Art provides recorded Evidences of their Observations which allow them to measure and compare over time.

<table>
<thead>
<tr>
<th>What or who cast the shadow?</th>
<th>Length of Shadow</th>
<th>Height of object or person</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>
A Line on Pendulums

Graph

<table>
<thead>
<tr>
<th>Time (sec)</th>
<th>Cycles</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
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<tr>
<td>60</td>
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<tr>
<td>90</td>
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<td>120</td>
<td></td>
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<tr>
<td>150</td>
<td></td>
</tr>
<tr>
<td>180</td>
<td></td>
</tr>
<tr>
<td>210</td>
<td></td>
</tr>
<tr>
<td>240</td>
<td></td>
</tr>
<tr>
<td>270</td>
<td></td>
</tr>
<tr>
<td>300</td>
<td></td>
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</tbody>
</table>

Write the equation:

Time (seconds)

What are you wondering now?

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541-383-0148
Blacklinemasters available at:
lbnovelli@bendbroadband.com

Getting In the Swing of Things
What did you find out?

<table>
<thead>
<tr>
<th>Length of twist tie</th>
<th>Number of Cycles In a Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Write about what you discovered:

How big a bubble can you blow?

Tell about your best bubble:

How many seconds did your bubble last?

Tell about your longest lasting bubble:
Mr. Groundhog, Mr. Groundhog

Topic
Light and shadows

Key Questions
1. Will we see Mr. Groundhog’s shadow?
2. What will happen to Mr. Groundhog’s shadow as we observe it during the day?

Learning Goal
Students will observe, trace, and discuss the shadow of a groundhog throughout a day.

Guiding Documents
Project 2061 Benchmarks
- Like all planets and stars, the earth is approximately spherical in shape. The rotation of the earth on its axis every 24 hours produces the night-and-day cycle. To people on earth, this turning of the planet makes it seem as though the sun, moon, planets, and stars are orbiting the earth once a day.
- Keep records of their investigations and observations and not change the records later.

NRC Standards
- The position of an object can be described by locating it relative to another object or the background.
- An object’s motion can be described by tracing and measuring its position over time.
- The sun, moon, stars, clouds, birds, and airplanes all have properties, locations, and movements that can be observed and described.

NCTM Standard
- Relate physical materials, pictures, and diagrams to mathematical ideas

Math
Measurement

Science
Physical science
- Earth’s rotation
  shadows

Integrated Processes
Observing
Comparing and contrasting
Communicating
Collecting and recording data
Interpreting data

Materials
For the class:
- Mr. Groundhog pattern (see Management 1)
- stick with pointed end, 30 inches long
- hammer
- large sheet of butcher paper (see Management 2)
- five markers of different colors

Background Information
Young learners usually experience shadows in relation to themselves. “My shadow keeps following me.” “My shadow sure is getting tall and skinny.” These observations, along with reflective discussions about them, form a very important foundation for later understandings. These prior observations are essential for students to eventually develop understandings about the relationship of the angle of the sun at different times of the day and the resulting change in an object’s shadow. Many young learners do observe that the sun’s position seems to change, as does their own shadow and the shadows of other objects (such as Mr. Groundhog in this activity). It is quite a leap, however, to assume that they make the connection in the observed changes in a shadow and the relative position of the Earth and sun.

We as teachers of young children need to have a greater understanding of what causes the changes in the shadows students are observing. It helps us ask appropriate questions that will direct children to reflect about the changes they are seeing. At this age level, the focus is on the observation of a shadow’s change rather than the "why" of the change.

It is important for us as adults to know that shadows are created as objects block the sun’s rays. The changes in shadows occur because the Earth rotates on its axis in a counterclockwise motion causing the sun to be seen in the eastern sky in the morning and in the western sky in the evening. Shadows that are cast because of the sun’s apparent motion can be marked and measured. As the Earth rotates, the angle of the sun’s rays on an object changes. As the angle of the sun changes in relation to the object blocking its light, the shadow of that object will change in length, width, and position.

Early in the morning, when the sun is low on the horizon, the resulting shadow is relatively long, thin, and located to the west of the object. As the day progresses, when the sun seems to move higher in the sky, the shadow gets shorter and plumper. When the sun is nearly overhead, the shadow will be at its shortest. Later
in the day, the sun’s relative position causes the shadow to lengthen again, but it now appears on the other side (east) of the object. Other changes in the shadow’s position and length will occur with seasonal changes.

Management
1. The groundhog figure is constructed by making a transparency of the picture provided. Place it on the overhead projector and then move the projector until the projected image is approximately 24 inches tall and 15 inches wide. Cut a piece of brown butcher paper twice the length and width of the groundhog. Fold the paper in half and trace the groundhog shape onto the double thickness. Cut the doubled paper. Staple the two layers all around the groundhog’s body, leaving the bottom open. Stuff the groundhog’s body with newspaper, then staple the bottom closed.
2. Create a mat on which to trace the groundhog’s shadow by taping side-by-side two five-foot lengths of butcher paper.
3. Look for an area outside where shadows from buildings, trees, or poles will not interfere with the groundhog’s shadow. It must also be an area where the class can form a circle and be seated around Mr. Groundhog and the tracing mat.
4. Hammer the stake into the ground in the center of the mat. Insert the stake up through the bottom part of Mr. Groundhog’s body.
5. If wind is a problem, either put heavy objects on each end of the mat or use plant stakes around the edges to keep the wind from moving the mat.
6. Make sure to use a different color each time you trace the groundhog’s shadow. It is difficult to trace so the teacher may need to do the tracing.
7. If you wish to do the shadow prediction part of the activity, you will need to make a graph by enlarging the one provided. Prediction markers are included.

Procedure
1. Read one of the stories suggested in Curriculum Correlation about groundhogs and shadows. Ask the students if the groundhog would see its shadow today. If desired, the students can use the prediction markers provided on the enlarged chart. Discuss the predictions before going outside to check.
2. Take the students outside and have them form a circle around the groundhog and the tracing mat. Ask about the shadow and discuss their observations. Trace the groundhog’s shadow as the students watch. Ask students what time it is and record the time inside the traced shadow. Also inside the shadow outline, record some of their observations about the shadow. Ask students what they just did at school before coming out to see the shadow.

Record their responses inside the traced shadow. (For example: 8:30 A.M. The groundhog’s shadow is longer than the groundhog is tall. We just had calendar time.)
3. Wait about an hour and ask the children what they think Mr. Groundhog’s shadow will look like now. After students make their predictions, go out again and make a circle around Mr. Groundhog and the tracing mat. They should discuss what they observe. Trace the groundhog’s shadow and inside record the time of observation, what changes they have observed in the shadow, and what they have just done before coming outside. (For example: 10:00 A.M. Mr. Groundhog is shrinking. He is getting fatter. We just finished snack.)
4. Repeat this process as many times as possible, each time observing the students and noting their observation skills.
5. Ask the students to describe how the groundhog’s shadow changed.
6. Ask them what changes might happen to their shadows during the day.
7. If possible, repeat this experience several times during the year.

Connecting Learning
1. What causes a shadow?
2. Describe how Mr. Groundhog’s shadow changed.
3. What changes did you observe?
4. Tell about your own shadow.
5. Explain how the game of shadow tag might change if you played it in the morning and then at lunch.
6. What did you learn by doing this activity?

Assessment
A few days after this activity, ask students to trace their own shadow in the early morning. After they have traced their shadow, ask them to think about Mr. Groundhog and then explain how their shadows will change. This can be done in writing or by having students dictate their predictions to you if they are not yet fluent writers.

Extensions
Students can observe, trace, and discuss the changes in the shadow of the sunflower, scarecrow, or other figures at different times of the year.

Curriculum Correlation
Make a transparency in order to enlarge Mr. Groundhog.
WILL THE GROUNDHOG SEE ITS SHADOW?

YES

NO

CYCLES OF KNOWING AND GROWING

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Prediction Markers
Taking a Fancy to Feathers

What students will learn:
Each plant or animal has different structures that serve different functions in growth, survival, and reproduction.

Materials:
Feathers of different sizes and types
Hand lenses, jeweler's loupes, and microscope, metric ruler or meter tape

Procedure:
1. Tell the students to close their eyes and then gently brush their faces with a feather. Ask students to guess what brushed their face. Encourage them to explain their guess with specific descriptive words.
2. Show the students how to make a pyramid book. (p. 108 of this manual). Tell them to sketch a feather in the first segment of the book. This sketch will be done from their prior experience with feathers (if any).
3. Now hold up a variety of feathers. Ask the students to describe what they observe about the feathers.
4. Give each student a contour feather and have them sketch the feather in the second segment of the pyramid book. Discuss their observations. Measure the feather and compare measurements with a partner's feather. Record all observations in this section of the pyramid book.

Barbara Ann Novelli 2015
5. Now give students hand lenses or jewelers loupes and let them observe the feather. In the third segment of the book, have them sketch what they see with the use of the loupe.

6. Introduce the vocabulary:
   Shaft, Barb, Barbules
   Ask them to identify these parts in their sketches by labeling them. Discuss their functions. The class may want to use some the resource books recommended in the provided bibliography.

7. Now, give students down feathers and have them observe and sketch the down feather. Provide hand lenses or jewelers loupes so they can more closely observe the structure and compare them with the contour feathers.

8. Bring the students together and compare their sketches and observations. Ask the students what role/function each type of feather might serve.

9. Repeat the procedure with flight feathers (sketching, using hand lenses and labeling their sketches.)

10. When all feathers have been observed measured and described lead the class in a binary sorting of the feather in relation to attributes discovered.

**Thoughtful Questions**
Explain the role of each feather.
How are the feathers alike? Different?

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Getting In the Swing of Things

What student will learn:
The position and motion of an object can be changed by pushing or pulling. The size of change is relative to the push or pull.

Materials: (per partners)
1 meter of plant staking material
1 weight such as a 1 inch washer
Meter tape (see appendix of manual)

Procedure:

1. Show the students the pendulum you made from a weight and a piece of plant staking. Suspend the pendulum from your hand.
2. Invite a volunteer to start the pendulum moving by giving it a gentle push. Ask students how they could get the pendulum to move in a different direction. Would you need to push harder or softer?
3. Students make their own pendulum while working with a partner. The pendulum is easily made by twisting some of the plant staking around a weight. Ask the students: How can you change the movement of the pendulum?
4. Allow student to play with the pendulum and discover how the change the movement.
5. Bring the students together and let them share their discoveries. Emphasize the strong and weak force concepts as well as directionality.
6. Focus now on frequency of completing a cycle by demonstrating a cycle to the students. A cycle is defined as swinging from a beginning point and returning to that point.

7. Ask the students how they can change the number of cycles in a minute. Allow students time to experiment. If student do not discover changing the length of the twister tie suggest that they try timing the cycles with a short length and a long one. Show them how to use their meter tapes to measure the length of the pendulum. Explain how to use the data sheet to keep a record of the changes.

After students have completed experimenting, direct the students to use their data sheets in discussing what they learned about the length of twister tie in relation to cycles.

**Thoughtful Questions:**

What did you do to change the direction of the pendulum?
What changes made the pendulum move faster? Slower?
Compare pendulums with different lengths of twister tie?
How would you design a pendulum if it needed to move slowly? Faster?
Getting In the Swing of Things
What did you find out?

<table>
<thead>
<tr>
<th>Length of twister tie</th>
<th>Number of Cycles In a Minute</th>
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</tbody>
</table>

Write about what you discovered.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Barbara Ann Novelli
Asking Clarifying Questions
The No-Put-Down Way!

- What we are wondering is...
- Can you explain how?
- This is what we found....
- Let's compare our results and procedure.
- Please describe your procedure...
- Show us how you...
- What we are thinking is...

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An Amazing Array of Math Games
1. Create a question:

2. Develop a Hypothesis

3. Procedure Steps:
   Consider variables:
   One variable kept the same (controlled)
   One variable manipulated (changed)
   One variable responding (dependent)

4. Materials Needed:

5. Data Organized (chart, graph Metric units only)

6. Conclusion:
   To be considered in your conclusion: What happened? Does the data support your Hypothesis? Explain any unexpected results. Are your results reliable?
Bubbles

Bubble Recipes

3.9 liters or 1 gallon water
175 ml or 2/3 cup Dawn or Joy Detergent
Age for several days

Songs and Poems

I'm a little bubble big and round
Floating high without a sound,
This little bubble won't last long
So blow some more before it's gone.
(Sung to I'm a little teapot)

Sing a song of bubbles
Floating in the air
Filled with rainbow colors
Swirling here and there
Blowing lots of bubbles
I don't want to stop
What fun to catch one
And touch it with a Pop!
(sung to Sing a Song of Sixpence)

Dip your pipe and gently blow
Watch you tiny bubble grow
Big and Bigger
Round and fat
Rainbow colored
And then Splat!
Margaret Hillert

They sailed like moons
Up toward the sky
To show the birds
That balls could fly
Some blew to the ground,
One lit on my nose
And a big one burst
When it hit my toes.

Two bubbles found they had rainbow curves
They flickered out saying:
"It was worth being a bubble just to have held that rainbow thirty seconds."
Carl Sandburg

Books and Resources

Bubble Bubble, Mercer Mayer
The Magic Bubble Trip, Ingrid and Dieter
Never Snap At a Bubble.
Bubbles, Bernie Zubrowski
Bubbles Seymour Simon
Soap Film and Bubbles, Aims Education Foundation
AAAS Science Resources for Schools,
1776 Massachusetts Ave., Washington, D.C. 20036

Barbara Ann Novelli 1992
This is a picture of the tool I used to make my bubble.

I think my bubble will look like this:

And this is what it really looked like:
Bubbling into Math

How big a bubble can you blow?

Bubble One  

Bubble Two  

Bubble Three  

Tell about your best bubble.  

How many seconds did your bubble last?

Bubble One  

Bubble Two  

Bubble Three  

Tell about your longest lasting bubble.  

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What kinds of patterns do groups of bubbles form?