Science Grade 1

Sunshine and Shadows

Description: Students will use science inquiry skills to explore sunlight and shadows. They will learn what they need to make shadows, how to change and move shadows, and how shadows move outside as a result of the changing relative position in the sky.

Standards Aligned With This Unit

CT State Science Standards:

Content Standard:

- 1.1 An object's motion can be described by tracing and measuring its position over time.

Expected Performances:

- A11. Describe the apparent movement of the sun across the sky and the changes in the length and direction of the shadows during the day.

Grade Level Expectations (1st Grade):

- 1.1 Changes in the sun's position throughout the day can be measured by observing changes in shadows outdoors. Shadows occur when light is blocked by an object. An object's shadow appears opposite the light source. Shadow lengths depend on the position of the light source.
- 1.4 Observations can be expressed in words, pictures or numbers. Measurements add accuracy to observations.
- 1.4 Metric rulers are used to measure length, height or distance in centimeters and meters; customary rulers measure length, height or distance in inches, feet or yards.

Science Integration:

Science Inquiry: Students in this unit use base knowledge to **make inferences** about manipulating shadows. They will also make **predictions** and **record data**. They will use their observations to decide whether or not their guesses were correct, and **measure** their results.

Science **Literacy**: In this unit students will read fiction and non-fiction texts related to the unit. They should be encouraged to identify the main idea (**A1 Literacy Standard**) of the text, and to make connections (**C1 Literacy Standard**) with what they have learned about in class and other texts. The teacher can also question the students about why the author included specific sections in the book (**B2 Literacy Standard**).

Science **Numeracy**: The students will be using math skills such as identify quantities as equivalent or nonequivalent (**CT Math Standard 1.3**), describing, naming and interpreting direction and position of objects (**CT Math Standard 3.2**), using standard units of measure to communicate measurement in a universal manner (**CT Math Standard 3.3**), organizing data in tables and graphs and make comparisons of the data (**CT Math Standard 4.2**), and determining the likelihood of certain events through simple experiments and observations of games (**CT Math Standard 4.3**).

SCIENCE CONTENT STANDARD 1.1

CONCEPTUAL THEME:

Forces and Motion - What makes objects move the way they do?

CONTENT STANDARD:

1.1 – The sun appears to move across the sky in the same way every day, but its path changes gradually over the seasons.

GRADE-LEVEL CONCEPT 1: ◆ An object's position can be described by locating it relative to another object or the background

GRADE-LEVEL EXPECTATIONS:

1. An object's **position** can be described by comparing it to the position of another stationary object. One object can be *in front of, behind, next to, inside of, above or below* another object.
2. The sun's position in the daytime sky can be described relative to stationary objects on Earth. For example, the sun can be "just above the treetops," "high or low in the sky," or "on the other side of the school."
3. The description of an object's **position** from one observer's point of view may be different from that reported from a different observer's viewpoint. For example, a box of crayons between two students is near Susan's left hand but near John's right hand.
4. When an observer changes **position**, different words may be needed to describe an object's position. For example, when I am sitting on the bench the sun is "behind" me; when I move to the slide, the sun is "in front of" me.
5. The same object when viewed from close up appears larger than it does when viewed from far away (although the actual size of the object does not change.) For example, a beach ball held in one's arms appears larger than it does when viewed from across the playground.
6. An object's **position** can be described using words ("near the door"), numbers (10 centimeters away from the door) or labeled diagrams.

GRADE-LEVEL CONCEPT 2: ◆ An object's motion can be described by tracing and measuring its position over time.

GRADE-LEVEL EXPECTATIONS:

1. Things **move** in many ways, such as spinning, rolling, sliding, bouncing, flying or sailing.
2. An object is in **motion** when its position is changing. Because the sun's position changes relative to objects on Earth throughout the day, it

CMT EXPECTED PERFORMANCES

A 11 Describe the apparent movement of the sun across the sky and the changes in the length and direction of shadows during the day.

	appears to be moving across the sky. 3. Changes in the sun's position throughout the day can be measured by observing changes in shadows outdoors. Shadows occur when light is blocked by an object. An object's shadow appears opposite the light source. Shadow lengths depend on the position of the light source.. **KEY SCIENCE VOCABULARY:** position, motion, shadow, push, pull, force	

Unwrapped Conceptual Ideas:

- You need a light source, a surface, and an object to create a shadow.
- You can change a shadows size by manipulating the distance between the object and the light.
- You can change a shadows length by manipulating the angle between the surface and the light.
- You can change a shadows position by manipulating the position of the light source or the position of the object.
- Shadows naturally change position during the day since the sun's relative position in the sky changes.

Unwrapped Major Skills:

- Student will be able to create shadows.
- Students will be able to manipulate the length of a shadow.
- Students will be able to manipulate the size of a shadow.

- Students will be able to manipulate the position of a shadow.
- Students will be able to make inferences about the time of day based on the relative position of the sun.

Common Misconceptions:
- All object cast shadows.
- When you shine a light on a solid object it always casts a shadow.

Instructional Strategies That Work:
Letting students lead the discussion with the teacher acting as a guide, allowing students to experiment and then demonstrate their findings, bringing students outside and allowing them to experience the effects of sunlight and shadows, allowing students to work together cooperatively, encouraging students to record data and use math skills to quantify data.

Vocabulary Words:
Light, shadow, surface, object, opaque, transparent, measure, length, centimeter, inch, sundial, "relative position"

Connections to Literature:
Nothing Sticks Like a Shadow, Ann Tompert
Me and My Shadows, Elizabeth Adams

Overview of Lessons:

Lesson One: Students will determine what is needed to make a shadow.
Lesson Two: Students will determine the necessary order for the surface, shadow, and object to create a shadow.
Lesson Three: Students determine that not all objects cast shadows.
Lesson Four: Students learn to manipulate the position of shadows.
Lesson Five: Students learn to why shadows move outside.
Lesson Six: Students use their knowledge of how shadows move outside to make sundials.
Lesson Seven: Students learn to manipulate the size of shadows.
Lesson Eight: Students will learn to manipulate the length of shadows.
Lesson Nine: Students will learn to manipulate the light source so that the shadow disappears.
Lesson Ten: Students will experiment with making shadows with two light sources.

Culminating Activity: Students will play "Shadow Simon Says", a game which will allow the teacher to assess their understanding of all the concepts they have learned in this unit.

Lesson One: What do we need to make shadows?

Student Goals:

1. Students will understand that a shadow will mirror its object.
2. Students will understand that to make a shadow a light source, an object, and a surface are needed.

Vocabulary: shade, shadow, object, light, surface

Materials: outside are on a sunny day or an indoor light source in a darkened room, paper for students to draw, pencils

Procedure:

1. Explain to students that they will be learning about shadows. Ask them if they can tell you what a shadow is. Listen and guide responses.
2. Ask them if they know how to make a shadow. After a few responses tell them this is what you will be learning about today.
3. Take the students to a place where they will be able to make shadows, such as outside on a sunny day or in a dark room in front of an overhead projector with the light pointed at a plain surface (outside works best).
4. Have students fact the light source (sun or artificial). Ask them where their shadow is (behind them). Then tell them to turn around and see if their shadow remains behind them. See if they can explain why their shadow is always behind them.
5. Encourage them to move around. Have the students explain what happens to their shadow when they move.
6. Ask them to look at their shadow and explain the difference between the area with the shadow and the area around the shadow. Ask why they think the shadow is darker than the area around it.
7. Explain that a shadow is the dark area on a surface when light cannot reach it. Ask the student to look at their shadow and identify the three things you need to make a shadow. (light, and item to block the light, and a surface for the shadow to fall on)
8. Ask the students in they can identify those three things specifically needed to make their shadow right now. (sun or overhead light, their body to block the light, and the ground or wall as the surface for the shadow to fall on.
9. Bring students back inside and have them draw a picture of how they made their shadow.

Lesson Two: Positioning light, objects, and surfaces to create shadows.

Student Goal:

1. Students will understand the order in which light, the object, and a surface must fall to create a shadow.

Materials: flashlights for each group, black construction paper, white paper, white crayons, glue sticks, scissors

Procedure:

1. Review with students what is needed to make a shadow (light, an object to block the light, and a surface for the shadow to fall on).
2. Ask if they think these objects need to be in any specific order to make a shadow, or if you can position them anywhere. Tell them that today you will be doing an experiment to test this out. Break the students into groups of three. Pass out a sheet of black paper to each student, and then a white crayon and a flashlight to each group.
3. Tell them they will be experimenting with how to make a shadow. They will be using the flashlight for light, their hands as the object to block the light, and the black paper as the surface. Tell them to experiment with putting these objects in different orders to make hand shadows. Allow time for exploration.
4. After sufficient time has passed, ask if the students found any way to position the three things to make shadows. As they offer ideas, model them yourself in front of the class so everyone can see. This discussion should be led by the students, however the teacher should guide the class to reach the conclusion that to make a shadow you need to place the object between the light and the surface.
5. After this conclusion is reached, the students can go back to their seats and make hand shadows. They can experiment with making different shapes with their fingers and watching the shadows follow their fingers. ****Note:** The teacher may want to model here how to take turns with the flashlight.
6. After students have had a few minutes to explore, they can make hand shadow prints. To do this one student holds the flashlight so it shines on the black paper. Another student put their hand between the paper and the light with their fingers spread wide. The third student traces the shadow with the white crayon. The student holding the flashlight should be instructed not to move it. After the hand is traced the students take turns so each of them have a traced shadow of their hand.
7. Finally the students can cut out the hand traced on the black paper and use the glue stick to glue it on the white paper.

Lesson Three: Do all objects make shadows?

Student Goal:

1. Students will understand that a shadow is the result of an object blocking light from falling on a surface.
2. Students will be able to understand why not all objects cast shadows.

Vocabulary: opaque, translucent

Materials: **book, a sheet of plastic wrap, a clear plastic cup, a coin, a pencil**, flashlight, a piece of chart paper titled "Does Light Shine Through It?" with a chart featuring the objects in bold, marker, Shadow Prediction worksheet

Procedure:

1. Review with students what a shadow is, and what object you need to create a shadow. Discuss the necessary order in which the light, object, and surface need to fall the make shadows.
2. Ask the students if they think all object make shadows? Encourage student to think and predict. Remind them that a shadow is cast when and object blocks light from falling on a surface.

3. Tell the students this is what we will be experimenting with today. Show the students the objects that they will be experimenting with (book, a sheet of plastic wrap, a clear plastic cup, a coin, a pencil).
4. Remind the students that a shadow is cast when an object blocks light from falling on a surface. Ask the student if they think these objects will block light. After they make predictions for each object shine the light though it (not on a surface yet) and see if light can pass through and be seen on the other side. Fill out results on a piece of chart paper with a chart titled "Does Light Shine Through It?".

Does Light Shine Through It?

object	result
Book	No
Plastic wrap	Yes
Clear plastic cup	Yes
Coin	No
Pencil	no

5. Remind the students again that a shadow is cast when an object prevents light from falling on a surface. Have them go back to their desks and fill out the Shadow Prediction worksheet.
6. After they have had time to do that, ask what predictions they made and why they made those predictions. Then tell the student we will be testing their predictions. Have one student come up to the front to be the flashlight holder and another to be the object holder. Turn on a lamp or overhead projector so that it shines on a wall. Have the student in charge of holding objects choose one object at a time to put between the light and the surface. Remind students that this order is necessary.
7. As each object is tested the students should record the results on their prediction sheet.
8. After all objects have been tested ask the students why they think some objects had shadows but others did not. Guide this discussion to reach the conclusion that if light passes through an object it will not cast a shadow because a shadow is only made when an object stops light from hitting a surface. Reference the chart you made as a class when you tested objects and point out that all the objects which let light pass through also did not cast shadows.

Lesson Four: Do Shadows Move

Student Goals:

1. The students will understand that

Materials: overhead projector, flashlights, paper cups

Procedure:

1. Review the previous less on the students (what is a shadow, do all objects cast shadows, what three things do we need to make shadows).
2. Ask the student if they think shadows can move. Gather several responses. Tell the students that today you will be studying how shadows move. Turn on the overhead projector in a darkened room and point it toward the wall. Have the students take turns casting shadows on the wall and ask them if they can make their shadows move. They students will most likely move their bodies. Then challenge them the make their shadow move without moving their bodies. Tell them today we will see how a shadow can move even when the object casting the shadow is still.
3. Have the students break up into groups of three. Give each group a flashlight and a cup. Tell the students to place the cup on the middle of a desk. Then tell them to take turns holding the flashlight and seeing if they can get the shadow to move without moving the cup. Give them time to experiment, monitor to make sure each student has a chance holding the flashlight.
4. After time has passed, ask the students if they were able to move. Guide their responses to reach the conclusion that you can get the shadow to move without moving the object if you move the light source (flashlight). Ask the students if they think this will be true for any object that casts a shadow, or just the cup. List to a few responses.
5. Test the theory with different objects. The class should see that this is true with all objects which cast a shadow. Ask the students if they can explain why that shadow moves when the light moves. Remind them that a shadow is the result of an object blocking light. Lead their responses to the conclusion that the shadow moves when the light moves because the shadow always has to be on the opposite side of the object since that is where the light cannot reach the surface.
6. Play the "Shadow Prediction Game" with the students. Have one student stand in an open are with the room darkened. Choose one student to hold a flashlight (turned off) and point it at the student standing. Then choose another student to predict where the shadow will fall once the flashlight is turned on. Provide an opportunity for almost all the children to participate.

Lesson Five: Why Do Shadows Move Outside

Student Goal:

1. Students will understand that shadows outside move because of the sun's relative position in the sky.

Materials: sunny day, access to a paved sunny spot which can remain undisturbed for several hours, orange traffic cone (or any other object which will stand tall on pavement for several hours), chalk

Procedure: **Note: It is best to start this lesson in the morning since it requires you to revisit the experiment after several hours.

1. Review the previous lesson with the students. Ask them how you can get a shadow to move without moving the object. After a few responses you can play the Shadow Prediction game to reinforce these concepts from the previous lesson.
2. Ask the students if they think that the shadow of a tree can move. Lead a discussion of where light comes from which creates the shadow of a tree. Once the students realize that the light source is the sun and not something they can manipulate, ask if they think the shadow can still move.
3. Tell the students that today you will be doing an experiment to test this idea. Ask them first to predict whether or not the shadow will move.
4. Bring the students outside to a paved area which can remain undisturbed for several hours. Place the cone (or a reasonable substitute) on the pavement and ask the students to observe the shadow it casts. Ask them if they can see it moving, or if they can think of any way to make it move without moving the cone.
5. Trace the shadow with chalk and write the time next to it. Tell the students you are going to leave the cone in this exact spot for a few hours, and then come back and check it again later. Ask for predictions about what you will see.
6. Come back after a few hours and revisit the cone setup. Ask the students to look at the shadow and see if anything has changed. Discuss how much the shadow moved and in which direction it has moved. Ask the students if they have any ideas about why it moved, or predictions about whether or not it will continue to move. Trace the location of the shadow again and write the current time next to that outline.
7. Visit the shadow one last time a few hours later. Ask the students to look at the shadow and see if anything has changed. Discuss how much the shadow moved and in which direction it has moved. Ask the students if they have any ideas about why it moved, or predictions about whether or not it will continue to move.
8. Move back inside to the classroom. Remind students of their previous experiment with the flashlight and their hands. In that experiment they learned that when the object is still, the show will only move when the light moves. Ask for guesses about why the shadow of the cone moved. Guide a discussion to reach the conclusion that the shadow moved because the light source (the sun) was moving. The student should reach the conclusion that all shadows move outside because the suns position shifts in the sky (be careful here not to say the sun moves in the sky).

Lesson Six: Sundials

Student Goals:

1. Students will monitor the changes in the position of shadows outside as the day goes on.
2. Students will understand the link between the how people used sundials to tell time many years ago, and how we use modern watches and clocks.

Vocabulary: sundial, gradual

Materials: white construction paper, clay, new pencils, markers, paperweights (any object will do, 4 per child), sunny day, access to a paved sunny area

Procedure:

1. Review the previous lesson with the students. Ask them to explain how shadows can move when the object is still, and how the shadows of objects outside can move during the day.
2. Ask the students how we tell time (watches, clocks). Explain that many yeas ago people did not have watches or clocks, and ask for guesses concerning how people told time back then. Lead the discussion to reach the conclusion that people watched the movements of the sun to track time.
3. Ask the students to describe the way that the shadow of the cone moved during the day. Explain to the students that before people had clocks they used the movement of shadows on something

called a sundial to tell time. Explain that since the suns position relative to the earth changes gradually, this created slow-moving shadows which could indicate the time. Tell the students that today they will be making their own sundials.

4. Give each student a piece of white construction paper. Tell them to put their name on it in small letters on the front. Then tell them to put a small dot in the center of their paper.
5. Bring the class outside. Give each student a piece of clay and a new pencil. Have the students stand in a straight line shoulder to shoulder all facing in the same direction. Tell them to place their papers on the ground, and distribute the paperweights so the students can place them in the corners of the paper.
6. Pass out the clay, one marker, and one pencil to each student. Tell the students to place the clay on the dot in the center of the paper, and then stick the pencil in the clay so it stands straight up. The students should look at the shadow that the pencil casts, and trace it with a marker. Next the shadow tracing they should write the current time. Ask the students for predictions about how the shadow of the pencil will change during the day. Return inside. (If the papers will not be safe where they are, the students may bring them back inside, as long as when they are brought back outside later they can be put in the same place and position.)
7. Revisit the sundials as often as possible throughout the day. Each time you come out, trace the new shadow and write the current time next to it. Bring the sundials back inside after several visits.
8. The students should study and discuss their sundials. Point out how the shadow and times recorded travel in a circular pattern around the clock, just like the numbers on our modern day watches and clocks.

Lesson Seven: Shadows Big and Small

Student Goals:

1. Students will understand the relationship between the distance between the light and the object, and the size of the shadow that the object casts.

Materials: flashlight, tangrams

Procedure:

1. Review the previous lessons and discuss the different ways that shadows move. Ask the student to explain the different ways that shadows change, besides moving from one place to another. Guide the discussion to the conclusion that shadows can also change by becoming bigger and smaller.
2. Ask the students for some ideas about how you can make shadows cast by the same object bigger or smaller. Listen to their thoughts, and then tell the students that they will have a chance to experiment with this idea. Break them up into teams and give each team a tangram and a flashlight. Tell them to see if they can find a way to make the shadow of the tangram bigger or smaller. Allow time for them to experiment.
3. After enough time has passed ask the students if they have figured it out. Allow them to come up to the front of the room and demonstrate what they did by casting shadows on the board while the room is darkened. After several students have demonstrated different techniques, start a discussion about what worked and what didn't work.
4. Lead this discussion to reach the conclusion that the closer the light and the object are, the large the shadow gets. Make sure to point out that this means we can keep the object where it is and bring the light closer, OR we can keep the light where is and bring the object closer. Demonstrate this in front of the class.
5. Play another shadow prediction game with the students. Have one student stand with a flashlight pointed at the board. Choose two students to stand between the flashlight and the board with the same tangram shape, but at different distances from the light. Have the students predict which shadow will be larger, and then tell the student with the flashlight to turn it on. Students can see if their predictions were correct. Repeat this until all students have had the opportunity to participate.

Lesson Eight: Shadows Short and Long

Student Goal:

1. Students will understand the relationship between the angle that the light comes from and the length of a shadow.

Vocabulary: difference, angle, measure, centimeters, cm, length

Materials: flashlights, paper cups, Long and Short Shadow Recording Sheet, rulers, tape

Procedure:

1. Review the previous lesson with students. Discuss how they now know to change shadows in two different ways. Review the way to make shadows change position, as well as how to make them larger or smaller.
2. Ask the class if they can think of any other ways to change shadows. Ask them if they have even gone outside and seen that everything makes a very long shadow, and then been in the same place at another time and the shadows were very short. After several responses tell them that today you will be experimenting with how to make shadows longer and shorter.
3. Ask the students if they have any ideas about how to make a shadow longer. Brainstorm and then tell students it is now time for them to try it out.
4. Break up the students into teams. Give each team a flashlight, a ruler, and a paper cup, and tell them to take turns making a shadow of the cup on the desk. After they make the shadow they should try to figure out how to make the shadow on the desk longer and shorter. When they have figured out how, they should illustrate the shadows on their Long and Short Shadow Recording Sheet, and then fill out their explanation of what they figured out. On the recording sheet they should also measure the two shadows (in centimeters) and find the difference in their length. You might need to remind them that we use subtraction to find the difference between two numbers.
5. Tape a paper cup to the board. After they have had time to fill out their sheets, ask the class what they came up with. Students can take turns coming up and demonstrating their technique. After several teams have shared, lead a discussion about what worked and what did not work. Lead this discussion to the conclusion that the angle that the light shines on the cup is what determines the length of the shadow (the smaller the angel from the surface, the longer the shadow is.
6. Hold the flashlight at a variety of different angles and ask the students to predict whether the shadow will be long or short.

Name_____

Long and Short Shadows Recording Sheet

My Short Shadow	My Long Shadow

It is _____cm long.	It is _____cm long.

A number sentence to show the difference is:

_____cm - _____cm = _____cm

My long shadow is _____cm longer than my long shadow.

Lesson Nine: Disappearing Shadows

Student Goals:

1. Students will understand that when a light source in directly overhead, the object will cast a minimal shadow.
2. Students will use their understanding of that concept to infer at what point in the day their bodies will cast minimal shadows.

Vocabulary: inches, in., overhead

Materials: sunny day, paper cup, flashlight, "Can my Shadow Disappear?" worksheet, yardstick, pencils

Procedure: ****Note: You will have to go outside the day before this lesson to determine at what time of the day the sun is directly overhead, creating the least shadow possible.**

1. Review what students have learned so far about the ways they can manipulate shadows (size, length, location).
2. Ask the students if they can imagine any way to make a shadow disappear while the light is still shining on the object. Listen to a variety of responses.

3. Explain to the students that today they will be experimenting with how to make a shadow disappear. Divide them into groups and pass out a paper cup and a flashlight to each group. Instruct them to take turns holding the flashlight and seeing if they can make the shadow disappear completely form the surface of the desk. Monitor their efforts, and if they need help remind them that in the last lesson we learned that the shadows were shortest when the angle between the surface and the light was greatest.
4. Allow plenty of time for the students to come up with solutions (they may not simply remove the cup from the table).
5. Call the class together for a discussion and ask several teams to come up to the front of the class and model their ideas. After a few volunteers, point out that as the angle between the surface and the light increased, the shadow became shorter and shorter. Demonstrate that if you continue that trend until the light is directly above the object shining down, the shadow disappears. Model this for the class, and then allow them briefly to return to their desks to try it for themselves.
6. After they have had the opportunity to see this for themselves, start another discussion. Ask them to remember what the source of light was that casts shadows outside (sun). Ask them to imagine that they went outside on a sunny day, and when they look down there is no shadow. See if they can imagine where the sun would have to be at that point. If they have difficulty with this, model it with the cup and the flashlight again to demonstrate that the sun would have to be directly above them if there was no shadow.
7. Take the children outside at a time when their bodies will cast shadows, have them work in pairs to measure their shadows and record them on their "Can my Shadow Disappear?" worksheet. Ask them how they predict their shadows will be different when the sun is directly overhead.
8. Take the children outside during the time of day when the sun is directly overhead. Instruct them to stand up straight with their feet together and their arms by their sides. Tell them to look around and see what their shadows look like. As them to explain why the shadows appear that way in their own words.

Name_____

Can My Shadow Disappear?

My Shadow at _____	My Shadow at _____
My shadow is _____inches long.	My shadow is _____inches long.

A number sentence which shows the difference is:

_____in - _____in = _____in

In the middle of the day my shadow was ____inches shorter.

Lesson Ten: Disappearing Shadows 2

Student Goals:

1. Students will understand how to make two shadows with two lights.
2. Students will understand how to use two lights to eliminate shadows.

Materials: flashlights, paper cups, "Making Shadows With Two Lights" recording sheet,

Procedure:

1. Review the last lesson with the students. Discuss how they were able to make the shadows disappear with the flashlight, and why their own shadows were hard to see when the sun was overhead. Lead their discussion to the conclusion that the shadows disappeared when the light was directly overhead because at that point no light was being blocked from the visible part of the surface.
2. Tell the students that today we will be experimenting with using two lights at once to do different things with shadows. Ask them what they think will happen when you use two flashlights at once and shine them on the cup. Listen to a few responses and tell them its time to find out. Divide them into teams and send them to their desks with two flashlights per team and a paper cup.
3. Tell the students you want to them to try to make two shadows at once. They can experiment with having two different people hold the lights, or having one person hold both lights. If they are able to make two shadows at once, they should record a picture of it on their "Making Shadows With Two Lights" recording sheet.
4. After enough time has passed ask the student to come up and demonstrate different ways that they made two shadows with two lights. Ask the students if they can explain why two shadows can be made with two lights. Lead the discussion to reach the conclusion that if there are two sources of light, light will also be blocked from two directions.
5. Ask the students to predict what would happen if you added in a third light.
6. Now tell the student that they should go back to their desks and see if they can find a way to use the two lights shining on the cup to make no shadow. Also tell them that this time the lights cannot be shining directly overhead. Watch them and provide assistance while they experiment. If the students are able to use both lights and not create a shadow they should record it on their "Making Shadows with Two Lights" recording sheet.
7. After sufficient time, allow several groups to show their techniques. Lead a discussion about what worked and what didn't work. The conclusion should be reached that if one light shines on the shadow that the first light created, there will be no shadow. Explain to the children that since a shadow is made when light can't reach a surface, if we shine another light on that surface the shadow will disappear.
8. Ask the students to explain this in their own words. Have one student cast a shadow with a flashlight and then challenge another student to find the place to shine the light so that shadow disappears.

Name_____

Making Shadows with Two Lights

Two Shadows	No Shadow

Culminating Activity: Shadow Simon Says

Materials: flashlights, paper cups

Procedure:

1. Review all the ways the student have learned to manipulate shadows (length, size, position). Review how shadows outside are affected by the different relative position of the sun.
2. Tell the students that today they will be playing a game using all the things they have learned about shadows. Break them up into pairs and tell them they will be playing Shadow Simon Says. One person will be Simon, and they will say a type of shadow to make. For example: make a long shadow, make a big shadow, make a shadow that goes to the right of the cup, place the light so there is no shadow.

3. Before the students begin playing, model this for them in the front of the class with a volunteer.
4. Give each pair a cup and a flashlight and tell them to begin playing. Monitor them for a while until you are sure they have the hang of it. Mention that you will be joining in to play with some of the groups.
5. Go around to each group and ask if you can play. Ask each child to make a shadow which varies in size, position, and length. Also ask them to make inferences about the time of day and the position of the sun. For example: Pretend the flashlight is the sun, and show me how the sun could shine on the cup so that there would be no shadow.
6. Assess the student by seeing how effectively they can manipulate the shadows with the flashlight (3 aspects of assessment), as well as how well they understand the effect of the suns relative position on shadows (last aspect of assessment). There are four aspects in total, and these will determine the student's achievement on the culminating activity.

1	2	3	4	5
The student shows no understanding of any of the four aspects of assessment.	The student shows understanding of one aspect of assessment.	The student shows understanding of two aspects of assessment.	The student shows understanding of three aspects of assessment.	The student shows understanding of all four aspects of assessment.