check their answers and point out differences among the rocks and minerals.
- Identify igneous (granite, basalt, etc.), metamorphic (marble, slate, etc.) and sedimentary rocks (limestone, sandstone, etc.) noting differences in texture.
- Show students some of the characteristics that identify minerals by demonstrating how magnetite is attracted to a magnet, talc feels greasy, pyrite has a metallic shine,

galena is very heavy, quartz has hexagonal or six-sided crystals and hematite leaves a dark streak on white paper.

- Give pairs of students a fossil and explain how plants and animals get trapped and preserved between the layers of sedimentary rock. See if they can guess the identity of their fossil remains. Explain that fossils are clues to the past that help to date rocks, act as environmental indicators and provide valuable information about patterns of evolution.

CLASSROOM ACTIVITY EXTENSIONS

1. Geologic Timeline: Divide the class into small groups and have each group of students sit on the floor around a long sheet of butcher paper. After an introduction to the term "geologic history" have the students draw a long line down the middle of their paper. Give each group a collection of items and tell them that you want them to place these items along the timeline in the appropriate order. Have the start of the timeline be the present day and the end be 100,000 years ago--when Connecticut was covered by glaciers. Sample items might include fossils, an old newspaper clipping, an antler or skull, a fresh flower, an old book, a picture of the pyramids (representing when they were built), a baby picture of yourself (the teacher), a sedimentary, igneous, and metamorphic rock, a picture of a dinosaur, etc. Allow students to walk around and look at other group's estimates to see how they compared with their own but encourage students not to look at other group's work while they are doing the activity. Discuss how different lengths of time are represented and what clues students used to decide how old an object is.

2. Rock Cycle Room: Make a walk-through rock cycle that is interactive and educational for other classes in your school. Use a hallway, room or other space in the school and work together as a class to demonstrate in pictures how rocks cycle through the earth. Explain how magma cools and crystalizes into igneous rock, how rocks are pushed up and form mountains, how weathering, water, ice and erosion break down mountains into rock particles, how these particles travel and are deposited in layers as sedimentary rocks, heated and pressurized to become metamorphic and finally either change back to igneous or return to magma. Get students to think of themselves as curators in a museum who are attempting to create a visual display that will clearly and effectively teach others about the rock cycle.

CEMETERY UNIT:
OUTDOOR ACTIVITIES

(Before or on the way to the Cemetery)
OUTDOOR ACTIVITY ONE

Title: Cemetery Synopsis
Objectives: Students will learn about the history of cemeteries, discovering how New Haven pioneered the modern cemetery movement that served as a model for public parks.
Time: 10 minutes
Materials: None
Preparation: None
Procedure:

- Introduce the cemetery field trip by explaining that graveyards are another example of open space. Although cemeteries are burial grounds for the dead, they also offer a park-like atmosphere for passive nature recreation and provide important habitat for wildlife. In addition, cemetery markers reveal valuable historical and social information about communities that relates back to their first lesson when they traced New Haven from pre-settlement times to the present.
- Explain to the students that the field trip will deepen their understanding of environmental and geologic concepts. They can see change over time by checking the condition of the gravestones to determine the long-term effects of weathering and erosion. The date on the marker reveals how long the stone has been exposed to the elements. They will discover that gravestones are made out of igneous, metamorphic and sedimentary rocks and that some stones are more resistant to decay than others. They will notice that vegetation and wildlife can hasten the deterioration of cemetery monuments, sometimes causing gravestones to tilt or even split.
- Discuss how colonial burial grounds were located in central meeting areas often near churches. In New Haven, a section of the Green was selected as the site for the Ancient Burial Ground but over time, it became overcrowded and started taking over the Green. It was a breeding area for disease especially during outbreaks of epidemics. The Ancient Burial Ground was an eyesore, over-ridden by grazing animals with no thought to landscaping and no effort made to bury family members next to one another.
- The Grove Street Cemetery, established in 1796 in response to the deteriorating conditions of the Green, was the first private cemetery organization in America and the first graveyard in which family members were buried together in perpetuity. Although people purchased specific plots, additional free lots were available to the poor. Virtually every cemetery in this country was modeled after the Grove Street Cemetery.
- The cemetery movement laid the groundwork for the public park movement. The Grove Street Cemetery functioned as public open space, providing a landscaped area for the enjoyment of city residents that was a source of pride for New Haven. At the

same time, it led to improvement of the Green's appearance by offering an alternative burial site. By 1821, all the markers from the Green had been moved to Grove Street and the Ancient Burial Ground was leveled even though the bodies remained buried at the site. The Grove Street Cemetery was New Haven in miniature, laid out in a grid-like pattern just like the City. Formal landscaping matched its symmetrical design, giving it a more urban look than a park-like atmosphere.

- A rural cemetery movement surpassed the Grove Street model in the 1830's, incorporating nature in its design of large-scale, softly landscaped areas that were open to the public. The success of rural cemeteries at encouraging an appreciation for nature led to the public park movement. Grove Street tried to copy the rural model by adding more naturalistic plantings but it was limited by its small size, flat terrain and angular layout. Grove Street Cemetery remained an important public open space even though it did not have the park-like landscape of the rural cemeteries.
- In the same way that parks imitated cemeteries, modern cemeteries started to model themselves after modern public parks. The lawn-park cemetery that was pioneered in 1855 emphasized open green space and uniformity in landscape and gravesite design. Again, the Grove Street Cemetery tried to match the new model by regulating the size and appearance of the grave markers. The end result was to limit the individualistic character of the graves that made Grove Street a public open space of social and historical significance.
- Tell the students that despite changes in design, they can learn a great deal about New Haven by reading the markers at the Grove Street Cemetery. The gravestones reveal information about epidemics, disasters, wars, occupations and lifespans. Explain that they will probably recognize names on the historical markers because many schools and streets are named after community leaders buried at the Cemetery. In particular, they should look a family plot with James Hillhouse, the individual who was instrumental in establishing the Grove Street Cemetery.

OUTDOOR ACTIVITY TWO

Title: Cemetery Search Overview

Objectives: Students will be familiarized with the data collection sheet for more accurate recording of information and will be given the ground rules for the field trip.

Time: 10 minutes

Materials: Cemetery Search worksheets (Worksheet 6.1), clipboards, Grove Street Cemetery maps, gravestone rock samples and pencils

Preparation: None

Procedure:

- Distribute a clipboard with a worksheet, map and a pencil to each student.
- Explain that each student should gather information from five different gravestones. They should try to choose examples from the 17th, 18th, 19th, 20th and 21st centuries. Show them on the map that the oldest gravestones were brought over from the Green and are laid along the north and west walls of the cemetery. Remind them that the bodies are still on the Green and that is why the markers are lined up in a row. Point

out that the map includes descriptions of special gravestones. Warn them that the older markers are often hard to read so they should not get discouraged if they cannot find one from the 17th century.

- Read through the categories on the data sheet, checking to be sure the students do not have any questions. Show them rock samples to help them understand the different types of gravestones. Explain that early on, settlers were limited to local stones (sandstone, slate, etc.) but as transportation improved, other types of rocks from farther away could be used (marble, granite, etc.).
- Discuss cemetery etiquette. Stress that although most of the markers are very old, there might be mourners visiting some of the newer graves. The students must be respectful of their surroundings (no climbing, running, shouting, etc.) and remember that they are visitors to a very special place in New Haven. A wall surrounds the cemetery so they should feel very safe exploring with their classmates but they must always stay in sight of one of the adult chaperones. They may work on their own or with a partner. At the end of the data collection period, the class will reconvene to discuss the results before boarding the bus. Back in the classroom, a more thorough compilation and analysis of the data can take place.

OUTDOOR ACTIVITY THREE

Title: Cemetery Search

Objectives: Students will gather historical, social and environmental evidence at a local cemetery to gain a better understanding of their community.

Time: One hour

Materials: Cemetery Search worksheets (Worksheet 6.1), clipboards, pencils and Grove Street Cemetery maps

Preparation: Fill out a transportation slip to schedule a bus several weeks in advance.

Procedure:

- Remind students of the ground rules for the cemetery study. Point out different types of gravestones, reinforcing the key categories. Use one gravestone as an example and fill out the data sheet with all the information from that marker.
- Survey the study area with the students by scanning the cemetery. Discuss the topography, noting how flat and uniform the site is. Talk about the landscaping and have the students try to identify and guess the ages of some of the trees and shrubs. Ask the students to look beyond the perimeter of the cemetery at the built environment completely surrounding the open space area. Describe how the cemetery is a safe haven for wildlife even though it has been changed greatly by humans. It provides important habitat for many wildlife species (raccoons, skunks, opossums, squirrels, rabbits, woodchucks, small mammals, snakes, toads, invertebrates, wild turkey, hawks, song birds, etc.). Tell the children to look for wildlife and animal signs as they are collecting data. Point out a squirrel or bird nest to encourage them to observe at all levels. See if they can spot wildlife enhancements added to the cemetery (birdfeeder, nest box, bird bath, etc.).

- Describe the lay out of the cemetery using the map. Note the grid pattern of labeled paths. Ask the students to point towards the north and west walls where the markers from the Green are located. Ask the students why some of the gravestones are bigger than others (a possible sign of wealth), and why groups of markers are fenced in (family plots). Show the students some notable graves on the map and challenge them to try to find them as they are collecting data.
- Tell students to collect data from five gravestones working alone or in pairs. Assign an adult chaperone to each student who will monitor behavior and help with the cemetery search. Ask the adults to bring the students back to the entrance in forty minutes.
- When the class has reconvened, ask a series of questions that encourages students to share their findings. Who found the oldest grave? Who found the newest grave? Did anyone find someone who died in a war, from a disease, etc.? Did people tend to die younger? Why? Were any stones hard to read? What color were they? Were newer stones a different color than older ones? Identify the stones by their color, telling the students whether they are igneous, sedimentary or metamorphic. Do some stones seem more resistant to decay? Were there lichens or moss on any of the gravestones? Were any stones tilted or tipped over? What were some occupations? Who found some community leaders? Did anyone see signs of wildlife? Was there anything else of interest (symbolism, epitaph, etc.)?
- Head back to school!

Adapted from Stones and Bones and Education Goes Outdoors, pp. 155-162

OUTDOOR ACTIVITY EXTENSIONS

1. How did you do? On a blank sheet of paper have students write down their feelings and attitudes towards the cemetery they visited. Ask them what they first think of when they hear the word cemetery? Use the words to begin a class discussion on our culture's use of cemeteries and what they have recently learned about the first park land being modeled after early cemeteries. Discuss how certain cultures use cemeteries as places for celebration--a very different concept than what most Americans are used to. Encourage students by letting them know that it is difficult to try new things and go to places that you are not used to, but that it challenges you to grow as a person and as a student.

2. Historical Figure: Have students choose a historical figure from those buried at the cemetery to study and research. Use sources including town histories, biographies, old maps, photographs, interviews with senior citizens, diaries, newspapers and public records. Use the New Haven Colonial Historical Society and their volunteers for any help you may need. Ask students to answer specific questions such as whether or not they saw anyone else at the cemetery that the person was related to (wife, child, aunt, father, sister, etc.). This is a great opportunity to teach a variety of ways to cite materials. Make sure to allow time for the presentation of materials.

CEMETERY UNIT:
FOCUS ACTIVITIES

FOCUS ACTIVITY ONE

Title: Reasons For Seasons

Objectives: Students will learn how the Earth's tilt on its axis creates different seasons as it orbits around the sun.

Time: 10 minutes

Materials: Desk, lamp, orange, skewer, thumbtack and rubber band

Preparation: Place a rubber band around the middle of an orange. Poke a skewer from the top through the bottom of the orange. Both ends of the skewer should extend equal distances from the orange. Push in the thumbtack one third of the way down from one end of the orange.

Procedure:

- Tell the children today is the last class of the *Open Spaces As Learning Places* program. Even though the environmental education program is coming to an end, the students should continue to enjoy nature year-round. The different seasons offer new opportunities for exploring environmental change as plants and animals adapt to variations in temperature and sunlight.
- Use models of the sun and the earth to show why there are different seasons. Place a lamp without a shade on a classroom table or desk and turn on the lamp. Stand a few feet from the lamp and hold up the orange with the skewer perpendicular to the desk. Explain to the students that the light bulb is the sun and the orange is the Earth. The skewer through the orange is the Earth's axis with the North Pole at the top and the South Pole at the bottom. The rubber band is the equator and the thumbtack in the orange represents New Haven.
- The Earth moves in two distinct ways. In a 24-hour period, or one day, the Earth makes one full rotation on its axis. This movement accounts for daytime and nighttime. Slowly spin the orange around completely and have the students guess when it is daytime and nighttime in New Haven. Describe how the Earth is actually tilted to one side at a 23-degree angle. Tip the skewer slightly towards the lamp. Explain that it is summer in the Northern Hemisphere when the North Pole is tilting towards the sun. The sun is shining more directly on the Northern Hemisphere and there are more hours of sunlight. When the North Pole is tilted away from the sun, it is winter in the Northern Hemisphere with less direct sunlight and fewer hours of daylight. The Earth orbits around the Sun in 365 ¼ days or one year. Walk around the lamp starting with the North Pole tilted towards the sun. Ask the students what season it is in New Haven (summer). Walk half way around the lamp so that the North Pole is tilting away from the sun. Ask what season it is now in New Haven (winter). Remind the students that Earth also would be rotating on its axis for day and night conditions. Now walk just one quarter of the way around the lamp. See if the students can guess that it is now spring in New Haven. Pass through summer over to the side opposite spring and ask what season it is now (fall).

- The sun warms and lights up the Earth from 93 million miles away. It provides energy for all living things on the planet. The tilt of the Earth's axis with respect to the sun results in seasonal changes in the amount of the sun's energy reaching the Earth's surface at a given location. These variations in heat and sunlight have a profound impact on the living things on the planet.

Adapted from Hands-On Nature, pp. 295-297

FOCUS ACTIVITY TWO

Title: Winter Survival
Objectives: Students will understand different winter survival strategies used by animals.
Time: 10 minutes
Materials: Animal posters
Preparation: None
Procedure:

- Explain to the students that northern animals have different adaptations for coping with winter as temperatures drop and snow makes travel more difficult. Food and water are harder to find with plants shut down and water locked up in frozen soil. In response to these seasonal changes, some animals migrate to areas with less severe conditions, others become dormant or hibernate to wait out the coldest times of the season. There are many animals that remain active, working hard to find food and water and to stay warm. Each winter strategy is a gamble with many animals unable to survive to spring. An animal's physical and behavioral characteristics determine its winter survival strategies. Ask the children what they do to adapt to colder winter conditions (wear warmer clothes, spend less time out of doors, etc.).
- Discuss how cold-blooded and warm-blooded animals have different challenges. Show posters of different animals as examples of different winter strategies. Cold-blooded animals (reptiles, amphibians and invertebrates) rely on external conditions to maintain an adequate body temperature. In winter, cold temperatures force them to become inactive when their body processes slow down considerably. Warm-blooded animals (birds and mammals) regulate their body temperature internally. Food provides them with energy for temperature regulation but in winter, food is less plentiful. Those animals that cannot find food either travel to places where there is an adequate food supply, or they build up fat reserves during times when food is more available, which serve as nourishment and insulation during cold winter months.
- Describe how migration is a seasonal mass-movement of animals in search of food or a place to reproduce. A wide range of animals migrate long distances as winter approaches including many types of birds (more than one-third of all bird species), ocean fish and whales, some insects and bats and a few land mammals such as caribou. Some animals travel hundreds and thousands of miles, while others move only a short distance to find more suitable winter survival conditions.

- Many cold-blooded animals crawl under the leaf litter or beneath rotten logs, sneak into crevices in trees or cracks in rocks, and burrow down into the ground often near plant roots below the frost-line. Some of them make their own antifreeze as an extra precaution to keep from freezing. Insects often time their life cycles to correspond to changing conditions. The immobile egg and pupal stages with their protective covering are well adapted to the cold. Some aquatic creatures, including many larval invertebrates, swim down to deeper waters or sneak into the mud to avoid frozen conditions.
- Winter is a struggle for northern warm-blooded animals whatever their winter survival strategy. Long-distance migration brings risks along with rewards. Animals expend a great deal of energy and are subjected to many perils along the way. The final destination with warmer temperatures and plentiful food and water provides preferred winter habitat but many migrating animals do not survive the journey. Hundreds of millions of migrating birds never reach their destinations, and it is estimated that over half of all first-year migrators die before finishing their first round of migration. Animals that stay put all year have two choices: 1) they can remain active, in which case, they must look for more protected areas, adapt their feeding habits to winter food availability, and conserve energy by limiting their activity and growing a thick winter coat or fluffing up their feathers; or, 2) hide out until there are more favorable conditions. Some mammals (skunks, raccoons, chipmunks, etc.) go through periods of dormancy in which their body temperature drops slightly and body processes slow down as they become inactive during particularly harsh times. Other animals (woodchucks, woodland jumping mice and many bats) become true hibernators as their body temperature plunges and their heart beats irregularly for an extended period of time. A hibernating woodchuck has a body temperature of 37.4 degrees Fahrenheit with a heart beat of four to five beats per minute as compared to a summer body temperature of 96.8 degrees Fahrenheit and a heart beat of 160 beats per minute. Bears are not considered true hibernators because their body temperature only drops by 10 degrees and their metabolism is half as fast as at other times of the year. While bears are dormant, they do not eat, drink, urinate or defecate. Female bears even manage to give birth and nurse their young in the winter using stored energy from fat.
- Winter showcases wildlife's amazing ability to adapt to changing conditions.

Adapted from Hands-On Nature, pp. 87-88

FOCUS ACTIVITY THREE

Title: Animal Tracks

Objectives: Students will become wildlife trackers as they learn to identify animals by locating track prints and patterns.

Time: 20 minutes

Materials: Large and medium sized poster board, hand and foot stamps, different colored inkpads, glue and photocopies of animal tracks

Preparation: Create series of track patterns (bounders, walkers/trotters, hoppers and waddlers) on poster board using hand and foot stamps and inkpads that are large enough for the students to follow using their hands and feet. Make animal track flashcards for local wildlife.

Procedure:

- Describe how it is difficult to spot wildlife because wild animals are quick to hide and are not always active during the daytime. Tracks are evidence that wildlife has been around even when animals have not been seen. They help identify wildlife and provide important information about habits and behavior. By studying track prints and patterns, it is possible to recreate the story of what an animal was doing, where it was going, how fast it was moving, when it was there and how many other animals were around.
- Explain to the students to remember the three P's when they are animal tracking: pattern, print and place. A motto among animal trackers is, "When in doubt, follow it out!" The first step in tracking wildlife is to determine the movement pattern. Body and movement features revealed by tracks make it possible to separate an animal into one of four movement pattern categories: walkers, waddlers, hoppers and bounders. Next, focus in on differences among groups of animals in each category and try to narrow down the species by measuring the size of the track, the stride (the distance between two prints or between sets of prints) and the straddle (the width of the tracks from the outer edge of one print to the outer edge of the next print or across the set of tracks). These measurements help estimate the approximate size of an animal. Finally, relate the location of the tracks to habitat preferences for a more accurate identification of wildlife species.
- Show flashcards and poster board patterns while describing each movement pattern category.
    (1) Walkers/trotters include members of the dog family (fox, coyote, etc.), cat family (bobcat, mountain lion, etc.), and hoofed animals (deer, moose, etc.). The track pattern is a straight line with the hind foot landing directly where the front foot has been. The animals move on a slight diagonal with the front foot on one side moving just before or along with the rear foot on the other side. Their body length, from shoulders to rump, is approximately the same length of their legs. There are differences among the family groups in this category. Dogs and cats walk on four toes while hoofed animals walk on two toes. Dogs have symmetrical toes that often leave claw marks and cats have asymmetrical toes that usually do not leave claw marks. There are distinct size differences with coyotes being bigger than foxes, mountain lions larger than bobcats and moose much bigger than deer. Habitat variations occur as well with bobcats

looking for rock outcroppings, and, in winter, moose preferring wetlands and red maple forest, and deer seeking shelter in coniferous forests.

(2) Waddlers include heavy-bodied, short-legged animals such as muskrat, beaver, opossum, raccoon, skunk, porcupine, woodchuck and bear. Members of this category walk slowly on flat feet with both feet on one side of their body moving at one time and then they shift their weight to the other side, moving those two legs. Their hind feet are much bigger than their front feet. In the track pattern, the hind leg often oversteps the front foot. There are many species differences that help identify waddlers. Raccoons and opossums have hind feet that look like human hands but it is quite easy to tell them apart because opossums have opposable thumbs. Bear and beaver both have large hind feet, however, a beaver's feet are webbed. Porcupines are quite pigeon-toed and muskrats often drag their tails as do opossums. Skunks leave more of a looping trail, while raccoons have a Z-shaped pattern. Woodchucks are not seen in northern areas during winter because they are hibernating. Habitat differences are distinct as well. Muskrat and beaver are found in wetlands, woodchucks in open areas, porcupines near rock outcroppings, bear in oak and beech forest especially during the fall, and opossums, skunks and raccoons frequent a variety of habitats including urban areas.

(3) Hoppers include most members of the rodent family (mouse, squirrel, etc.) and the lagomorphs (hare and cottontail rabbit). They move by pushing off with their larger hind feet, landing on their smaller front feet and then swinging their back legs around their front feet. Their track pattern consists of four prints with the hind feet in front of the front feet. Rodent patterns are a square shape whereas lagomorphs leave more of a triangular pattern. Habitat differences are less distinct since rodents are found in a wide range of habitats. Red squirrels and snowshoe hares prefer coniferous forests, gray squirrels frequent deciduous woods, and cottontails are found near open areas.

(4) Bounders, all members of the weasel family, have long, narrow bodies with short legs and move like a Slinky or an accordion. They push off with their back legs, land on their front legs one at a time, and then lift up on their front legs so the back legs can land in exactly the same spot as the front prints. Bounders usually leave a two print pattern, but occasionally, the hind prints do not land directly in the front prints, leaving a three or four print pattern. The bounders from the weasel family include, from smallest to biggest: least weasel, short-tail weasel, long-tail weasel, mink, marten, fisher and otter. Skunks are members of the weasel family but they are considered waddlers. Otter track patterns are distinct because of their webbed feet and the wide slide tracks they leave behind when they slide on their bellies. Minks and otters prefer wetlands, while weasels, fishers and martens are found in a wide range of habitats.

- Tape the track patterns to the floor and separate the class into four movement pattern groups. Allow the students to become walkers, waddlers, hoppers and bounders by trying to match their hands and feet to the track patterns on the poster board. Have them rotate so they can try out all the categories.

Adapted from Project Seasons, pp. 157-162 and Mammal Tracks, pp. 1-6

FOCUS ACTIVITY FOUR

Title: Track Stories

Objectives: Students will identify wildlife tracks and interpret the story they tell about animal interactions, behavior and habits.

Time: 20 minutes

Materials: Track scenarios (Handout 6.2), track pattern cards (Handout 6.3), animal stamps, stamp pads and track story worksheet and answer sheet (Worksheet 6.2)

Preparation: Create track scenarios by drawing a variety of animal track patterns that interact in different ways.

Procedure:

- Divide the class in half. One group participates in the Track Stories Activity while the other half creates Track Field Guides.
- Distribute track scenarios and track pattern cards. Ask the students to start at the bottom of the page and identify the main character in the track story using their track pattern card. Have them follow the tracks up the page to discover what other animals the main character encounters on its adventures. Explain that they need to tell the animal's story by identifying and interpreting all the tracks in the picture. In order to figure out what happens, they should think carefully about the pattern, print and place of all the tracks.
- Have them fill in the track story worksheet using animal stamps as well as words. Check their answers and give them another track scenario depending on the time and the interest level of the group.

Adapted from Project Seasons, p 161, Hands-on Nature, pp. 218, and NatureScope – Amazing Mammals Part I, pp. 45-52

FOCUS ACTIVITY FIVE

Title: Track Field Guide

Objectives: Students will create their own field guide to animal tracks in New Haven as a resource to continue their search for nature beyond the program.

Subject Area: Life Science

Time: 20 minutes

Materials: Blocks of wood, track templates, Dr Scholl's footpads, glue, yarn, scissors, cardstock, ink and inkpads

Preparation: Prepare animal track stamps by cutting footpads into the shape of animal tracks and gluing them to the wood blocks. Print half-sheets of cardstock with names of animals that correspond to the track stamps. Punch a double set of holes on the side of each labeled half-sheet.

Procedure:

- Lay out stacks of labeled cards next to matching stamps. Place inkpads near the track stations.

- Explain to the students that they are creating their own track field guides using life-size stamps of animal prints. Demonstrate the process by first inking a stamp and then pressing it down firmly just once on a matching card. Direct them to rotate systematically through the stations until they have completed stamping all the different cards. When they are done, give each student a cover page and two pieces of yarn. Have them create a book by adding a field guide cover and tying together the pages with the yarn. Be sure they write their name on their field guide
- Tell the children that tracking is a year-round activity. Snowy conditions are wonderful but other substrates are good for tracking as well. Encourage students to look in muddy areas, especially on riverbanks and near ponds. Beaches with smooth, moist sand also are excellent places for tracking. Point out that much can be seen around their neighborhoods. Suggest luring wildlife to leave tracks by putting out some bait in a muddy section near home or school, or laying down some flour as a tracking substrate. All the students need to do is stop, look and remember the three P's: pattern, print and place.

Adapted from Project Seasons, pp. 163-164

FOCUS ACTIVITY SIX

Title: Resource Management
Objectives: Students will understand the importance of environmental stewardship and natural resource management.
Time: 10 minutes
Materials: Beans and assorted candies
Preparation: None
Procedure:
- Reflect on the program by describing the open space field trips. Through exploration and discovery, the students learned that nature is all around them, even in a city. Classroom and outdoor activities showed that ecological systems are dynamic and interconnected with natural patterns and processes changing the environment all the time. People influence the environment as well, in positive and negative ways.
- Once more, define open space as an area not planned for development. Ask the children to think back to the first day of the program when they traced New Haven from pre-settlement times to the present. Remind them of New Haven's changing landscape and how the park movement sought to preserve open space. Even though land is put aside as open space, natural areas are still vulnerable to development. Many schools have been built on parkland in New Haven. Explain that New Haven residents are stewards for the City's open space. Past mistakes illustrate the importance of preserving open spaces for future generations.
- Discuss how people determine the future of the environment. Humans can easily disrupt the special balance among resources within ecological systems. At the same time, human survival depends on the materials cycling through natural processes.

These shared resources that connect people to nature are finite. Protection of open space areas helps conserve natural resources that are in limited supply.

- Tell the students that they are going to play a game that reveals the importance of conserving resources. Divide the class in half. Have one group of students sit in a circle around a pile of 25 beans that represents all Earth's resources. Explain that they have 30 seconds to each grab beans from the center of the circle. When a student gathers 10 beans, they can be traded in for candy. The game is over for a group when there are no longer any beans in the center. If after a 30-second round any beans remain, the amount of beans left behind doubles. As soon as any student has 10 beans, they can trade them in for candy. If their team still has beans in the middle, they continue playing.
- Repeat the game until the students figure out that the best long-term strategy is to conserve resources. There are plenty of resources for everyone in the group if the students are patient, trust each other and leave behind resources for the next round.

Adapted from a Sense of Place, p. 119

At the end of this lesson the teacher may choose to assign the Cemetery Review and Reason for Seasons Review Sheets.

FOCUS ACTIVITY EXTENSIONS

1. Tracking Charades: Divide the class into small groups and explain that they are going to have a chance to practice their walking/trotting, bounding, hopping and waddling. Each team will act out all four movement patterns in front of the class while the other teams in the audience each have one guess at a correct answer. Keep score on the chalkboard. Whichever team raises their hands first and recognizes the correct movement pattern gets a point. You can try for four points per turn and then another group must get up in front of the class to act out the four patterns. Bonus points will be given to teams that answer correctly *and* give the name of a specific animal that falls into the category of the particular movement pattern just acted out.

2. Go Tracking! Using the field guides that your students have made for themselves, get outside to the schoolyard, the cemetery, the nearest park or local trail and spend some quality time looking for animal signs. Remember to teach students that silence, patience and careful observation are the best ways to successfully find animal tracks. To build more depth in your students' understanding of tracking consider reading aloud Tom Brown, Jr.'s book, *The Tracker*. This story is about a young New Jersey boy who meets an ancient Apache man that teaches him about the wild and all the mysteries of living in nature.

CEMETERY UNIT:
NATURE JOURNAL

ASSIGNMENT SIX

Title: Recollections Of New Haven
Objectives: Students will gain a deeper understanding of New Haven's past through interviews with elderly residents who witnessed change in city neighborhoods.
Time: Conducted after last day of Cemetery Unit
Materials: Nature journal and pencil
Preparation: Students should write out a series of questions for their interview.
Procedure:

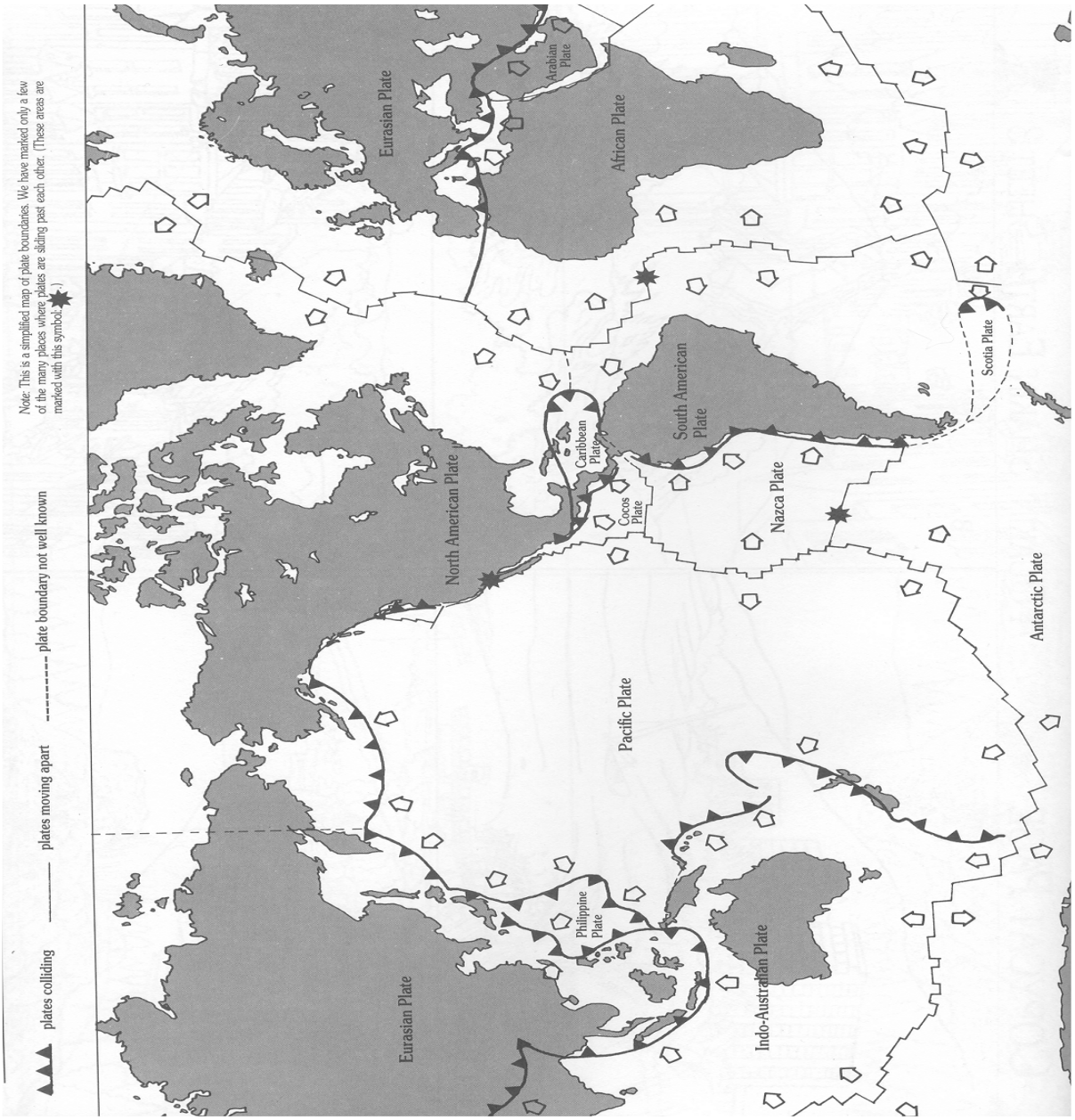
- Ask the students to interview an elderly member of the community. The person should have lived in New Haven for many years. The individual can be a family member, neighbor, friend, teacher or anyone the student feels comfortable talking to. They should write down the questions and answers from their interview in their nature journal. They should try to record the most important information. Tell them that they will share the highlights of the interview with their classmates.
- Give the students some ideas for questions, such as:
  - How long have you lived in New Haven?
  - What was your neighborhood like?
  - What were some of your favorite things to do growing up in New Haven?
  - How has the city changed?
  - What do you miss most about how New Haven was in the past?
  - Do you have any interesting stories to share?
- Remind the children to be respectful and attentive.

Adapted from A Sense Of Place, p. 98

***Note:** Facilitator/Teacher should have students write assignment in notebooks on the last day of the Cemetery Unit. As it is the last unit of the *Open Spaces as Learning Places* program, assignments should be collected, corrected, and student presentations should be made shortly after the end of the Unit.

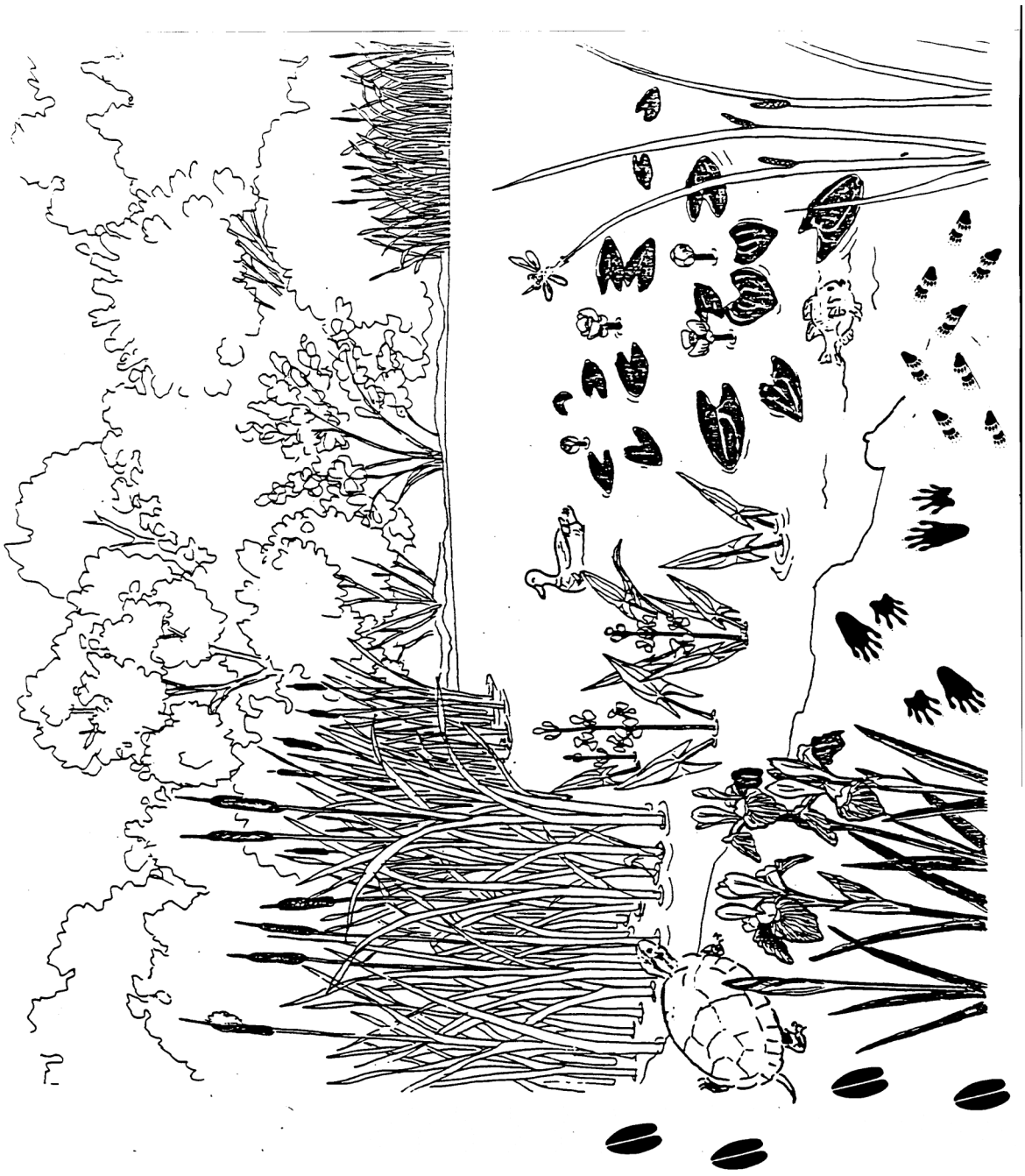
CEMETERY UNIT:
HANDOUTS, WORKSHEETS & REVIEW SHEETS

CEMETERY HANDOUT 6.1 Plate boundary handouts



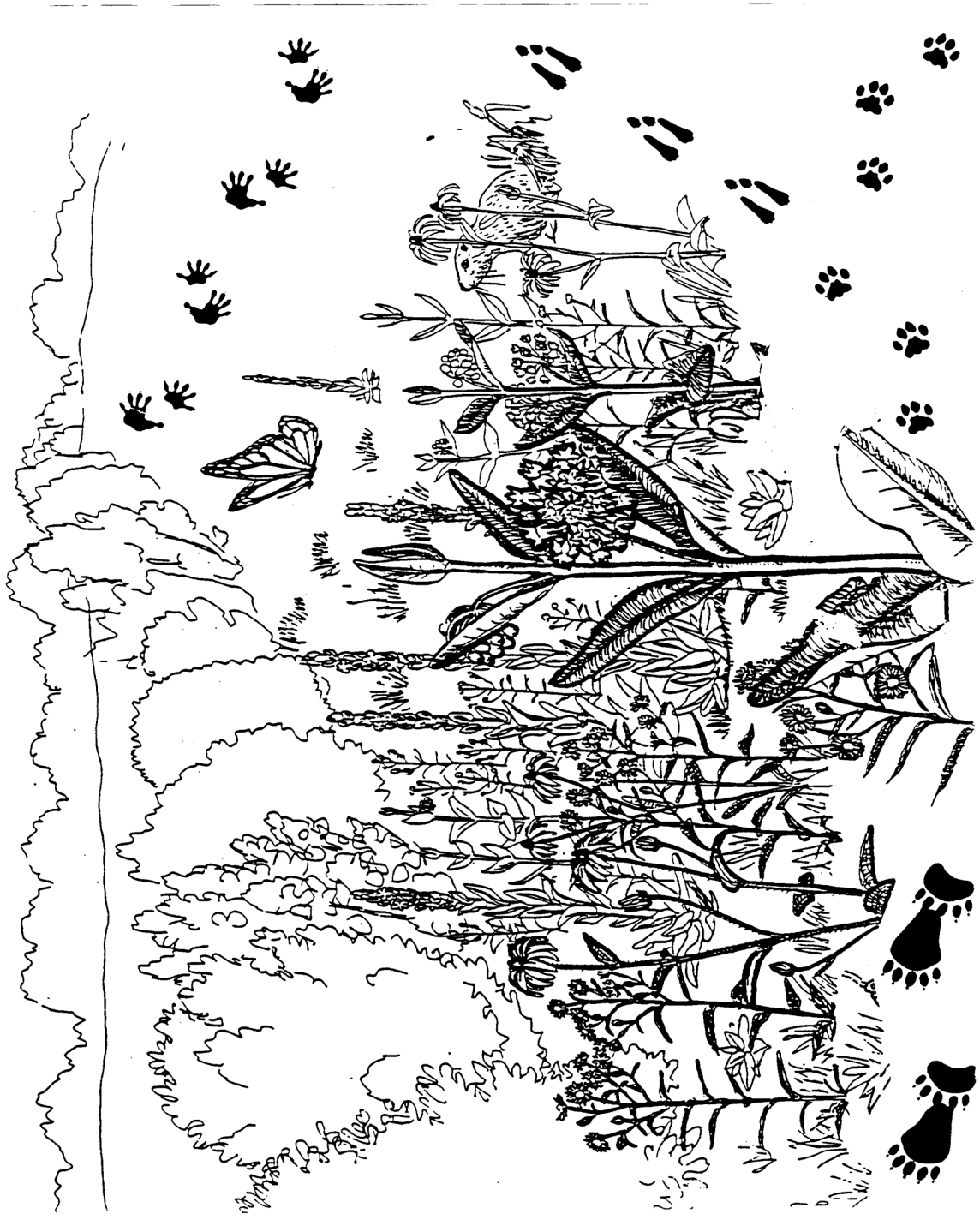
CEMETERY HANDOUT 6.2 Track Scenerios

Track Scenerio #1



CEMETERY HANDOUT 6.2 Track Scenerios (cont.)

Track Scenerio #2



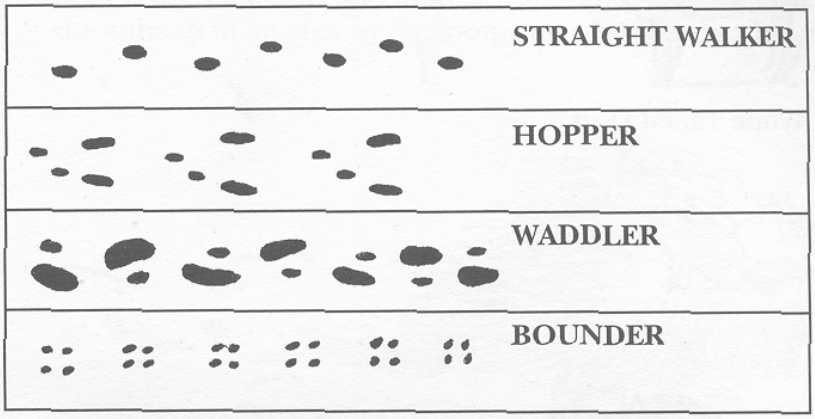
Cemetery Handout 6.2 Track Scenerios (cont.)

Track Scenerio #3

CEMETERY HANDOUT 6.3 Pattern Cards

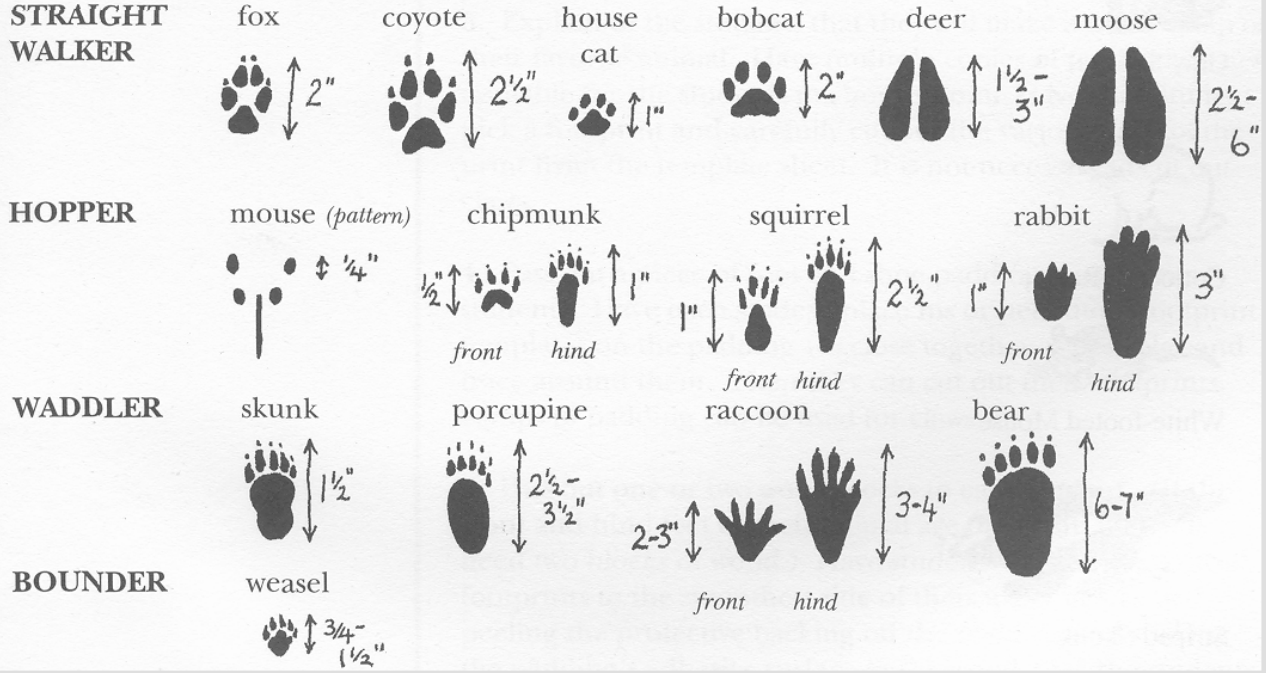
Okay, Track Detectives, you are on your own! Use the secret code, and in dirt, mud, or snow, identify tracks wherever you go!

First, what **PATTERN** *are the tracks in?*



What **PLACE** *are they found? Remember to look for homes, leftover food scraps, and other clues such as feathers, fur, blood, scat, etc. left at the scene.*

Now check the **PRINT** *of the animal's foot. Notice the overall shape, measure its size, note the presence or absence of claws, and count the number of toes.*



CEMETERY WORKSHEET 6.2 Cemetery Search Data Sheet

NAME_____

Collect information from FIVE gravestones. Record your data using the key. Remember to use your *observation* skills to look for wildlife signs.

Gravestone	Name	Year of Birth/Death and Age (if listed)	Other Information (Cause of Death, Occupation, Symbol)	Stone Color	Stone Condition	Plant Cover	Comments: (Location, Tilted, Wildlife Signs)
1							
2							
3							
4							
5							

KEY

Stone Color:
RED WHITE
BLACK GRAY
Speckled

Stone Condition
EASY TO READ
QUITE HARD TO READ
Very Hard to Read

Plant Cover
OPEN
SOME COVER
Shaded

CEMETERY WORKSHEET 6.2 Track Stories

Name_____

Track Scenario #1

A duck is floating happily on the pond. A _____ walks from the irises to the cattails. A _____is drinking at the edge of the pond until a _____comes toward it. The _____ walks quickly away from the pond to avoid being sprayed!

Track Scenario #2

A _____ comes walking through the field toward the forest. An _____walks from the forest toward the field. A _____ is hunting a _____ and then catches it.

Track Scenario #3

A _____ climbs down from the tree. A _____ is watching the _____ come down from the tree and catches it. A _____chases a _____. The _____ escapes by climbing up a tree.

CEMETERY WORKSHEET 6.2 Track Stories (cont.)

ANSWER SHEET

Track Scenario #1

A duck is floating happily on the pond. A *DEER* walks from the irises to the cattails. A *RACCOON* is drinking at the edge of the pond until a *SKUNK* comes toward it. The *RACCOON* walks quickly away from the pond with to avoid being sprayed!

Track Scenario #2

A *BEAR* comes walking through the field toward the forest. An *OPOSSUM* walks from the forest toward the field. A *BOBCAT/MOUNTAIN LION* is hunting a *RABBIT/HARE* and then catches it.

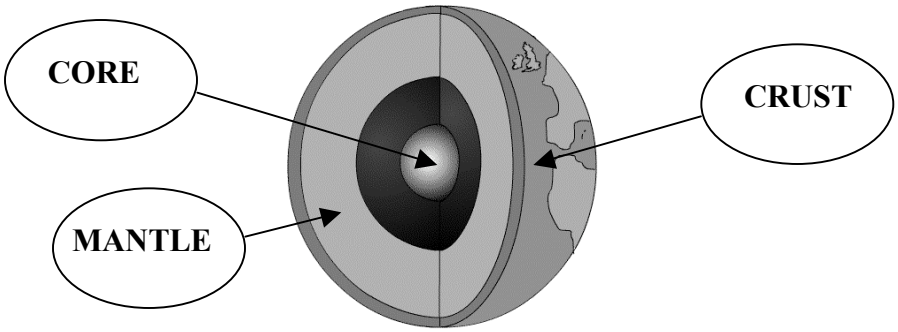
Track Scenario #3

A *SQUIRREL* climbs down from the tree. A *FOX/COYOTE* is watching the *SQUIRREL* come down from the tree and catches it. A *FISHER/MARTIN/ MINK* chases a *PORCUPINE.* The *PORCUPINE* escapes by climbing up a tree.

REVIEW SHEET 6.1 Cemetery Review

1. Layers of the Earth
Draw a line from each box to the right bubble!

This bubble points to where the lava of a volcano comes from.	This is the thin skin of the Earth that is very rocky.	This part is very, very hot and has a lot of metal.



2.Who's Who?
Match my tracks to my picture. Then, tell me if I am a Waddler, Walker or a Hopper.

WADDLER

HOPPER

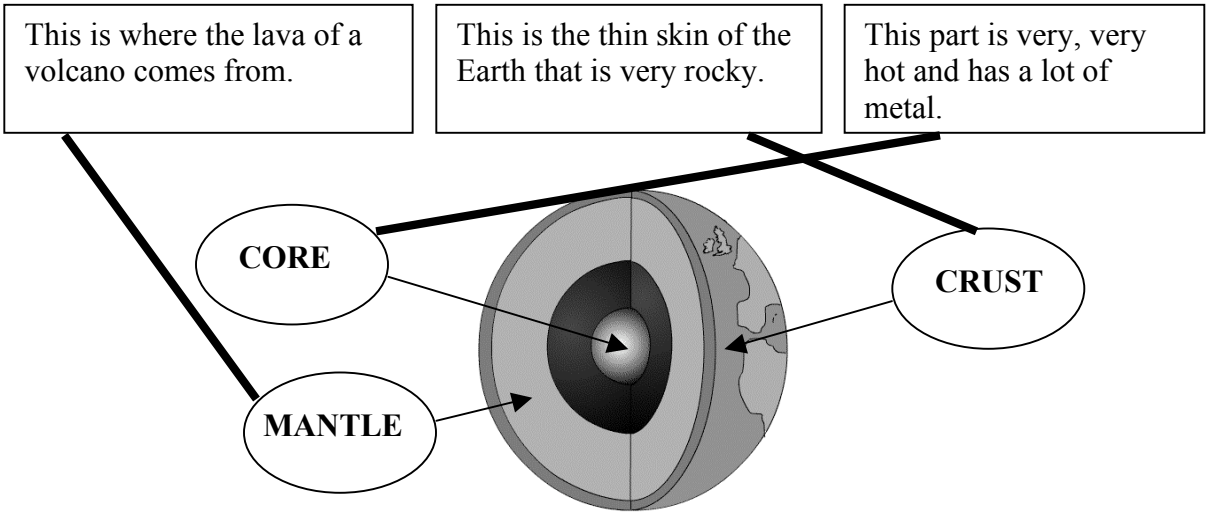
WALKER

REVIEW SHEET 6.1 Cemetery Review (cont.)

ANSWER SHEET

1. Layers of the Earth

Draw a line from each box to the right oval!



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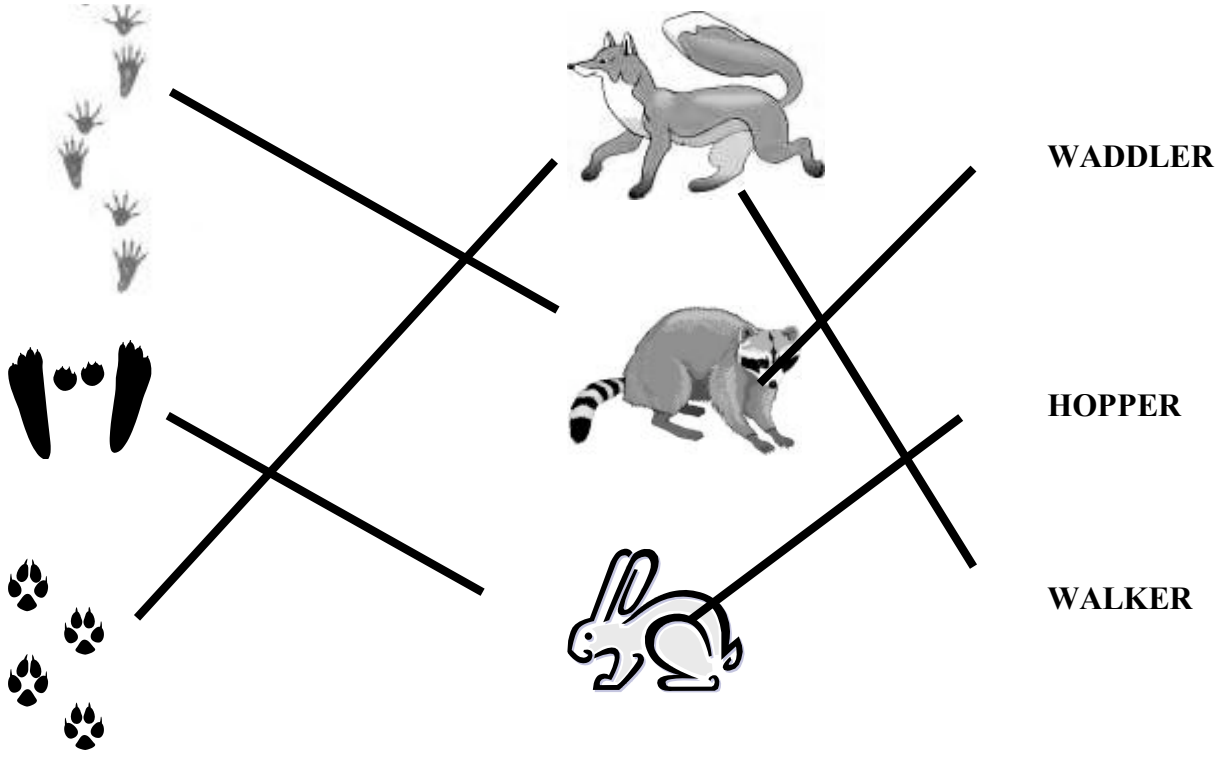
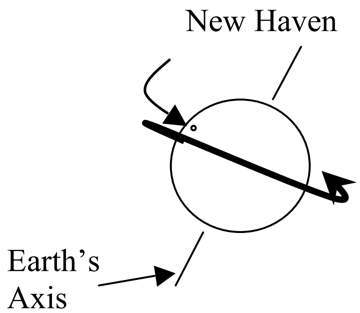


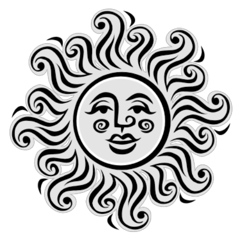
REVIEW SHEET 6.2 Reason for Seasons

As we learned in class, the Earth moves in two different ways. In a 24-hour period or one day, the Earth makes one full rotation on its axis. This movement accounts for daytime and nighttime. The earth is also rotating around the sun. It takes one year for the earth to go around the sun.
Below are pictures of the earth showing New Haven's location on the globe. Your challenge is to:

(1) Figure out whether it is daytime or nighttime in each picture.
(2) Figure out what season it is—summer or winter. (Remember, the tilt of the axis determines the season.)

Circle the correct answers





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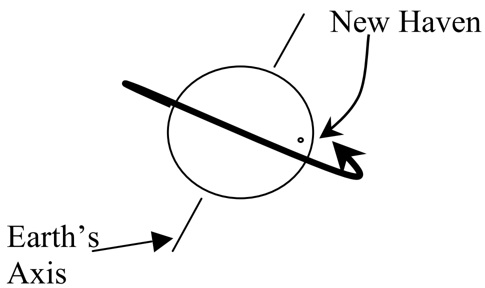

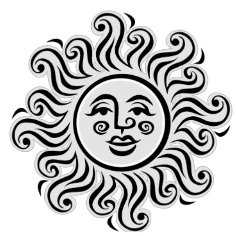

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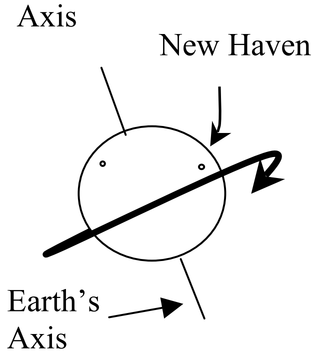

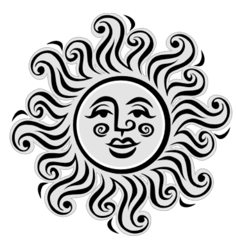

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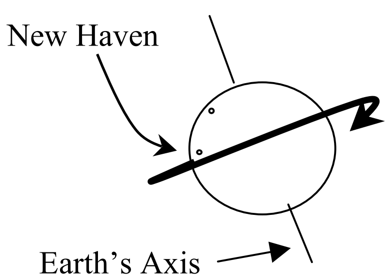

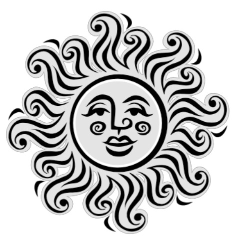

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REVIEW SHEET 6.2 Reason for Seasons (cont.)

ANSWER SHEET

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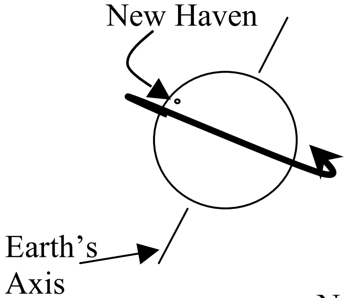

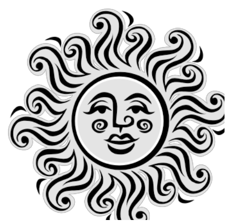

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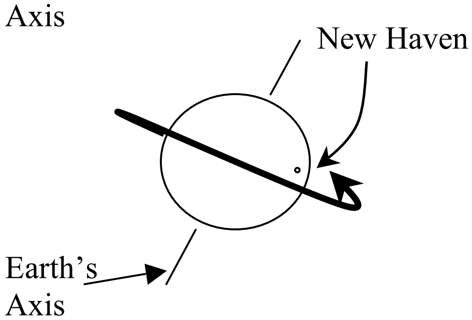

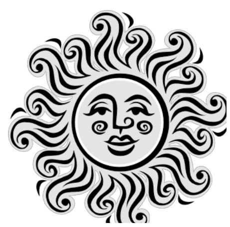

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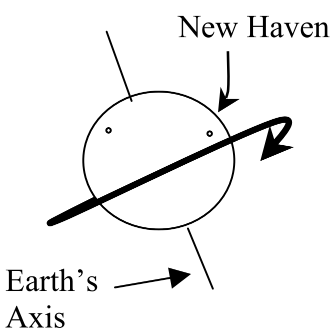

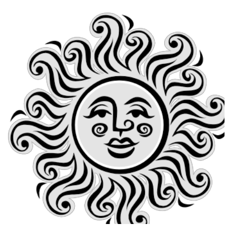

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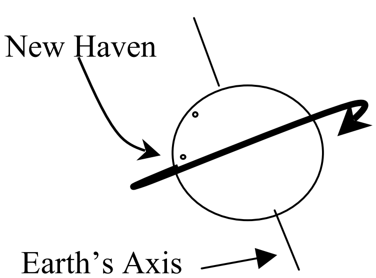

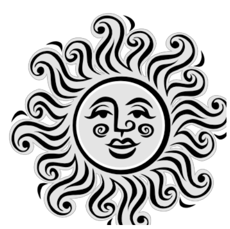

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