

UNDER THE WEATHER GRADE 8

LESSON # 1

TITLE: SEASONS/CLIMATE

OVERVIEW:

Students will learn that the Sun is a major source of energy for changes on the Earth's surface, affecting weather. The Earth's seasons are attributed to its tilted axis and revolution around the Sun. The atmosphere and ocean also affect climate.

STANDARDS:

Standard 8: Earth in the Solar System and Forces that Shape the Earth

Benchmark 8.8.3: Describe how the Earth's motions and tilt on its axis affect the seasons and weather patterns.

Benchmark 8.8.4: Explain how the sun is the major source of energy influencing climate and weather on earth.

MATERIALS NEEDED:

1 beach ball or other sphere to represent the Sun

3" diameter Styrofoam balls

8" long sticks (chopsticks work fine)

1 marker (any color) – mark the equator and tropic zones

DURATION:

45 minutes or roughly 1 class period

PROCEDURE:

Utilizing Science on a Sphere (SOS) at Bishop Museum or;

Place a sphere in the middle of the room to represent the Sun

Students note N for North on the top of Styrofoam ball and S for South on the bottom. They also draw the equator around the middle of the ball horizontally. The Earth is tilted approximately 23 degrees off true.

Students push sticks (chopsticks) through Styrofoam ball to represent Earth's axis at 23-degree angle.

Have students stand in a wide circle around the sphere. Students should be as close to the perimeter as possible, since this will reduce the opportunity for them to roughhouse.

Ask students to hold their earth ball in front of their chest, with the North Pole pointing straight up. Explain that the earth's axis is NOT straight up and down, but in fact tilted towards the North Star, Polaris. Ask students to tilt their earth balls towards Polaris (point out position of star on far wall). Check to see that all the balls are tilted towards Polaris. Assist students if necessary.

Ask one student who is farthest away from Polaris (i.e. the sun is in between them and Polaris) whether his/her north pole is tilted towards or away from the sun (towards the sun). Ask another student who is closest to Polaris whether his/her north pole is tilted towards or away from the sun (away). Ask the class to

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make a guess as to which student represents the earth in the summer and which student represents the earth in the winter. Put “winter” and “summer” signs over the appropriate students.

Ask students which season comes between winter and summer (spring). Have class guess which student is in the spring position. Put the “spring” sign on the appropriate student. Have class guess which student is in the autumn position and put “autumn” sign on the appropriate student. Ask the spring and autumn students whether their axis is tilted towards or away from the sun. Have students notice that in both spring and autumn, the earth’s axis is tilted neither towards nor away from the sun.

BACKGROUND INFORMATION FOR TEACHER:

Using a sphere in the middle of the room to represent the Sun, the students use Earth balls to show seasonal rotation.

Students will understand that the earth’s axis is tilted.

Students will understand that the seasons are caused by the tilt of the earth’s axis relative to the sun.

The Science on a Sphere (SOS) program is titled “Under the Weather.”

Average temperatures range between 22° and 26° C (72° and 79° F) throughout the year at low elevations. Lowland temperatures vary only a few degrees from month to month and rarely more than 6° C (10° F) from day to day. Extreme temperatures rarely occur. Daytime temperatures hardly ever rise above 35° C (95° F), and temperatures below freezing are practically unknown at elevations of less than 1,200 m (4,000 ft). Weather conditions above about 2,500 m (about 8,200 ft) can be quite severe, especially during the winter months.

Traditional Hawaiian seasons may be generally classified into two periods. *Kau*, or the summer period, normally lasts from mid-April until mid-October; *ho’oilo*, or the winter season, usually lasts from mid-October to mid-April. Although mild by the standards of temperate areas, the winter season is characterized by slightly lower temperatures than those that occur during the summer, and by frontal or cyclonic storms that can bring strong northerly winds and much rainfall to some areas of the islands.

ASSESSMENT:

Benchmark 8.8.3: Describe how the Earth’s motions and tilt on its axis affect the seasons and weather patterns.

formative assessment – Lesson #1 Successful creation of Earth ball and understanding of Earth’s position relative to the Sun.

Benchmark 8.8.4: Explain how the sun is the major source of energy influencing climate and weather on earth.

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WEB RESOURCES

Seasons and Months: Stories of an Ancient Island: Traditions of O'ahu: Asia-Pacific Digital Library - <http://apdl.kcc.hawaii.edu/~oahu/stories/months.htm>

PRINT RESOURCES

Holt Science and Technology, Earth Science, Teacher Edition, Chapter 15 – The Atmosphere, Chapter 16 – The Atmosphere, Section 1 *Understanding Weather*.

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CULTURAL RESOURCE

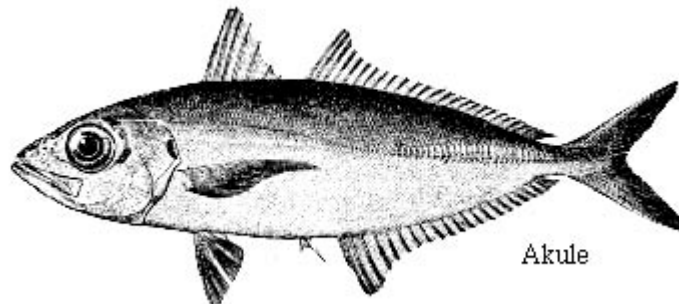
Seasons and Months

As in most tropical climates, there are two seasons in Hawai'i, the cooler wetter season called Ho'oilō, and the hotter, drier season called Kau. Both seasons last about six months.

In ancient times, the months were marked by the appearance of different stars and constellations in the eastern sky at sunset. The names of the months varied from district to district and island to island. The following names are from the Prince Kūhi'o Hawaiian Civic Club Calendar, published annually.

Ho'oilō (Cooler, Wetter Season)

Welehu (Oct.-Nov.)--Makali'i (Pleiades) appears in the ENE sky after sunset. Rainy season. Makahiki, a four-month long harvest festival, dedicated to Lono, a god of rain and agriculture, began toward the end of Kau and continued into the new year. 'Opelu and akule fishing.



Makali'i (Nov.-Dec.)--Sun rises and sets at its southern limit (winter solstice). Land prepared for planting. 'Opelu and akule fishing; 'ama'ama (mullet) spawning and kapu through Feb. Kohola (humpbacked-whales) feed and breed in island waters through April.

Ka'elo (Dec.-Jan.)--'A'a (Sirius) and Orion in the eastern evening sky. 'Uala (sweet potato) planting in dry leeward areas to take advantage of winter rains. Reef and inshore fishing.

Kaulua (Jan.-Feb.)--Ke Ali'i o Kona i ka Lewa (Canopus) in the SE by S evening sky. In traditional times, aku kapu lifted at the end of Makahiki; 'opelu kapu through July during its spawning season; reef and inshore fishing. Planting period for all crops--kalo, 'uala. Gourds, wauke (bark cloth), olona (for cordage), bananas, yams, arrowroot.

Nana (Feb.-Mar.)--Sun rises due east and sets due west (spring equinox). Mulch and weed gardens; vigorous plant growth begins. 'Ama'ama fishing season opens; malolo (flying fish) spawning.

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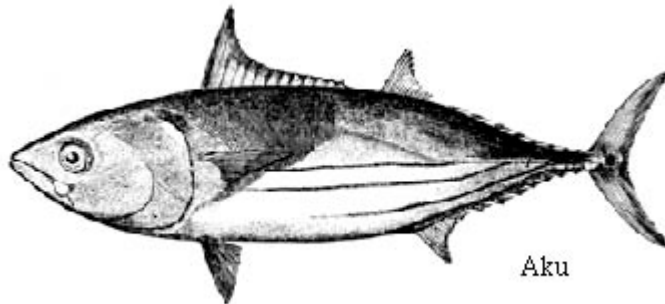
Welo (Mar.-April)--Leo in the eastern evening sky. All things grow, crops maturing. 'Ama'ama and malolo fishing. Deep-sea fishing through summer. 'Ilio-holo-i-ka-uaua (monk seal) pups are born, spring through summer.

Kau (Hotter, Drier Season)

Ikiiki (April-May)--Makali'i in the WNW evening sky; Hokule'a (Arcturus) in the ENE evening sky. 'Uala planting with summer rains. Honu (green sea turtles) come ashore to lay their eggs in the sand through summer. Great schools of moi (threadfish) and malolo.



Ka'aona (May-June)--Sun rises and sets at its northern limit (summer solstice). 'Ulu (breadfruit) ripens. Ula (lobster) and moi kapu through August during their spawning seasons. Aku and 'ahi (tuna) season.



Hinaia'ele'ele (June-July)--Manaiakalani (Maui's Fishhook, or Scorpio) in the SE evening sky. Humid weather, sudden storms. 'Ohi'a 'ai (mountain apple) ripens; gourds and melons ripen. In traditional times, 'opelu kapu lifted; aku kapu through Jan. during its spawning season; akule spawning.

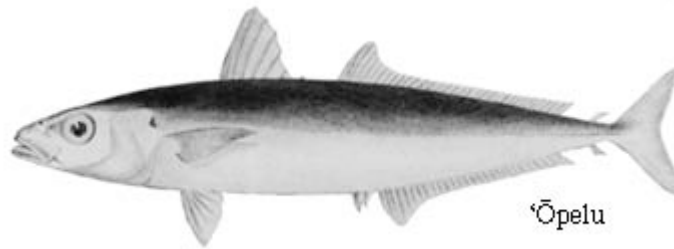
Hilinaehu (July-August)--Leo in the western evening sky. 'Ohi'a 'ai abundant. He'e (octopus) fishing with lures.

Hilinama (Aug.-Sept.)--Sun rises due east and sets due west (fall equinox). Tubers ripen for harvest; sugar cane blossoms, vines dying off. Ula and moi season; 'opelu fishing.

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'Ikuwa (Sept.-Oct.)--Iwakeli'i (Cassiopeia) in the NNE evening sky. Thunder and rain. Plant growth slows. Kalo and 'uala harvest. Preparation for the Makahiki Harvest Festival. Akule and **'Opelu** plentiful.

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REFERENCE MATERIAL

CLIMATIC REGIONS OF HAWAII – It is convenient to recognize seven climatic sub regions in Hawaii. These are defined chiefly by the major physiographic features of the State and by location with reference to windward or leeward exposure. Since one region grades into another, it would be misleading to attempt to draw sharp boundaries between adjacent regions. In general, however, the regions and their characteristics are as follows:

- (1) **WINDWARD LOWLANDS**, generally below 2,000 feet on the north to northeast sides of the islands. This region lies more or less perpendicular to the prevailing flow of the trade winds, and is moderately rainy, with frequent trade wind showers. Partly cloudy to cloudy days are common. Temperatures are more nearly uniform and mild than in other regions.
- (2) **LEEWARD LOWLANDS**, except for the Kona coast of Hawaii that has a distinctive climate. In these areas, daytime temperatures are slightly higher and nighttime temperatures are slightly lower than in windward locations. Dry weather prevails except for occasional light trade wind showers that drift over from the mountains to windward and for periods of major storms. In some leeward areas an afternoon sea breeze is common, especially in summer
- (3) **INTERIOR LOWLANDS**, on Oahu and Maui. In the northeast, these lowlands have the character of the windward lowlands in the southwest, of leeward lowlands. The central areas are intermediate in character, and – especially on Oahu – are sometimes the scenes of intense local afternoon showers from well-developed clouds that form as a result of local heating of the land during the day.
- (4) **THE KONA COAST OF HAWAII**. This is the only region in the islands where summer rainfall exceeds winter rainfall. There is a marked diurnal wind regime, with well-developed and reliable land and sea breezes, especially in the summer. Summer is also the season with a high frequency of late afternoon or early evening showers. Conditions are somewhat warmer and decidedly drier than in windward locations.
- (5) **RAINY MOUNTAIN SLOPES ON LEEWARD SIDE**. Rainfall and cloudiness are very high, with considerable rain both winter and summer. Temperatures are equable. Humidities are higher than in any other region.

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- (6) LOWER MOUNTAIN SLOPES ON LEEWARD SIDE. Rainfall is greater than on the adjacent leeward lowlands, but distinctly less than at the same level on the windward side except that the zone of maximum rainfall usually occurs just to leeward of the crests of the lower mountains. Temperature extremes are greater than on the rainy slopes of the windward sides of the mountains, and cloudiness is almost as great.
- (7) HIGH MOUNTAINS. Above 2,000 or 3,000 feet on the high mountains of Mauna Kea, Mauna Loa, and Haleakala rainfall decreases rapidly with elevation. Near the summits of Mauna Loa and Mauna Kea, rainfall is scant and skies are clear a high percentage of the time. Relative humidities may reach values of ten percent or less. The lowest temperatures in the State are experienced in this region, with values below freezing being common.

THE CLIMATIC SETTING – The most prominent feature of the circulation of air across the tropical Pacific is the persistent trade-wind flow in a general east-to-west direction. In the central North Pacific, the trade winds blow from the northeast quadrant, and represent the outflow of air from the great region of high pressure, the Pacific Anticyclone, whose typical location is well north and east of the Hawaiian Island Chain. The Pacific High, and with it the trade-wind zone, moves north and south with the sun, so that it reaches its northern-most position in the summer half-year. This brings the heart of the trade winds across Hawaii during the period May through September when the trades are prevalent 80 to 95 percent of the time. From October through April, Hawaii is located to the north of the heart of the trade winds. Nevertheless, the trades still blow across the islands much of the time, though with a frequency that has decreased to 50 to 80 percent in terms of average monthly values.

The dominance of the trades and the influence of terrain give special character to the climate of the islands. Completely cloudless skies are extremely rare, even though much of the time, the dense cloud cover is confined to the mountain areas and windward slopes, while the leeward lowlands have only a few scattered clouds. Showers are very common; yet while some of these are very heavy, the vast majority are light and brief – a sudden sprinkle of rain and that is all. Even the heavy showers are of a special character, in that they are seldom accompanied by thunder and lightning. Indeed, a flash of lightning followed by a crash of thunder is infrequent enough so that many people who have lived only in Hawaii have no real notion of the violence of Mainland thunderstorms as evidenced by the lightning and thunder that are their typical accompaniment. Finally, the trade winds provide a system of natural ventilation much of time throughout most of the State and bring to the land, at least in the lower lying

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regions, the mildly warm temperatures that are characteristic of air that has moved great distances across the tropical seas.

THE CHARACTER OF HAWAIIAN CLIMATE – the native Hawaiians recognized only two seasons. KAU was the fruitful season, the season when the sun was directly or almost directly overhead, when the weather was warmer, and when the trade winds were most reliable. HOO-ILO was the season when the sun was in the south, when the weather was cooler, and when the trade winds were most often interrupted by other winds. Modern analysis of the climatic records shows the soundness of this Hawaiian system of seasons, although analysis requires a slight modification of the old definitions. Whereas the Hawaiians recognized two six-month seasons, with KAU extending from May through October and HOO-ILO from November through April, it is more accurate to recognize a winter season of seven months (October through April) and a summer season of only five months (May through September). Under this arrangement, summer is very definitely the warmer season, the season with an overwhelming dominance of trade winds, and the season when widespread rainstorms are rare. Also throughout the lowlands, summer is the drier season in terms of average monthly rainfall, except on the Kona Coast (leeward coast) of the Island of Hawaii.