LESSON MAKER PRO

Sunlight by Numbers

Calculate how the noon Sun angle changes across places and seasons.

HIGH SCHOOL · ESS.3

ESS.3 "Students will develop an understanding of Earth's systems and cycles. Use mathematical representations (e.g., latitude, longitude, and maps) to calculate the angle of noon solar incidence and relate the value to day length..."

NAME _____ DATE _____

FIND THE NOON SUN ANGLE

Use positive numbers for north latitude and north solar declination, and negative numbers for south. The noon Sun angle above level ground is 90° - |latitude - solar declination|. At the same place, a higher noon Sun spreads sunlight over less ground, while changes in day length also affect the total sunlight received.

WORKED EXAMPLE

Find the noon Sun angle at 34° N when solar declination is 10° N.

1. Write latitude as +34° and declination as +10°.
2. Find the difference: |34 - 10| = 24°.
3. Subtract from 90°: 90° - 24° = 66°.

Answer: 66°

PRACTICE 6 problems

1 Find the noon Sun angle at 40° N when solar declination is 20° N.

ANSWER _____

2 Find the noon Sun angle at 25° N when solar declination is 5° S.

ANSWER _____

3 Find the noon Sun angle at 15° S when solar declination is 20° S.

ANSWER _____

4 Find the noon Sun angle at 45° S when solar declination is 15° N.

ANSWER _____

5 At 30° N, find the noon Sun angle on the June solstice. Which of the two dates in the table has longer daylight at this location?

SOLAR DECLINATION

Date	Declination
June solstice	23.5° N
December solstice	23.5° S

ANSWER _____

6 Use the table to find the noon Sun angle at each site on a day when solar declination is 23.5° N.

SITE LATITUDES

Site	Latitude
A	20° N
B	20° S

ANSWER _____

APPLY IT Show your work

1 Your school is choosing between June and December for an outdoor noon event. The school is at 35° N. Solar declination is 23.5° N on the June solstice and 23.5° S on the December solstice. Find both noon Sun angles. Which event would have more concentrated sunlight on level ground, assuming clear skies?

WORK SPACE

ANSWER _____

2 Two student beach-cleanup teams compare noon sunlight on the June solstice. Team A works at 10° S, and Team B works at 50° S. Solar declination is 23.5° N. Find each team's noon Sun angle. Which team receives more concentrated sunlight on level ground at noon, assuming clear skies?

WORK SPACE

ANSWER _____

CHALLENGE One step up

A campus is north of the 20° N subsolar point on a day when solar declination is 20° N. Its noon Sun angle is 80°. Find the campus latitude. Then find its noon Sun angle when solar declination is 20° S. Explain why its noon sunlight is less concentrated on the second day.

WORK SPACE AND ANSWER

Sunlight by Numbers

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Find the noon Sun angle at 40° N when solar declination is 20° N.	**70°**
2	Find the noon Sun angle at 25° N when solar declination is 5° S.	**60°**
3	Find the noon Sun angle at 15° S when solar declination is 20° S.	**85°**
4	Find the noon Sun angle at 45° S when solar declination is 15° N.	**30°**
5	At 30° N, find the noon Sun angle on the June solstice. Which of the two dates in the table has longer daylight at this location?	**83.5°; June solstice**
6	Use the table to find the noon Sun angle at each site on a day when solar declination is 23.5° N.	**A: 86.5°; B: 46.5°**

PART 2 · APPLY IT

1. **June: 78.5°; December: 31.5°; the June event** June: 90° - |35 - 23.5| = 78.5°. December: 90° - |35 - (-23.5)| = 31.5°; the higher June Sun concentrates sunlight on less ground.
2. **Team A: 56.5°; Team B: 16.5°; Team A** Team A: 90° - |-10 - 23.5| = 56.5°. Team B: 90° - |-50 - 23.5| = 16.5°, so Team A has the higher noon Sun.

CHALLENGE

The campus is at 30° N. On the second day, the noon Sun angle is 40°. The lower Sun angle spreads sunlight over more ground.

All angles are measured above level ground. Accept equivalent signed-number calculations and explanations that connect a higher noon Sun to more concentrated sunlight.