LESSON MAKER PRO

Sunlight by Latitude

Calculate noon Sun angles and compare seasonal daylight.

HIGH SCHOOL · ESS.3.1

ESS.3.1 "Use mathematical representations (e.g., latitude, longitude, and maps) to calculate the angle of noon solar incidence and relate the value to day length, distribution of sunlight, and seasonal change."

NAME _____ DATE _____

FIND THE NOON ANGLE

The noon Sun angle, measured above level ground, is 90° minus the distance between your latitude and the Sun's declination. Declination is the latitude where the Sun is directly overhead, so subtract latitudes on the same side of the equator and add them on opposite sides. A higher noon angle concentrates sunlight on less ground, but a higher angle does not always mean a longer day.

WORKED EXAMPLE

At 35° N, the Sun's declination is 12° N. Find the noon Sun angle.

1. Both latitudes are north, so their distance apart is 35° - 12° = 23°.
2. Noon Sun angle = 90° - 23° = 67°.

Answer: 67°

PRACTICE 6 problems

1 At 20° N on an equinox, the Sun's declination is 0°. Find the noon Sun angle.

ANSWER _____

2 At 40° N, the Sun's declination is 20° N. Find the noon Sun angle.

ANSWER _____

3 At 40° N, the Sun's declination is 20° S. Find the noon Sun angle.

ANSWER _____

4 At 30° S, the Sun's declination is 20° S. Find the noon Sun angle.

ANSWER _____

5 On a day when the Sun's declination is 20° N, use the table to find each site's noon Sun angle. Which site has a longer day?

TWO SITES ON THE SAME DAY

Site	Latitude
A	10° N
B	60° N

ANSWER _____

6 On an equinox, the Sun's declination is 0°. Use the table to find both noon Sun angles. Do the sites have different daylight hours?

TWO SITES ON AN EQUINOX

Site	Latitude
C	10° S
D	50° S

ANSWER _____

APPLY IT Show your work

1 Two schools plan outdoor solar-powered charging stations for a June solstice festival. The Sun's declination is 23.5° N. Use the table to find each school's noon Sun angle. Which school has the higher noon angle, and which has the longer day?

FESTIVAL LOCATIONS

School location	Latitude
Boston	42° N
Austin	30° N

ANSWER _____

2 A student tracks sunlight for a solar-powered phone charger at 40° N. Use the table to find the noon Sun angle on each solstice and the difference between the angles. Which solstice has the longer day at this location?

SOLSTICE DECLINATIONS

Solstice	Sun's declination
June	23.5° N
December	23.5° S

ANSWER _____

CHALLENGE One step up

On a day when the Sun's declination is 20° N, a site north of that latitude has a noon Sun angle of 62°. Find the site's latitude. Compare its day length with that of a site at 20° N on the same day, and explain why the site with the lower noon angle can have the longer day.

WORK SPACE AND ANSWER

ANSWER KEY

Sunlight by Latitude

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	At 20° N on an equinox, the Sun's declination is 0°. Find the noon Sun angle.	**70°**
2	At 40° N, the Sun's declination is 20° N. Find the noon Sun angle.	**70°**
3	At 40° N, the Sun's declination is 20° S. Find the noon Sun angle.	**30°**
4	At 30° S, the Sun's declination is 20° S. Find the noon Sun angle.	**80°**
5	On a day when the Sun's declination is 20° N, use the table to find each site's noon Sun angle. Which site has a longer day?	**A: 80°; B: 50°. Site B has a longer day.**
6	On an equinox, the Sun's declination is 0°. Use the table to find both noon Sun angles. Do the sites have different daylight hours?	**C: 80°; D: 40°. No, both have about 12 hours of daylight.**

PART 2 · APPLY IT

1. **Boston: 71.5°; Austin: 83.5°. Austin has the higher noon angle, but Boston has the longer day.** Subtract 23.5° from each latitude, then subtract each result from 90°. On the June solstice, the more northerly location has a longer day.
2. **June: 73.5°; December: 26.5°; difference: 47°. The June solstice has the longer day.** June's angle is 90° - (40° - 23.5°) = 73.5°, and December's is 90° - (40° + 23.5°) = 26.5°. Subtract the angles to get 47°.

CHALLENGE

The site is at 48° N because 90° - 62° = 28° and 20° N + 28° = 48° N. The 48° N site has a longer day than the 20° N site, even though its noon Sun angle is lower, because daylight lasts longer farther north on this day.

Accept about 12 hours for both equinox sites. Noon Sun angle describes the Sun's height at one moment; it does not by itself determine day length.