



EARTH



DAY

EXPLORERS

Facilitator Guide



PURDUE
UNIVERSITY®

Extension

Weather Affects Plans

Grades: Pre K - 2nd

Weather Science



Table of Contents

Grades PK-2:

Weather Affects Plans	
Part 1 _____	3
Weather Affects Plans	
Part 2 _____	4

Grades 3-5:

Water (H ₂ O) _____	6
Soil Erosion	
Part 1 - Water _____	8
Part 2 - Wind _____	9

Grades 6-8:

Weather Or Climate? _____	11
Table 4 _____	11
Soil Needs Its Space _____	13
Table 5 & 6 _____	13 & 14

Extra Worksheets

Weather Word Search _____	15
Weather Word Scramble _____	16

Curriculum Authors: Natalie Carroll, Professor at Purdue University; and Don Haberlin, high school teacher and instructor at Ivy Tech and Purdue University.

Toolkit Contributors: Laura Dodds, County Extension Director at Purdue Extension Marion County; Jayde Grisham, Agriculture and Natural Resources Educator at Purdue Extension Marion County; Rebecca Klein, Director of Operations at Purdue Extension Marion County and Retired Scientist; and Dr. Kathryn Orvis, Professor and Extension Specialist in the Department of Horticulture and Landscape Architecture at Purdue University.

Design by: Maria Stockdale, Communications Coordinator at Purdue Extension Marion County.

Created in March 2024.

Weather Affects Plans

Grades: Pre K - 2nd

Weather Science



Big Picture (Part 1 and 2)

Keeping weather data is a lifelong hobby for some people, particularly gardeners and farmers because their crops depend on weather conditions. Students keep temperature data from professional sources and consider how the temperature affects their outdoor activities. Students explore the attributes of different clothing materials, record observations, and discuss how clothing is designed to meet our needs.

Facilitating the activity (Part 1 and 2)

Youth might need help obtaining the daily high and low temperatures. Radio stations often give the expected temperatures, as does the Weather Channel. If youth have Internet access, they can enter their city or zip code at the NOAA (National Oceanic and Atmospheric Administration) website www.forecast.weather.gov, and get temperature data. Encourage youth who enjoy keeping records to make their charts. You can help youth calculate the difference in daily high and low temperatures and discuss when these values tend to be larger (spring and fall) or smaller (summer and winter) and how this affects us. For part 2, each student would receive a copy of Table 2 and complete it based on today's weather. Then, they would be prepared to discuss it as a group.

As a class or in groups, have students explore clothing materials. Prompt their exploration with questions like "When you cover your hand with the material, can you feel any air movement?" More adult guidance may be needed for younger students, especially if you utilize water/heat sources to explore the materials. It may be easiest to explore outside in the sun. Older students may be confident recording their observations in groups, or observations could be compiled as a class.

Share what happened (Part 1)

Questions:

- What was the highest temperature during the week?
- What was the lowest temperature during the week?

Answers: Weather dependent

Apply:

Question: Did the weather affect your outdoor activities?

Answer: Interpretive – no right or wrong answer

Question: When has the weather affected family plans?

Answer: Interpretive – no right or wrong answers

Question: What effect does the weather have on...

Answer:

- Vacation plans: Some people like to vacation where it is warm and sunny, so they vacation in the summer or in warm places during the winter. Some people like to snow ski, snowboard, or ice skate, so they vacation where there is ice and snow.
- Building a house: Average temperatures affect the presence and/or size of heating and air-conditioning systems. Humid areas may use dehumidifiers; dry areas may need humidifiers. Homes in regions of the United States with cold winter temperatures need more insulation and windows that resist heat loss. People may install fewer windows in cold areas to reduce heat loss.
- Walking a trail or hiking: Expected temperatures and precipitation determine the clothing youth wear or take on a walk or hike.

Share what happened (Part 2)

Questions:

- Did you pick what you are wearing today based on the weather?
- Do you have clothes in your closet you don't wear very often, why?

Answer: Our clothing choices are based on the weather we expect to have for the season and weather pattern.

Question: What are some qualities of the clothing you are wearing now?

Answer: Varies. If they are stumped, encourage them to think of their jacket/coat they wore that day and shoes too (mesh, padding, waterproof bottom, etc).

Question: Have you ever had the material qualities of your clothing change (like getting holes, or getting too small or thin or cracked)? What happened?

Answers: They had to get rid of it, or repair it, or give it away.

Apply:

Question: If you lived where it was warm most of the year, like Florida, what would be different about the clothes you wore?

Answer: In Florida, youth would have more hot-weather clothing and only a few items for cooler weather.

Question: What if you lived in a cold place like Alaska? What do you think your clothes would be filled with?

Answer: In Alaska, youth would have more heavier cold-weather clothing and very little clothing for hot days.

Question: Sometimes being near a body of water or on the snow can cause sunlight to reflect off the ground getting under hat brims that would normally protect us from a sunburn. What could you use/design to help protect your skin from a sunburn?

Answer: Sunscreen, the black "tape" on a baseball player's cheeks, a ski mask/goggles, or other creative design.

Pre K - 2nd Weather Affects Plans continued...

Question: It can be dangerous if we get sweaty while playing outside in the snow. The same insulation that keeps us warm traps our sweat, and we get wet and cold. What could we do to prevent this problem?

Answer: Take off layers before we get sweaty, get warm clothing, but also wear clothes that help dry our sweat or pull it away from our bodies, change into dry clothes, or other creative answers.

STANDARDS & SKILLS (Part 1 & 2)

- **Weather Skills:** Collecting data.
- **2023 Indiana Academic Standards:** K-ESS2-1, 1-ESS1-2, 2-ESS1-1, 2-ESS2-1.

Water (H₂O)

Grades: 3rd - 5th

Weather Science



Big Picture

Youth should understand that water vapor condenses out of air when the air is cooled. More water vapor can exist in warmer air than in cooler air. Cold air cannot hold water vapor very well. For air to cool in the atmosphere, it must rise. When air rises, the air pressure decreases, which causes cooling. Using a spray can will cause it to cool as the pressure is released. If you let the air out of a tire with your finger, your finger gets cold as the pressure is released. The air in an existing cloud is rising; otherwise, the cloud would not exist. With the right conditions, a cloud begins to produce precipitation, and the cycle begins again. On a sunny day, clouds form cotton ball shapes in the sky. The sun heating the ground and making the air rise causes these. When the sun sets in the evening, the clouds disappear because the rising of air stops.

Facilitating the activity

Youth might be able to complete this activity without adult assistance. It is difficult to understand why the water in the jar comes out of the air. Many youth conclude that the water came from the ice or inside the jar. This phenomenon is called sweating. "The glass is sweating" implies that water is going through the glass. Youth might need to be directed to the idea that the water existed as water vapor in the air before condensing in the jar.

Share what happened (Part 1):

Question: Which jar had water condensing on the outside?

Answer: Water condensed on the outside of the jar with ice in it.

Question: Where do you think the condensed water came from?

Answer: The water condenses from water vapor in the air.

Question: Why did water condense only in the cold jar?

Answer: The air must be cooled to get water vapor to condense.

Share what happened (Part 2)

Question: What did you observe at each step inside the jar?

Answer: The glass sides were clear after shaking the water in the jar. After pouring ice water over the jar, the glass's inside fogged.

Question: What happens to the temperature of the air when water condenses?

Answer: When water vapor condenses, the air temperature is cooled.

Apply:

Question: Study the picture of the water cycle (Figure 1, page 8 of toolkit). How does what you learned about precipitation relate to the water cycle?

Answer: Water evaporates into water vapor at the surface and condenses into clouds up in the air. Rain from the clouds brings the water back to the surface.

Question: When does dew form? When does frost form?

Answer: Dew forms in the morning. Frost forms in the evening.

Question: Would you ever expect dew or frost to form when things are warming up?

Answer: No, the air must cool for water to condense.

Question: Have you ever watched clouds on a sunny day? What do they look like?

Answer: A variety of answers may be noted: marshmallows, cotton balls, puffy, etc.

STANDARDS & SKILLS (Standards included account for doing both Water and Soil Erosion activities)

- Weather Skills: Understanding how temperature and cloud formation are related to and contribute to the water cycle.
- 2023 Indiana Academic Standards: 3-ESS2-1, 3-ESS3-1, 3-5-ETS1-3, 4-ESS2-1, 4-ESS3-2, 5-LS2-1, 5-ESS2-1, 5-ESS3-1

SUCCESS INDICATOR: Youth can explain how evaporation and condensation are a crucial part of the water cycle.

Soil Erosion

Grades: 3rd - 5th

Soil & Weather Science



Water Erosion (Part 1):

Big picture

Erosion is the wearing away of land surface by rain or irrigation water, wind, ice, or other agents that abrade, detach, and remove soil from one point on the earth's surface and deposit it elsewhere. In the United States the cost of water and wind erosion each year is estimated in billions of dollars because loss of the upper soil layer causes reduced productivity and soil pollution of water and air. Soil erosion is a global problem. It can contribute to instability in regions that cannot produce adequate food and fiber. Agricultural fields and gardens need healthy soil to be productive. The loss of topsoil reduces productivity. Soil that is left uncovered is more susceptible to erosion than covered soil. Therefore, no-till practices and cover crops are recommended to retain soil.

In this activity, we focus on understanding how erosion occurs. The factors contributing to soil erosion by wind or water are climate, soil properties such as aggregation and soil moisture, soil cover, and land management. Surface roughness, unsheltered distance, and wind velocity contribute to wind erosion (see Table 1, page 9). Topography also contributes to water erosion. Soil movement has some benefits: soil nourishes floodplains, creates deltas and islands, and replenishes wetlands. In a more natural system, soil movement would occur more sustainably, and the loss of productive soils would not be an issue. However, many people are concerned that world urbanization, agricultural methods, and other modern-day impacts on soil have tipped the balance significantly.

The concerns of soil movement include:

- Loss of excessive amounts of fertile soil
- Decrease in the depth of streams, rivers, lakes, and reservoirs, which can lead to increased water temperature, affecting aquatic species
- Increased water purification requirements

Facilitating the Activity (Part 1):

Constructing the boxes and gathering the materials can be difficult for youth. They might need help finding and making them correctly. The boxes can vary in size. Working in groups with different soil types would be beneficial in comparing the results and sharing some of the materials, such as the sprinkling can and fan.

Table 1. Factors of Soil Erosion

Wind Erosion	Water Erosion
Climate	
Soil Properties (aggregation and soil moisture)	
Soil Cover	
Land Management	
Surface roughness	N/A
Unsheltered distance	N/A
Wind velocity and turbulence	N/A

Share what happened (Part 1):

Question: Did the water get washed from the bottom of the box?

Answer: If yes, you observed gully erosion; if no, continue...

Question: Did the water make small channels in the soil surface?

Answer: If yes, you observed rill erosion

Question: Did the water remove a smooth, even portion of the soil without creating small channels?

Answer: If yes, you observed sheet erosion.

Wind Erosion (Part 2)

Big Picture

Wind erosion occurs when wind forces of about 13 miles per hour or more start to move soil particles. Soil-blowing usually starts on large, flat, open areas, exposed hilltops, tracks or paths made by tractors or animals, and corners or turns where excessive turning and cultivation have pulverized surface soils. Wind erosion is most common on sandy and muck soils, which are more easily windblown than silts and clays. The pore space around the larger sand particles allows them to be dislodged more easily. The smaller pore space of silts and clays helps hold the particles together, especially if wet or moist.

Facilitating the activity (Part 2):

Youth might find the picture helpful as they set up this experiment. They should observe how wind can erode soil and imagine that grass and plant residue might slow erosion.

Share what happened (Part 2):

Question: Did you observe any wind erosion?

Answer: Yes, you observed wind erosion.

Question: What do you think what happened with soil during extreme weather such as a tornado?

Answer: Soil erosion will be increase.

Apply (Parts 1 & 2)

Question: Did you observe more than one type of erosion?

Answer: See the Share section in Part 1.

Question: How might soil erosion be reduced?

Answer:

- Home: planting native plants (prairie planting), installing rain gardens, or stabilizing stream banks.
- Agriculture: cover crops, residue (rough surface), grassed waterways, plant rows perpendicular to the prevailing wind, strip cropping, planting crops of varying heights, or not farming highly erodible lands.

Question: Why do you think preventing soil loss is important?

Answer: Healthy soil is required to produce the food and fiber that people worldwide need. A lack of adequate food can cause hunger.

Question: Discuss local examples of soil erosion caused by water.

Answer: Varies- Construction sites and agricultural crop fields are good places to look.

STANDARDS (Part 1 & 2)

2023 Indiana Academic Standards: 3-ESS2-1, 3-ESS3-1, 3-5-ETS1-3, 4-ESS2-1, 4-ESS3-2, 5-LS2-1, 5-ESS2-1, 5-ESS3-1

SUCCESS INDICATOR (Part 1 & 2): Youth can describe how water and wind erosion occur.

Weather or Climate

Grades: 6th-8th

Weather Science



Big Picture:

The difference between weather and climate can be confusing. Climate includes all the different types of weather that happen year-round and is based on the last 30 years or more of weather records. Weather is simply what happens at a specific time in the atmosphere. Therefore, today's temperature is the weather; the average temperature for today is the climate. Weather can vary widely in Indiana because of our changing seasons, but the seasons are part of our climate. Climate does not change when the seasons change, but the weather changes with the seasons. This activity aims to engage youth in thinking about weather vs. climate and related issues and ideas. So, "single occurrence" should always be checked when "weather" is checked, and "average" should be checked when "climate" is checked.

Facilitating the Activity:

Help youth identify the difference between weather and climate. They might need help thinking about climates other than Indiana's.

Table 4. Answers

Table 4. WEATHER OR CLIMATE?				
Announcer's Statement	Example		Reason	
	Weather	Climate	Single Occurrence	An Average
Yesterday the high was 55°F and the low was 43°F.	X		X	
Today we are expecting a high of 61°F.	X		X	
That is 10 degrees above the normal high of 51°F for this date.		X		X
We will have clear skies today with no rain forecasted for the next three days.	X		X	
We usually would have four inches of rain this month.		X		X
Hurricane season is beginning in the tropics.		X		X
A tropical storm is developing in the Atlantic Ocean.	X		X	
To the north, a massive snowstorm is on its way.	X		X	
We do not normally see a snowstorm like this at this time of year.		X		X
Tornado season is upon us, and we must be prepared.		X		X
We usually expect four or five tornado outbreaks to occur this month.		X		X
This morning a tornado damaged a building on High Street downtown.	X		X	

Share what happened:

Question: Did you find it difficult to decide which statements in Table 4 concerned weather and which concerned climate?

Answer: Some youth might have difficulty determining where the X's belong, especially if they do not clearly understand that weather is defined over a short time frame. Climate is the average temperature over 30 years or more.

Apply:

Question: Are the clothes you wear today determined by the weather or the climate?

Answer: Determined by the weather.

Question: How might weather impact your plans?

Answer: Interpretive

Question: How might climate impact your future?

Answer: Climate change: "The earth's surface temperature depends on a process called the heat budget. Like any other type of budget, this budget remains balanced if the amount of energy coming in equals the amount going out. If the energy balance is disrupted, the result would be a temperature change. Ice ages occur when the energy going out exceeds incoming solar energy; global warming occurs when the incoming solar energy is greater than the energy going out. Clouds play a major role in the heat budget. Clouds act as both a block to solar energy coming in and an insulator trapping heat below. An indication of climate change would be a gradual shift in the earth's average surface temperature. Locally, annual temperatures might fluctuate due to differences in weather systems from one year to the next. On a global scale, however, those local fluctuations are canceled out, and the earth's average temperature should remain the same. However, the global average temperature, currently 57°F (14°C), has risen almost 1 degree over the last century. Some scientists predict that temperatures will rise another 2 to 6 degrees over the next century!"

Reference: Atmospheric Radiation Measurement Program (ARM),
http://education.arm.gov/teacherslounge/lessons/climate_change.pdf,
Downloaded June 2014

STANDARDS & LIFE SKILLS

- Weather Skills: Determining the difference between weather and climate
- 2023 Indiana Academic Standards: MS-LS2-4, MS-ESS3-2, MS-ESS2-5, MS-ESS2-6, MS-ESS3-5

SUCCESS INDICATOR: Youth can distinguish between weather and climate and predict the impacts of weather and climate using examples.

Soil Needs Its Space

Grades: 6th - 8th

Water & Soil Science



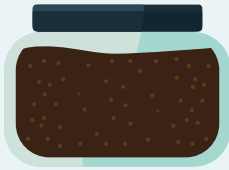
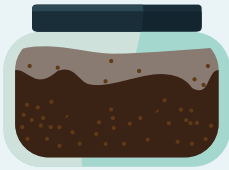
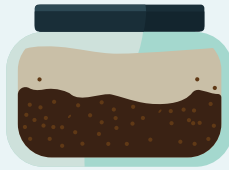

Big Picture:

Learning the basic components of soils is essential for youth who are starting to study soils. Youth should be able to list the four major components of soil: minerals, water, air, and organic matter. Mineral matter comes from weathered rocks. Organic matter is a decayed plant and animal residue or living organisms. Pore space (air) is an essential component of soils. Different soil types have differing amounts of pore space and varying abilities to hold water. Aquifers hold water in pore spaces that we access by using wells. Organic matter content is quite variable based on the soil-forming factors. The ideal soil has about 5 percent dark-colored organic matter; however, many soils do not have this amount, so you often see lighter-colored soils. Adding organic matter is one of the best ways to improve poor soil for gardens and landscaping. This investigation helps determine the space available for two soil components — water and air. Youth often have difficulty visualizing soil pore space because they consider soil a solid. This activity shows that water can fill soil pore space in dry soils. Water enters pore space and forces air out.

Facilitating the Activity:

If the soil used in this activity is saturated (filled with water), the soil does not absorb any additional water. The measurement of soil plus water will be the height of the jar. Productive soil for agriculture — soil that supports plant life — must contain about 50 percent pore space with equal parts air and water and 50 percent solid materials. Soils that support a building or filter wastewater require different proportions of the four major soil components. Generally, prime agricultural soils are not suitable for wastewater absorption fields. Youth should see some difference in the two water heights and soil plus water, but not too much. The water level is not much different for soil than for soil plus water because water enters the pore spaces in the soil as it displaces air. Help youth understand that the water in the pore space has forced the air out. Pore space can hold either water or air, but not both. If the soil is saturated for too long, plant roots die from lack of oxygen. Depending on the species and its life stage, plants can tolerate saturation for different amounts of time.

Measurement	Height (in inches)	
a) Soil height	3.5	
b) Water + soil height	3.7	
c) Pore space (b-a=c)	0.2	

Table 6. What I See (Example)				
Time (hours)	0	1	3	24
Picture				
Description	All the water looks muddy	The heavier soil particles are starting to settle out.	More settling.	The water is clear and defined layers might be visible.

A typical soil is about half solid particles and half pore space, which holds both air and water. Organic matter is a small fraction of most soils, only 2-5 percent, and is mainly present on the soil surface. Soil component percentages vary for different types of soil and soil parent material. A typical soil has:

- 45 percent inorganic minerals
- 5 percent organic material
- 25 percent water
- 25 percent air

Share what happened (Parts 1 & 2):

Question: Was there a difference in the height of the water and the water/soil mixture? How would you explain this?

Answer: Youth should see that some of the water enters the soil and begin to envision that it has gone into air spaces in the soil.

Apply (Parts 1 & 2):

Question: Why is it important for soil to have pore space?

Answer: Soil without pore space cannot store air and water for plants. All the rain we receive would become runoff.

Question: How could a pollutant spilled on the grass be transported to drinking water?

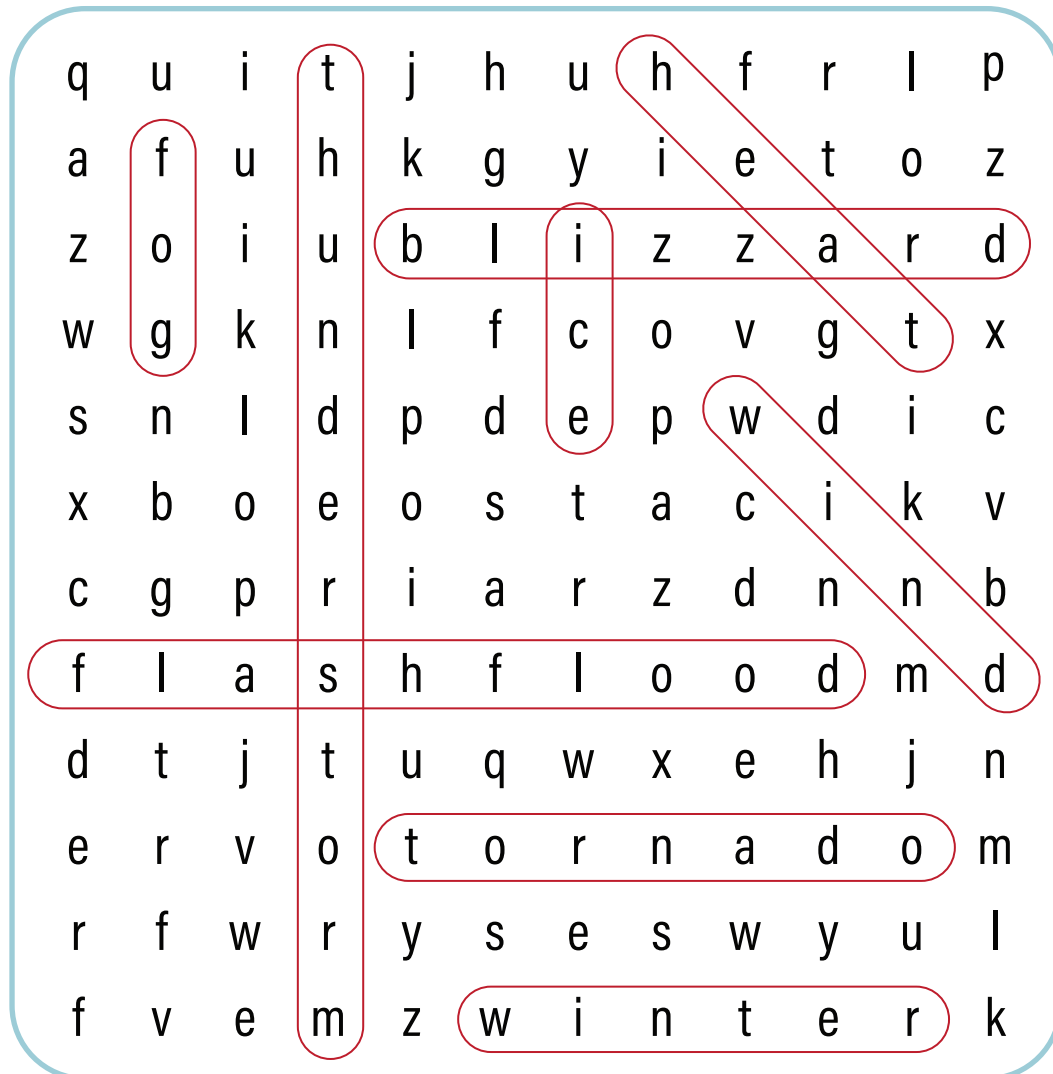
Answer: Rainwater can transport pollutants, especially water-soluble pollutants, through the soil via pore spaces to aquifers, which are areas of saturated soil.

STANDARDS & LIFE SKILLS

2023 Indiana Academic Standards: MS-LS2-5, MS-ESS3-1, MS-LS1-5, MS-ESS2-4, MS-ESS3-4

SUCCESS INDICATOR: Youth can explain that soils are made of four major parts: minerals, water, air, and OM.

Weather Word Search



- blizzard
- heat
- tornado
- flash flood
- ice
- wind
- fog
- thunderstorm
- winter

Weather Word Scramble

Scrambled Letters	Weather Word	My definition
ahrewet	weather	The state of the atmosphere with respect to temperature, wind, cloudiness, moisture, pressure, etc.
rai	air	A mixture of odorless, tasteless gases such as nitrogen and oxygen that surround the earth and form its atmosphere
tarew	water	A transparent, odorless, tasteless liquid, a compound of hydrogen and oxygen (H ₂ O)
athe	heat	A condition of being hot or warming
miudtihy	humidity	The amount of water vapor present in the air
nsu	sun	Star around which the earth and other planets revolve and from which they receive light and heat
herta	earth	The third planet from the sun, the planet we live on
nwid	wind	Air in natural motion, moving horizontally at any velocity along the earth's surface
nswo	snow	Precipitation that falls in the form of ice crystals
nria	rain	Water that falls to the earth in drops with a diameter of more than 0.5 mm
lhia	hail	Showery precipitation in the form of irregular pellets or balls of ice more than 5mm in diameter falling from a cumulonimbus cloud
scoldu	clouds	A visible collection of particles of liquid water or ice suspended in the air
ateuprrmeet	temperature	Degree of hotness or coldness measured on a definite scale
etamilc	climate	The average condition of the weather at a place, over a period of years, as exhibited by temperature, wind, velocity and precipitation