# The Reasons for the Seasons
## (The Active Learning Approach)

**Materials:** 4 Globes, One light on stand with soft white bulb, 4 flashlights, Four sets of "Seasons" Cards, Four laminated black cards with 1 inch holes in center; also Materials for "Skittles" Lab.

**ACTIVITY ONE:**

1. Place a lamp fixture in the center of your classroom.
2. Tape the electric cord to the floor.
3. Remove the shade and place a large soft white bulb in the lamp.
4. Turn on the lamp and turn off the classroom lights.
5. Have student teams (four is good) hold an Earth globe and walk around the lamp (sun) modeling the orbital path of the Earth. Each team can walk as a team.

   **NOTE:** If viewed from above, the Teams walk in a **counterclockwise** direction!

   **NOTE:** Do variations of this, such as; Each Team stands at a different season and the Teams walk around together, shouting the new season as they move into that area.

6. Have teams place large colored laminated cards on the classroom floor with the dates and names of the spring and fall (autumnal) equinox and the summer and winter solstice.

   **NOTE:** Have four sets of different colored cards. Play a speed game. First Team done placing cards at the appropriate spots gets the 4 points, second done - 3, etc.

   **NOTE:** Be sure teams do not change the orientation of the axis while orbiting the model sun.

7. Quiz Teams on various aspects of this set-up, such as:

   What Season are you at now, Team One?
   How do you know?
   Are we closer or farther away for this season?
   What season is the Southern Hemisphere experiencing now?
   How do you know?
   At what angle is the Earth pointing toward the Sun?
   What is the Special Day called? Date of that Day?

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## ACTIVITY TWO:

7. Now, turn off the lamp and have the Teams turn on the flashlights, which now represent the Sun.

8. The Teams hold the globe 3 feet away from the flashlight and place the black laminated card with the one inch hole between them.

9. Adjust the distances so the flashlight shines a one inch beam of light on the equator. Have the Teams measure the size of the beam of light on the globe to be sure. [The shape should be a perfect circle - 1 inch across.] This is called **Direct Sunlight**.

10. Slowly tilt both the flashlight and cardboard to move the light beam away from the equator toward the Tropic of Cancer or Capricorn, being careful not to change their relative positions. Have students measure the size of the light beam as it moves north or south. [The shape should be an oval, larger than 1 inch across.] This is called **Indirect Sunlight**.

11. While the new location receives the same amount of light (solar energy), what happens to the light's size and shape, and thus **Intensity** as it moves away from the equator? [It increases in size, thus decreasing the amount of solar energy in any one area.]

    Where on the globe is the light beam most intense?
    What is the shape of this area?
    What causes this?
    Where on the globe is the light beam least intense?
    What is the shape of this area?
    What causes this?

**ACTIVITY THREE:**

12. Do the **Angle of Sunlight Lab** with Jellybeans, Skittles, or dried beans.

**ACTIVITY FOUR:**

13. **Cut & Paste "What Season is This?" Worksheet**

**ACTIVITY FIVE:**

14. **Label the Seasons Worksheet** - Use one from your textbook series. The more "traditional" type. More likely to be on a state assessments test. They can probably do it now!

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# DECEMBER 22

# MARCH 21

# JUNE 21

# SEPTEMBER 22

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# VERNAL EQUINOX

# AUTUMNAL EQUINOX

# SUMMER SOLSTICE

# WINTER SOLSTICE

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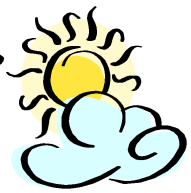
# ANGLE OF SUNLIGHT LAB



**Name**_____ **Class**_____

**Directions:**

1. Shine the flashlight directly at the grid on this page, at right angles, from a height of about 15 cm. Trace the lighted area with a pencil. Label #1.

2. Change the angle of the flashlight to about 30$^{o}$. Hold the flashlight at about 15 cm above the paper. Trace the area. Label #2.

**Observations:**

**1a:**

| Number of full blocks | + | Half the Number of Partial Blocks | = | Approximate Area |
|---|---|---|---|---|
| _____ | | + _____ | = | _____ |

**1b:**

Number of Beans X 40 $^{o}$C / Approx. Area (from Step 1a) = Temp. of One Block oC

_____ X 40 $^{o}$C * / _____ = _____ **$^{o}$C**

**(*The amount of heat absorbed by one "bean.")**

**2a:**

| Number of full blocks | + | Half the Number of Partial Blocks | = | Approximate Area |
|---|---|---|---|---|
| _____ | | + _____ | = | _____ |

**2b:**

Number of Beans X 40 $^{o}$C / Approx. Area (from Step 2a) = Temp. of One Block oC

_____ X 40 $^{o}$C * / _____ = _____ **$^{o}$C**

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**ANGLE OF SUNLIGHT Summary Questions:**

1. If the flashlight were sunlight, which angle would heat the paper the **most**?

2. In general, where would the world have higher temperatures?

   Why?

3. Refer to a world map and list at least 6 different countries you think would have the highest temperatures on the planet:

4.. If the flashlight were sunlight, which angle would heat the paper the **least**?

5. In general, where would the world have lower temperatures?

   Why?

6. Refer to a world map and list at least 6 difference countries you think would have the coldest temperatures on the planet:

7. How would the angle of sunlight affect the temperature of the lighted area?

   As the angle of the sunlight increases,
   the temperature of the lighted area _____.

8. Which lighted area ($90^{o}$ or $30^{o}$) would be called <u>direct</u> sunlight? _____

   <u>Indirect</u> sunlight? _____

9. Compare <u>Jefferson City</u> to <u>Miami, Florida</u>, using what you've learned in this lab.

10. Compare <u>Jefferson City</u> to <u>Toronto, Canada</u>, using what you've learned in this lab.

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**TEACHER NOTES FOR ANGLE OF SUNLIGHT LAB:**

1. You can do this quicker by walking around with one flashlight and holding it at 90º and 30º and having the students trace the light on the paper. If you have enough flashlights for each small group and enough time, then talk them through the process.

2. In #1a: Students count the blocks in the traced circle. In #2a: : Students count the blocks in the traced oval. Add half the partial blocks.

3. In #1b: Place Beans or Skittles in the circle so they lay close together but not overlapping. Multiply by 40. Divide by Area in #1a. This is the temperature if you live in this area.

4. In #2b: Spread the Beans or Skittles out in the oval so they fill the area. They will NOT be touching. DO NOT ADD BEANS OR SKITTLES. USE THE SAME AMOUNT FROM #1!! Multiply by 40. Divide by Area in #2a. This is the temperature if you live in this area.

5. Make transparencies of both pages. On the front page, walk the students through the math. You will put notes on the first page later.

6. The most important thing to remember is that as you walk around the room adding Skittles or whatever to the perfect circle, each one represents the amount of heat absorbed by that area on the planet Earth. DO NOT GIVE THEM MORE FOR THE OVAL! The sun is about the same distance away and the amount of solar energy doesn't change. (The elliptical orbit of the Earth is just about a perfect circle, but not quite.) Thus the same amount of Solar Energy reaches Earth from both winter and summer positions.

7. Keep a watchful eye on your students, because they may "borrow" beans from a neighbor to fill the oval and thus mess up their math!

8. After all the math is done, I walk the students through the entire concept, placing "Notes" in the margins by #1 and #2 shapes. Students refer to these notes often while answering the questions on the back of the lab.

#1: NOTES IN MARGIN
Summer
Summer Solstice
June 21
Direct Sunlight
90º
Higher Temperatures

#2: NOTES IN MARGIN
Winter
Winter Solstice
December 22
Indirect Sunlight
30º
Lower Temperatures

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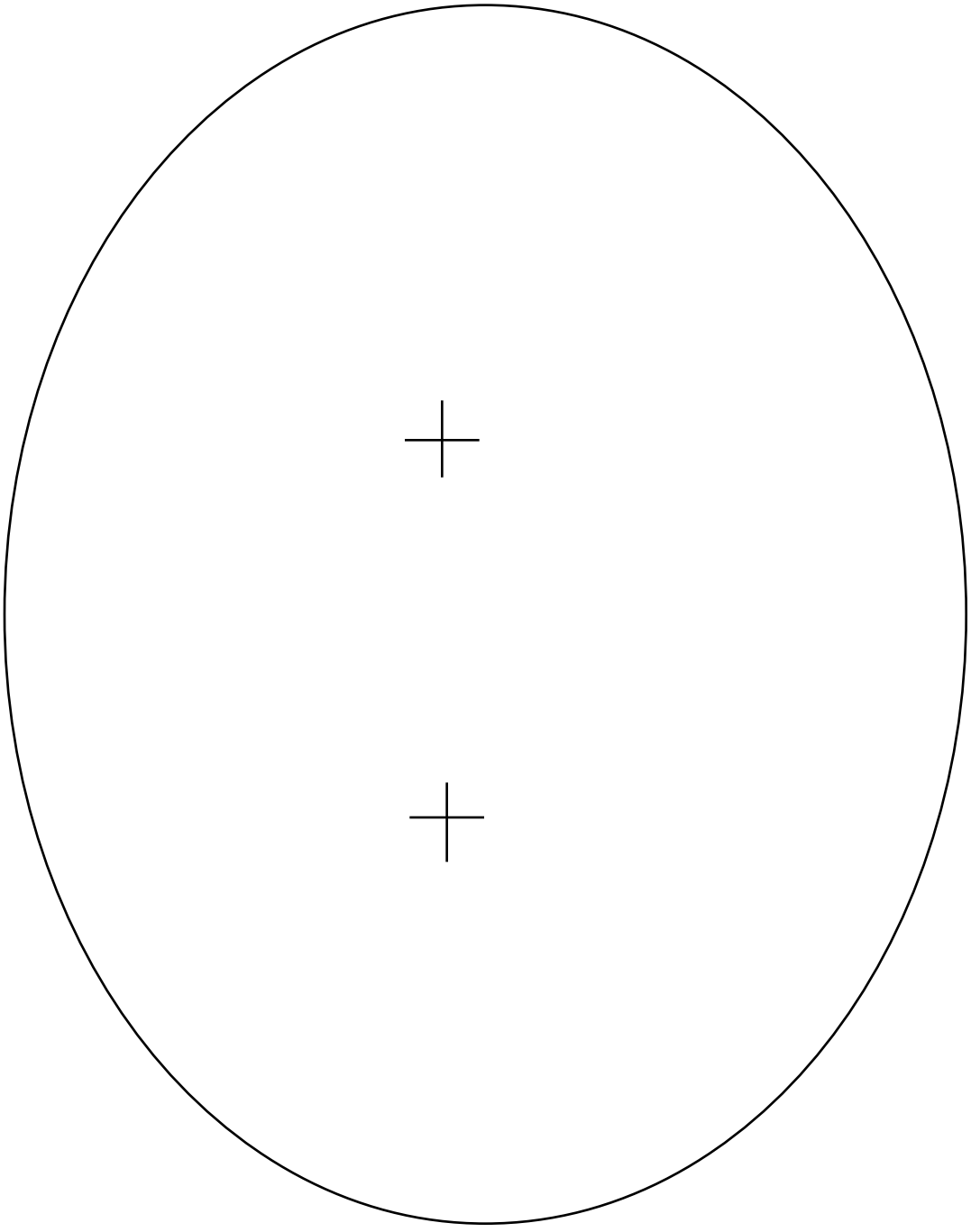
# What Season Is This?

Name_____ Class_____

**Turn the paper sideways while gluing.**



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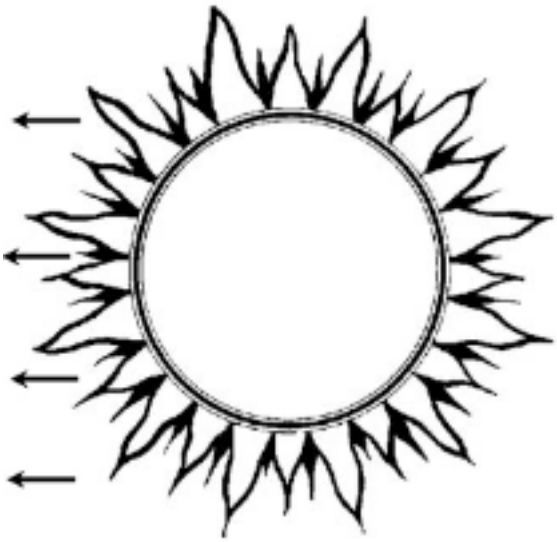
Cut out the sketches and paste on the front page.



Cut out the labels and paste at the appropriate place on the first page.

| | | | |
|---|---|---|---|
| **SUMMER** | **WINTER** | **SPRING** | **FALL** |
| **DECEMBER 22** | **MARCH 21** | **SEPTEMBER 22** | **JUNE 21** |

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**SUMMARY QUESTIONS:**

1. List the **three causes of seasons on Earth**.
    a)
    b)
    c)

2. How does the tilt of the earth contribute to the occurrence of the seasons?

3. How does the parallelism of the Earth's axis contribute to the occurrence of the seasons?

4. How does the revolution of the Earth around the Sun contribute to the occurrence of the seasons?

5. What happens in the Northern Hemisphere on June 21?
    Where is the Tropic of Cancer? Why?
    Where is the Arctic Circle? Why?
    Where is daylight constant on June 21?
    What happens to the daylight period in the Northern Hemisphere after June 21? Why?

6. What happens in the Northern Hemisphere on December 22?
    Where is the Tropic of Capricorn? Why?
    Where on Earth is daylight constant on December 22?
    What happens to the daylight period in the Northern Hemisphere after December 22? Why?

7. Why are daylight and nighttime of equal length on an **equinox**?
    Give the names and dates of the equinoxes.
    Where is the sun straight overhead at an equinox?
    Describe what happens at the North Pole and the South Pole at each equinox.

8. What evidence is there that distance from the sun is not a cause of seasons?

9. How does the path of the sun across the sky differ on the first day of summer from the first day of winter?

10. You should have pasted the Sun on one of the plus marks (foci) in the middle of Earth's orbit. What is located at the other plus sign? (And it's not the Moon!)

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