"Can we go outside?"
Well, let's predict the weather!

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This curriculum unit is recommended for Grades 5

Key words: weather, climate, temperature, air pressure, wind speed, wind direction, clouds, cirrus, stratus, cumulus, cumulonimbus, nimbostratus, front line, precipitation, thermometer, barometer, anemometer, wind vane, rain gauge, metrology

Teaching Standards: See Appendix 1 for teaching standards addressed in this unit.

Synapsis: In this unit, students will learn about the mechanisms of weather and apply their knowledge to develop a way to predict the upcoming weather based on daily observations. On the 5th grade science end-of-grade exam, the subject of weather is important. This curriculum unit is designed not only to cover content related to weather, but also to inspire students to go outside and observe the sky a little differently. Although climate change will not be directly taught, the connection with nature will set them on a path to be a better environmental observer and hopefully they will remember the knowledge to further observe climate change.

I plan to teach this unit in the 3rd quarter for weather unit to 24 students in 5th grade Japanese Immersion science class.

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Introduction

Rationale

Climate change is real and it is supported by a number of climate scientists with proof of the evidence of environmental changes over the last 150 years. According to the Climate Science Special Report, global annual average temperature has increased by more than 1.2℉ for the period 1986-2016 relative to 1901-1960.[1] Averaged as a whole, the January 2019 global land and ocean surface temperature was 1.58 °F above the 20th century average and tied with 2007 as the third highest temperature since global records began in 1880. January 1976 was the last time the monthly global land and ocean temperature was below the 20th Century average.[2] Furthermore, arctic sea ice extent averaged for October 2019 was 2.19 million square miles, the lowest for any October in the 41 year continuous satellite record. This was 88,000 square miles below that observed in 2012—the previous lowest record for October —and 1.04 million square miles below the 1981 to 2010 average.[3]

This is not someone else's problem—this is a worldwide issue which everyone has to take some action on the individual level. I wish I lived in a world where I can swing a wand and magically stop climate change. But no, we are living on planet Earth which needs care from us. So, what should we do?

The first step is to be aware of the conditions that we are facing. Revealing the cause, evidence, and solutions will help you decide courses of action. In the late 90s, growing up in Japan, my elementary teacher provided me information about climate change for the first time. Now I know that the information was not 100% accurate, but it somehow helped me become more responsible with the actions that I'm taking even today.

So, the second step is to be responsible. Human beings have done so much to build a convenient life, but there are consequences for these conveniences. Even though we are all residents of Earth, and mother nature is letting us use her seemingly abundant resources, we have been overlooking the costs to the environment that we depend on to survive. We need to wake up and do something to nurture and preserve the environment as a place for our communities to continue to live in. Sustainability is our responsibility.

Based on what you learned and what you feel you are responsible for, you need to make the right choice. I am not expecting everyone on Earth to own a hybrid car or install solar panels on their houses. There are so many different levels of choice that are available today. For instance, do more recycling, save more energy, eat less meat, etc. A lot of important decisions are made by politicians and global companies, and it seems like your choice has too little to offer. However, our individual choice can change the course of their direction as well. So make the right choice every day. Collectively, it will make a huge difference.

Speaking of my own choices, beyond recycling and saving energy, I've been using education as a tool to support conversations about the existing solution strategies for a better, more sustainable human-environment balance. As an educator, I advocate and encourage my 5th grade students to recycle and save energy in class. They don't necessarily conceptualize the relationship with climate, but they will learn my message, in this case "care for the environment," from what I have done and what I am going to teach in my curriculum unit. I hope my curriculum unit will reach out as many people as possible and contribute to ways that we are all thinking to mitigate the current climate change.

School/Student Demographics[4]

I teach at E.E. Waddell Language Academy, a K-8 county-wide magnet school in the South Learning Community. We have a population of 1375 with 929 students at the elementary level and 444 in middle school. E.E. Waddell offers five languages: French, German, Japanese, Chinese and Spanish as language immersion in elementary school, with Spanish beginning in middle school. Our school is incredibly diverse. The majority of the staff is bilingual and 30% of the teachers including myself and teacher assistants do not have US citizenship. The student body is very diverse as well: 43% Caucasian, 22% African American, 22% Hispanic, 6% Asian, 6% Multiracial and less than 1% each American Indian and Pacific Waddell Language Academy was awarded the American Council on the Teaching of Foreign Language (ACTFL) Melba D. Woodruff Prize for an exemplary Foreign Language Program. This prize recognizes schools that align their curricula with the World Readiness Standards for Language Learning and integrate languages with content areas. In addition, Waddell is consistently recognized by Magnet Schools of America as one of its top merit schools; recognized by the North Carolina Department of Public Instruction as a Prepared Global Ready School, and recently received the International Citizen of the Year Award at the Charlotte Chamber of Commerce Economic Growth Recognition Dinner. Internationally, Waddell is a PASCH school, partner school of the German Foreign Ministry and the German Central Agency for Schools Abroad; officially accredited by the French Ministry for Europe and Foreign Affairs with the Label Franc Education; and since the opening of the Confucius Institute at UNC-Charlotte in 2017, again identified as a Confucius Classroom School.

Parents who want their child to learn a second language enroll their child to E.E. Waddell Language Academy. Each year an average of 90% of the students who newly enter our school do not have a cultural background of the target language. Despite the difficulty of Japanese language acquisition, the families who enroll in the Japanese program are interested in Japanese as a discipline and culture. Language immersion starts from the first day of kindergarten, with the exception of special education and ELA. Whether or not the student becomes fluent in Japanese depends on a student's personality and aptitude. It is extremely crucial that students understand the target language to keep up with their learning. When students really don't understand the content or language, teachers intervene with an explanation in English.

My 5th grade class has 24 students: 8 boys and 16 girls. Th demographics of the class is 3 native Japanese, 3 half Japanese, 13 white, 3 black, and 2 Latin. The parents of this

group actively support and engage in school activities. Socio-economics range from middle class to upper class and students' academic performance is relatively high. Unlike the other language programs, the Japanese program has only one class strand so the students stay in the same group from kindergarten to 5th grade. I had this group of students when I taught 2nd grade in 2016, so I know the students and parents very well. I remember one time when students had inside recess, they made a poster with the message of "save the ocean". This group of students has keen awareness for the environment and nonetheless they love the nature.

Unit Goals

The generation of students is over stimulated with video games or gadgets and it seems to take away time for students to interact with and observe their surroundings in nature. My unit is aimed at bringing back student interest and fostering empathy for nature and, in the case of this curriculum unit, the weather.

First, students will build the knowledge about basic factors that affect our daily weather. As they learn the concepts, students will be able to apply their knowledge to predict the latest weather by using simple models and weather instruments. This will shift students' interests from content in textbooks to the surrounding outdoor nature. Enabling students to predict weather will trigger them to observe the clouds more and think deeply how the weather changes. In the end, students will produce a running record of weather that occurs over a month by collecting and recording data. This will set them on a path to be a better environmental observer and generate interest more broadly in weather and climate patterns.

Content research

What is the difference between weather and climate? Weather is the condition of the atmosphere over a short period of time. When we go outside for recess, we check weather forecast rather than climate. Climate, on the other hand, is the average weather condition over a long period of time in a specific region.[5] For example, if you were to move to a different region of the country, you would care more about the climate than the weather on a specific day. A good example of climate is desert, tundra and tropical climates. North Carolina has a humid subtropical climate with hot summers and mild winters.[6] Climate researchers take data of the weather over specific periods. If there is any deviation in the data when compared with the data from a different period, you can conclude that the climate is changing.

Climate change is often measured with temperature changes because the impact of climate change is big on temperature. Another reason is that temperature is easier to collect than other factors.[7] Evolution of technology allowed us to excavate evidence to measure the temperature millions years ago. For example, wind speed and volcanic activities can be measured by the air melted in the ice cap. The average temperature drops in the occasion of volcano eruption because the smoke overcasts and blocks the sunlight. Another example is how annual growth rings of a tree reveal the amount of sunlight of that year.[8] Even though there are

some uncertainties in the data, climate scientists have enough data to support the discussion of climate change.

The climate has been changing constantly ever since the Earth was created. 70 million years ago, the global average temperature used to be higher than now.[9] Going up and down in temperature is a natural phenomenon. Then why would we care about the climate change happening now? Although it is still in debate, a lot of scientists support the theory that the extinction of mammoths was due to climate change that happened more than 20,000 years ago. Do we feel guilty about the extinction of mammoths though? 20,000 years ago pre-dates all known advanced civilizations, so most people assume the path is one of the natural climate history of our Earth. But the present day climate change is different because scientific evidence shows repeatedly and in many independent ways that human beings are the main reason the current climate change and ecosystem changes are happening.

As pointed out above, climate change itself may not be problematic over the long term. However, the current climate change today is happening in a relatively short period of time. As you can see in the Figure 1[10], the rise of temperature in the last 250 years indicates an abnormal leap. Nonetheless to say, it is the result of human civilization and industrialization. It's clearer when you take a look at the Figure 1 along with the emission of carbon dioxide (Figure 2[11]).

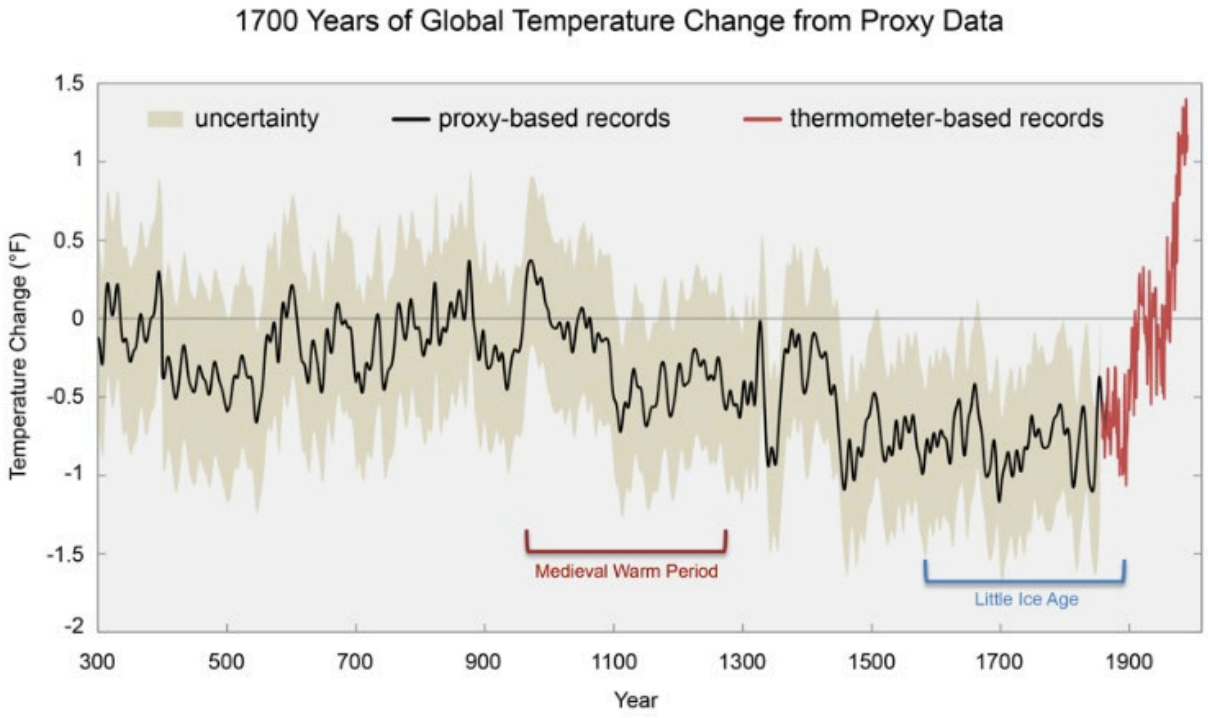
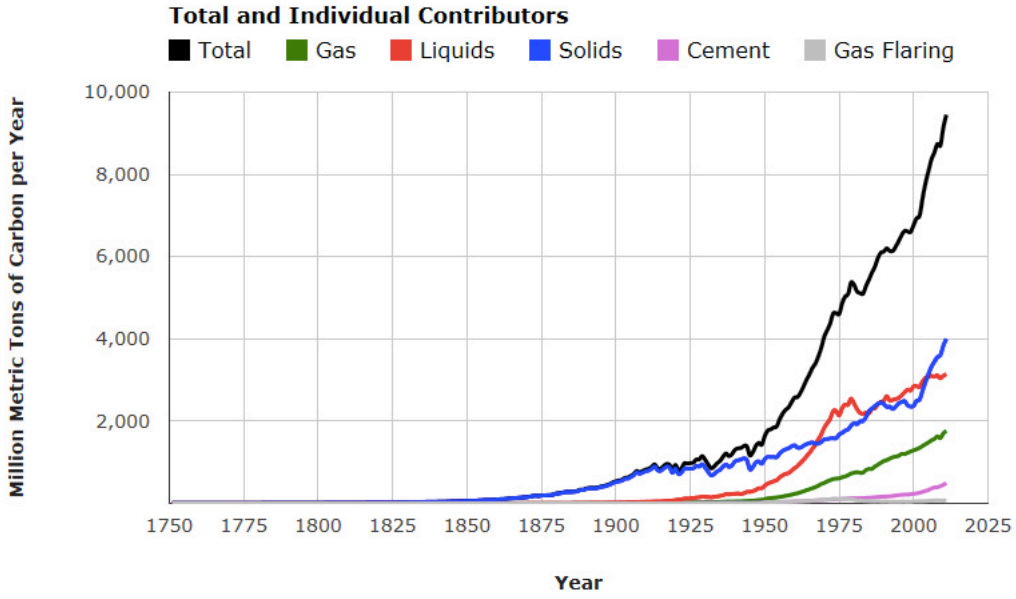


Figure 1



Source: Boden, T.A., G. Marland, and R. J. Andres. 2015. Global, Regional, and National Fossil-Fuel CO_2 Emissions. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A. doi: 10.3334/CDIAC/00001_V2015.

Figure 2

Notice that there is a time lag between the two Figures because the emission of carbon dioxide wouldn't immediately raise the temperature. But it is obvious that the temperature is constantly increasing as we emit more carbon dioxide. A number of climate scientists must agree that the climate is definitely changing, and the data is not a coincidence. Regarding this situation, Dr. Jim Hansen and his colleagues, NASA climate scientists, remarked:

> *"The climate induced by anthropogenic release of CO2 is likely to be the most fascinating global geophysical experiment that man will ever conduct. The scientific task is to help determine the nature of future climatic effects as early as possible."*[12]

The cause of the current climate change is considered due to the increase of greenhouse gases.[13] Imagine that you are in front of a fireplace with a blanket on. The extra greenhouse gases in the atmosphere enhances the greenhouse effect and warms the planet, which is something like placing a blanket over the entire planet while sitting in front of a fireplace. Some of the well-known greenhouse gases include carbon dioxide, methane, halogen and nitrous oxide.[14] Of all greenhouse gases, the one that we emit the most by human activities is carbon dioxide (CO2).

CO2 is a form found in the air, but essentially it is carbon. Just like water cycles, carbon is recycled by nature as well. It continuously transfers between the atmosphere and living/non-living things. The process is called the carbon cycle. Naturally carbon enters the air when animals breathe out. Also when organisms die and decay, some of it is turned into CO2 by decomposition and some is stored in the ground as fossil fuel.

In the history of human beings, we found a way to boost energy by burning fossil fuels such as coal, oil, gasoline, and natural gas.[15] This is disrupting the carbon cycle and human beings are putting too much carbon in the air. Not only that, but we also deforest trees for land use. Trees reduce the amount of carbon though photosynthesis and give off oxygen. They also cool down the temperature by shading the surface of the ground. Development of our life brought us a lot of conveniences, however, the cost is huge.

Emissions of CO2 are strongly tied to the economy. In fact, scientists often use the following formula to calculate total carbon emissions:

$$I = P \times A \times T$$

I: Total carbon emissions
P: Population (the number of people)
A: Affluence (GDP, $ per person)
T: Technology (carbon emitted per $)[16]

As you can see in the formula (sometimes called the "IPAT" relation), increases in the population, gross domestic product (GDP), and/or technology increase the emissions of CO2. Decreases would decrease CO2 emissions. It is not easy to cut any of the factors, especially population and GDP, so politicians, scientists, engineers, and major global companies have been seeking alternative solution and technology to balance economy and climate, but it's a slow process. And even now in this moment, CO2 is building up faster in the atmosphere than carbon cycle can remove it. As an individual, we need to be hopeful and keep making the right choice to influence the decisions of policy makers.

Sixteen year old Greta Thunberg, who gave a speech at the United Nation Climate Action Summit this year, brought attention from all over the world to the climate issue. In a 2019 speech, she furiously appealed to those decision makers:

> *"For more than 30 years, the science has been crystal clear. How dare you continue to look away and come here saying that you're doing enough, when the politics and solutions needed are still nowhere in sight? You say you hear us and that you understand the urgency. But no matter how sad and angry I am, I do not want to believe that. Because if you really understood the situation and still kept on failing to act, then you would be evil. And that I refuse to believe."*[17]

As a 5th grade classroom teacher, what kind of approach should I take to teach climate change? Greta Thunberg's speech was great, but I do not want to create any anger or fear in students' emotion. What would happen when teachers lay the weight of climate change on an eleven-year-old already weighed down with the many concerns of their rapidly changing life? An education writer, David Sobel, at least suggests that we need to give students time to connect with nature and love the earth before we ask them to save it. He also suggests that in early childhood, activities should center on enhancing the developmental tendency toward empathy with the natural world.[18]

In my curriculum unit, instead of directly teaching the cause and the solution of climate change, I would like to focus on what I have taught in the 5th grade weather unit and extend it with nature observation to nurture and foster empathy towards the earth. Maybe more important is that students can predict the weather and use their knowledge to further discuss about climate change in upper grade.

General teaching strategies

Lesson 1: Weather forecast

Hand out the packet/journal to students (Appendix 2 or 3). Write their name down and read the objectives together on the front over of the packet. Start the unit by brainstorming situations of when we would need to know the weather. Give students 3 minutes to discuss in a group. Students might come up with answers like "we need to know the weather when we go outside for recess or a field trip", "we need to check the weather if the school will be closed due to the hurricane or snow fall", etc. Anchor down that weather is very important because it affects our decision making. Bring attention to the word "天気よほう" on the top of the second page and ask them what it means. Students might be able to guess the meaning of the first two letters with their previous knowledge. Give them a clue that we watch this when we want to know the weather—the weather forecast. In order to know the weather, we often look up the weather forecast. Now ask students what information meteorologists need to know to predict the weather. Give students a couple of minutes to discuss in a group. Draw their answers and write the following.

- 気温 (temperature)
- 気あつ (air pressure)
- 風向 (wind direction)
- 風速 (wind speed)
- 雲 (cloud cover)

Emphasize that each of these factors are very important to predict the weather. Because these factors influence one another in a complex manner, weather is constantly changing. However, thanks to the development of science, we can forecast the weather relatively well. Starting from the next unit, we will unpack each one of these factors and by the end of the unit students will be able to reasonably predict the latest weather.

Lesson 2: Temperature

Look at the word "気温" and analyze the meaning. "気 (ki)" means atmosphere and "温 (on)" means warm. 気温 is temperature and it literally means the warmth of the atmosphere. Use students' knowledge of experience to compare the temperature in an occasion when there are clouds and there are no clouds. Usually temperature is higher on a clear day because the sun heats up the ground. On the other hand, the temperature is lower on a cloudy day because the clouds mitigate the heat from the sun. Draw pictures in the table as you explain. Next, compare the temperature at night with and without clouds. Different from the day time, the cloud effect on temperature is quite opposite. Without the heat, the air gets cold. Cold air is denser than warm air therefore it sinks. On a night without clouds, the temperatures is low for that reason. However, at night time, cloud cover blocks the cold air coming down and traps the heat from the ground. So usually on a cloudy night, the temperature is warmer.

Lesson 3: Air pressure

Bring attention to the word "気あつ". "気 (ki)" as you learned in the previous lesson is atmosphere. "あつ (atsu)" as in "あつ力 (atsuryoku)" in Japanese means pressure. Therefore, "気あつ" means pressure of atmosphere. It might be hard to imagine for 5th graders that air has pressure. Just like all existing matters in the universe, air has mass as well. The air gets pulled by gravity and falls on the ground. That is the air pressure. Air pressure is hard to understand in daily life. Give students a couple of minutes to think of some occasions where they may have observed air pressure. Most students come up with an example of air plane. Some might come up with diving deep in the water, which in this case is the water pressure with a similar idea.

Remember in the unit of heat transfer students learned convection. Review how convection of heat works---cold water sinks and warm water rises. Explain that the same thing happens on a larger scale with air. Cool are sinks and warm air rises. When air gets cool and sinks, the weight of the air pushed outward---"高気あつ (kokiatsu)" high pressure. High pressure usually brings dry weather. When air gets warm and rises, it feels lighter---"低気あつ (teikiatsu)" low pressure. Low pressure usually means wet weather. Draw the diagram in the journal.

Lesson 4: Wind

Remember the reading of the kanji "風". It reads as "kaze" which means wind. Wind is basically air in motion. Wind blows because air pressure circulates the air. Although we don't feel it, air pressure is an important factor to determine wind direction "風向 (fuukou)" and wind speed "風速 (fuusoku)". Wind blows from high pressure to low pressure. The greater the difference between the air pressure, the faster the wind blows. Draw the model in the journal. Notice that this model is on a larger scale. Local wind is more complicated.

On the promethean board, project the current surface map with isobars[19] and analyze which direction the wind blows in North Carolina. Use this opportunity to also look at surface map in Japan[20] and predict the wind directions.

Lesson 5: Clouds

Observing the shape and altitude of clouds is another important factor to determine the latest weather. Ask students the reading of the kanji "雲". It reads "kumo" and they should know it means 'cloud'. In the journal, there is a cloud chart. Provide a translation for each cloud in English and have students look up the clouds. 10 minutes should be long enough to fill in the whole chart.

- 巻積雲 (kensekiun) --cirrocumulus
- 高積雲 (kousekiun) –altocumulus
- 乱層雲 (ransouun) --nimbostratus
- 積乱雲 (sekiranun) --cumulonimbus
- 乱雲 (ranun) --cumulus
- 巻雲 (kenun) --cirrus
- 層積雲 (sousekiun) --stratocumulus
- 巻層雲 (kensouun) --cirrostratus
- 高層雲 (kousouun) --altostratus
- 積雲 (sekiun) --cumulus
- 層雲 (souun) --stratus

Highlight cumulus, stratus, cumulonimbus, and cirrus because these four clouds are most likely to appear on the EOG. To wrap up the lesson, take students outside with journal and identify the clouds in the sky.

Lesson 6: Front line

"前線 (zensen)" literally it means front line. A large body of air mass with the same temperature moves around. When two air masses meet each other, they form a front. There are two important fronts the 5th graders need to know—"かんれい前線 (kanrei zensen)" and "温だん前線 (ondan zensen)". かんれい前線 is known as a cold front. By now students should understand that cold air sinks. When cold dry air mass meets warmer air mass, it slips under the warmer air mass and scoop it up. This will form the clouds like cumulonimbus and bring thunderstorms, maybe with a chance of hail, tornadoes, or blizzards depending on the climate. On a weather map, a cold front

is represented by a line with triangles and it moves towards the direction of the points. 温だん前線 is a warm front. Warm air rises so the warm moist air mass passes above the colder air mass. This will form clouds like nimbostratus which will bring a long period of rain in the region. On a weather map, a warm front is represented by a line with semicircles and it moves towards the directions of the semicircles.

Lesson 7: Weather forecast tools

In order to collect data to forecast the weather, meteorologists use tools. Although 5th graders learned these tools in 2nd grade, this would be a good chance to review. Spend half of the class time to have them look up weather tools on their Chromebook. In the journal, the name of the tools is already written in Japanese. Students might be able to guess the meaning from the characters, but it is best to go over the reading of each word in Japanese just in case. Then, have students find the English translation, draw pictures and write descriptions. When most of them are done, fill in the chart together.

- 温度計 (ondokei) --thermometer
- 気あつ計 (kiatsukei) --barometer
- 風向計 (fuukoukei) –wind vane
- 風速計 (fuusokukei) --anemometer
- 雨りょう計 (uryoukei) –anemometer

Lesson 8: Meteorology

This is the most exciting part of the unit---Students actually predict the weather! Print out and make a weather forecast journal for each student (Appendix 5 or 6). Hand out the journal and read the objective on the front cover. On the back of the front cover, there is a list of vocabulary. Students will need to refer to the list when they record the data. Go over each vocabulary word and show them how to make a reference.

Every morning, you need to write down the air pressure. Students will need to compare it to the afternoon to see if it's rising or falling. In the afternoon, take students outside with their journal and weather forecast tools. Observe the atmosphere and sky to record the data on the journal. For the first couple of days, students will take more time with need of your assistance, but soon they will be able to forecast independently. I suggest doing this outside right before recess. Students who finish the forecast early can go play. Continue this for a month and build a climate record in the back of the journal.

Evaluation

Collect and briefly take a look at students' weather forecast journal before they set off to recess every day. Evaluate if students' observation and prediction are reasonably correct. At the end of the unit, students will have enough data to create a line graph to analyze the increase of temperature. That is essentially a seasonal change in climate.

This is an informal assessment with the total point of 100. Each complete page is three points. Partially complete page is two points and hardly complete page is one point. There are thirty pages for a month (3x30=90). The last ten points are the completion of the climate chart.

Appendix 1

5.E.1.1 Compare daily and seasonal changes in weather conditions (including wind speed and direction, precipitation, and temperature) and patterns.

5.E.1.2 Predict upcoming weather events from weather data collected through observation and measurement.

Appendix 2

Weather

5.E.1.1 Students know that light travels from the sun to the earth. Some of this light is reflected back into space, some is absorbed by the land, water, and air.

5.E.1.2 Students know that numbers are used to describe air temperature, wind speed, and the amount of precipitation that occurs. Students know that wind direction is described using cardinal directions (N, S, E, W) and numbers. Students know how to measure air temperature with a thermometer, wind direction with a wind sock or vane, wind speed with an anemometer, and precipitation with a rain gauge.

Name : _____

1 . Forecast :

▪ ▪

▪ ▪

▪

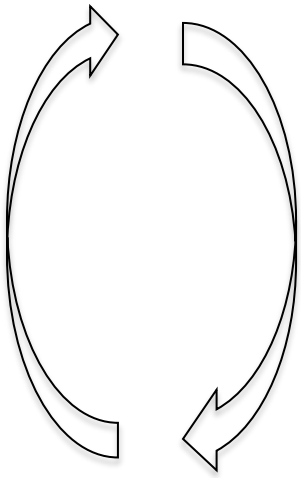
2. Temperature :

	Clouds	No Clouds
Day		
Night		

* Temperature is _____ at night because there is no _____.

3. Air Pressure :

_____ Pressure



_____ Pressure

4. Wind :

Wind Direction :

Wind Speed :

L

980 mb

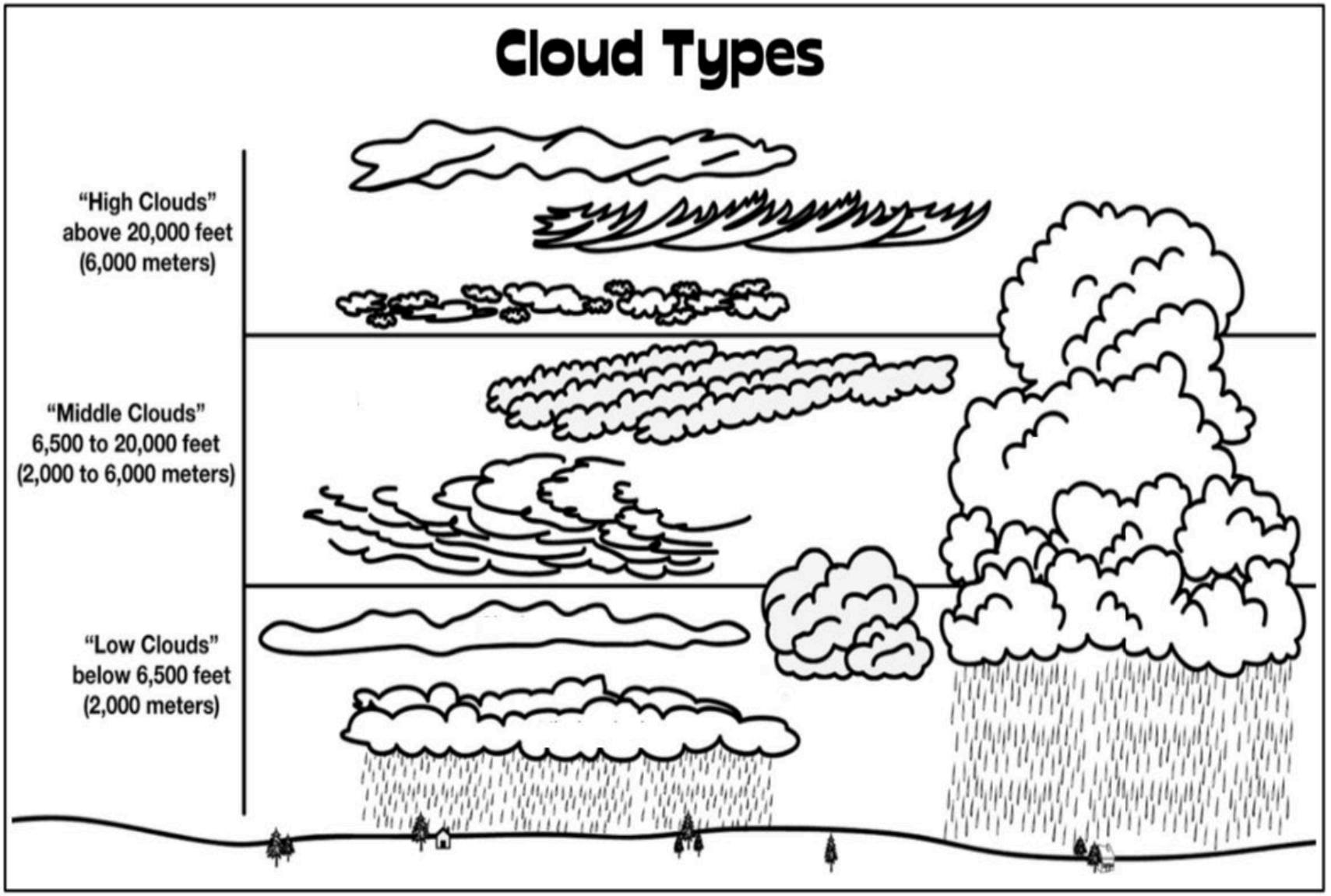
H

1020 mb

L

1010 mb

5. Clouds :



Altocumulus Altostratus Cirrocumulus Cirrostratus Cirrus Cumulus Cumulonimbus Nimbostratus Stratus

6. Front Line :

	Cold Front	Warm Front
Picture		
Clouds		
Weather		

7. Precipitation :

-
-
-
-
-
-
-

8. Weather instruments :

Thermometer	Description
Picture	

Barometer	Description
Picture	

Wind Vane	Description
Picture	

Anemometer	Description
Picture	

Rain Gauge	Description
Picture	

Appendix 3

天　気

5.E.1.1 Students know that light travels from the sun to the earth. Some of this light is reflected back into space, some is absorbed by the land, water, and air.
光は太ようから地きゅうにとどく。

5.E.1.2 Students know that numbers are used to describe air temperature, wind speed, and the amount of precipitation that occurs. Students know that wind direction is described using cardinal directions (N, S, E, W) and numbers. Students know how to measure air temperature with a thermometer, wind direction with a wind sock or vane, wind speed with an anemometer, and precipitation with a rain gauge.
気温や風速、こう水りょうは数字で表すことができる。気温を計るのは温度計、風こうは風こう計、風速は風速計、こう水りょうは雨りょう計で計る。

名　前：_____

1. 天気よほう：

・　　・

・　　・

・

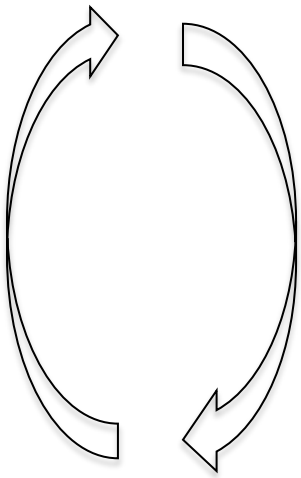
2. 気　温：

雲	あ　る	な　い
昼		
夜		

＊ 夜は_____のねつがないので、気温は_____。

3. 気あつ：

_____気あつ



_____気あつ

4. 風：

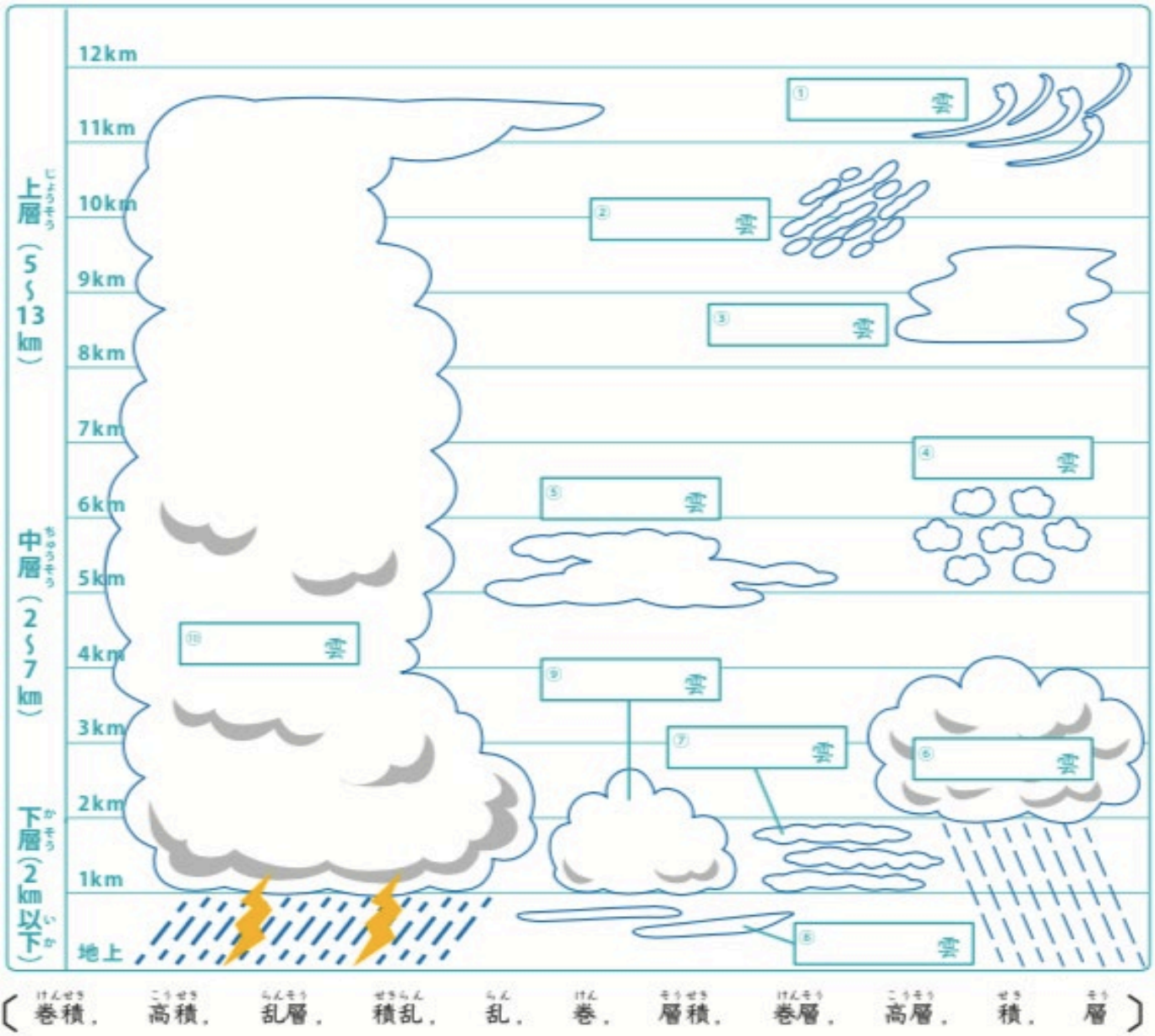
風こう：

風　速：

L　　H　　L

980 ミリバール　　1020 ミリバール　　1010 ミリバール

5. 雲：



6. 前　線：

前線		
絵		
雲		
天気		

7. こう水：

-
-
-
-
-
-
-

8. 天気よほうの道ぐ：

日本語：温度計	せつ明
えい語：	
絵	

日本語：気あつ計	せつ明
えい語：	
絵	

日本語：風向計	せつ明
えい語：	
絵	

日本語：風向計	せつ明
えい語：	
絵	

日本語：雨りょう計	せつ明
えい語：	
絵	

Appendix 4

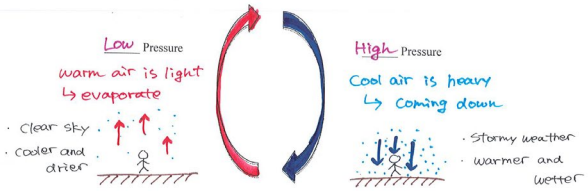
1. Forecast : A prediction of the weather for a specific time
- temperature
- air pressure
- wind
- cloud
- precipitation

2. Temperature :

	Clouds	No Clouds
Day	cool	HOT
Night	Traps the heat warm	cold cool air coming down

* Temperature is cool at night because there is no sun light.

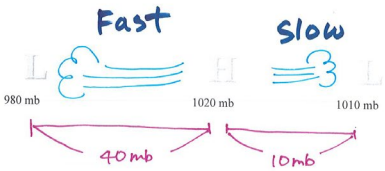
3. Air Pressure : the weight of the air

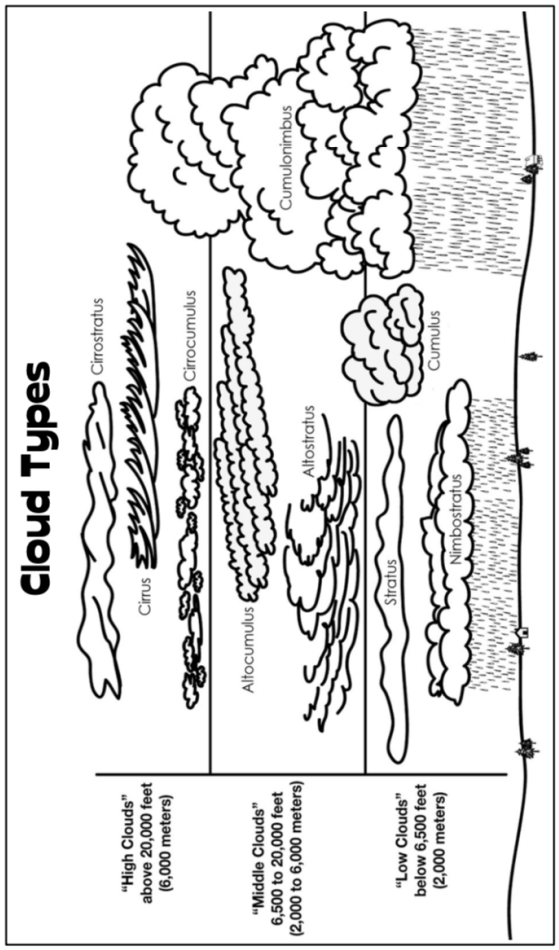


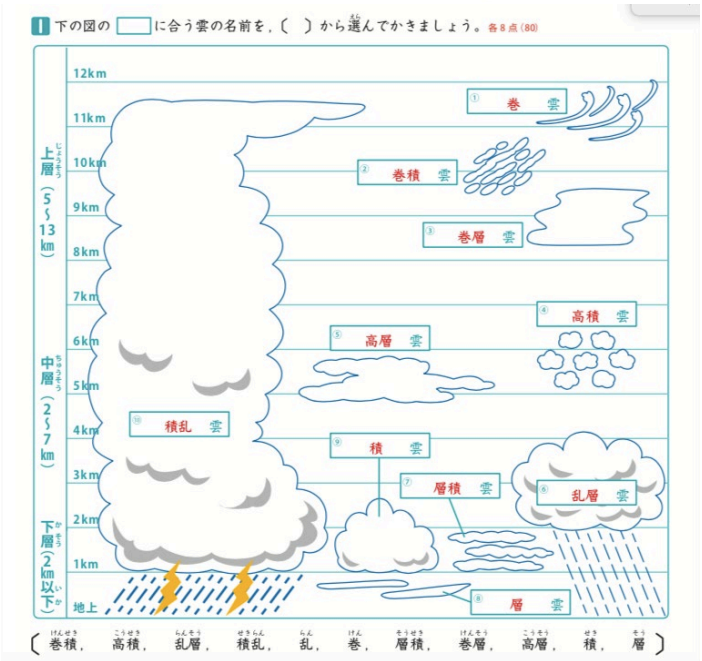
4. Wind : air in motion

Wind Direction : wind blows from high pressure to low pressure

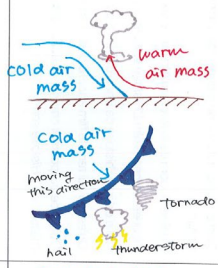
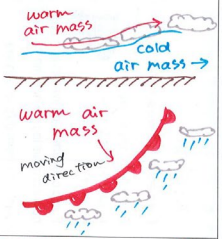
Wind Speed : the greater the difference between the air pressures, the faster the wind blows







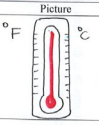
6. Front Line : boundaries of air masses

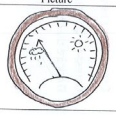
	Cold Front	Warm Front
Picture		
Clouds	Cumulonimbus	Nimbostratus, stratus, fog
Weather	thunderstorm	constant showers

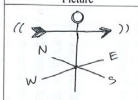
7. Precipitation : water falling from a cloud to the surface.

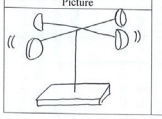
- rain
- drizzle
- fog
- hail
- snow
- sleet
- thunderstorm

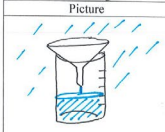
8. Weather instruments :

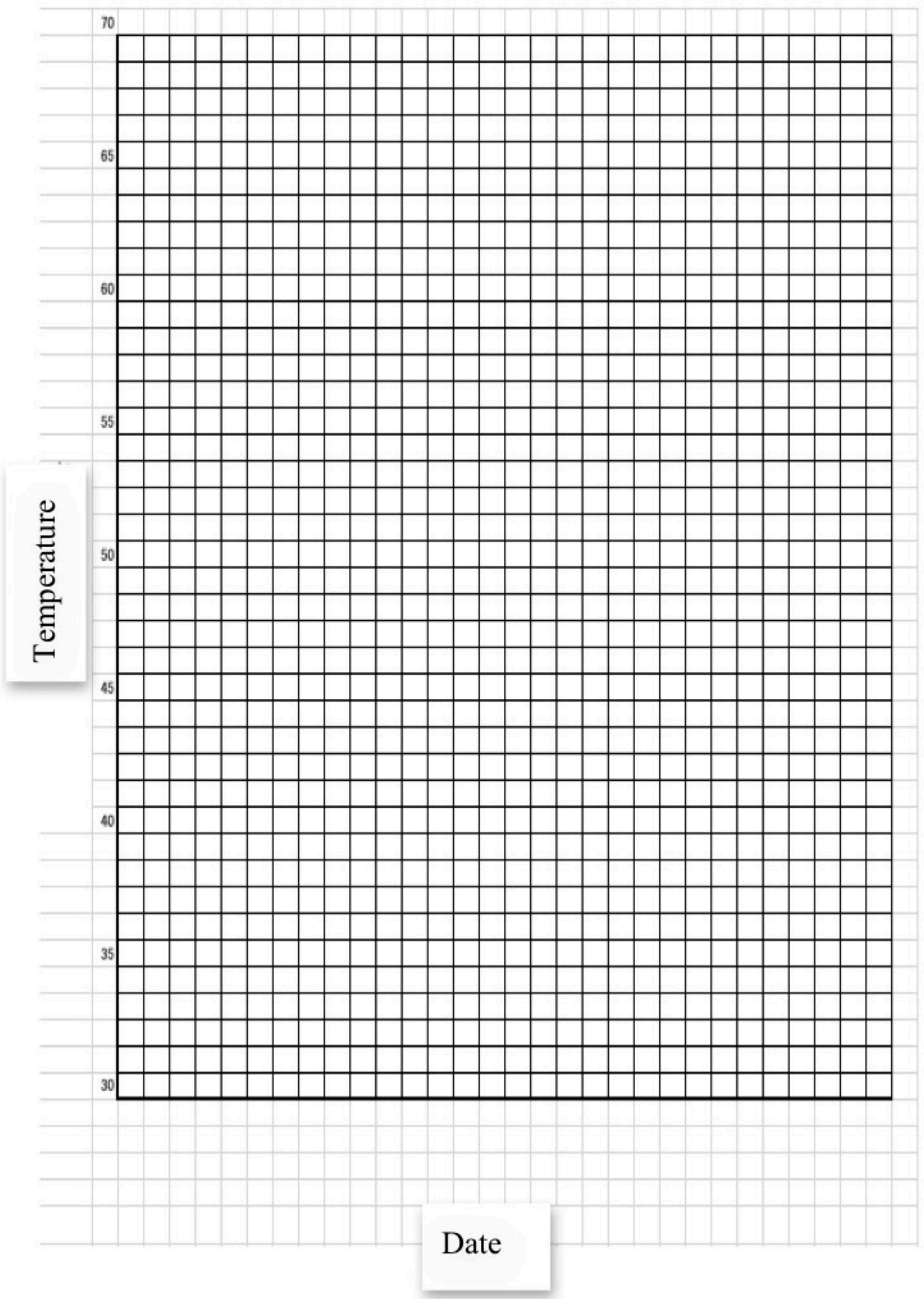
Thermometer Picture	Description
	Measures temperature. Fahrenheit (°F): · Boiling: 212 °F · Freezing: 32 °F Celsius: · Boiling: 100 °C · Freezing: 0 °C

Barometer Picture	Description
	Measures air pressure U.S. uses millibar (mb). It is same as hectopascal (hPa).

Wind Vane Picture	Description
	Measures wind direction. Also known as weather vane.

Anemometer Picture	Description
	Measures wind speed.

Rain Gauge Picture	Description
	Measures the amount of rain. Rainfall is measured in millimeters (mm) or inches (in).



Meteorology

5.E.1.4 Students are familiar with manual and electronic weather instruments, sensors, and computers as well as how they can produce a 'running record' of weather changes that occur over time by collecting and recording data. This collection of data can be analyzed as a basis for predicting weather trends.

Name：_____

Reference

Cloud Cover

0-10%	Clear
11-50%	Partly Cloudy
51-90%	Mostly Cloud
91-100%	Overcast

Temperature Feels Like

0-20°F	Freezing
21-40°F	Cold
41-60°F	Cool
61-80°F	Mild
81-90°F	Warm
91-100°F	Hot
101-110°F	Very Hot

Wind Speed

- strong
- weak
- N/A

Humidity Feels Like

0-30%	Dry
31-70%	Normal
71-100%	Humid

Cloud Type(s)

Date：_____ Time：_____

Cloud Cover：_____

Cloud Type：_____

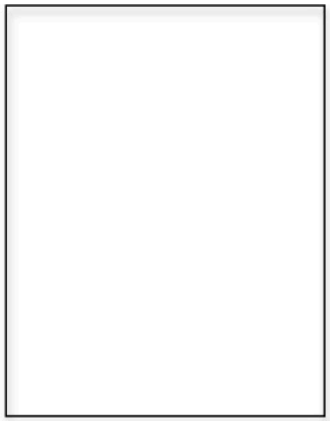
Temperature：_____°F

Feels like：_____

Wind Speed：_____

Wind Direction：_____

Cloud Sketch



Precipitation：

No Precip Drizzle Fog Hail Rain Sleet Snow Thunderstorm

Air Pressure：_____mb

Rising Steady Falling

Humidity：_____% Feels like：_____

Mostly Cloudy	+10%
Overcast	+20%
Tall Cumulus	+30%
Cumulonimbus	+50%
Stratus	+10%
Nimbostratus	+50%
Barometer Falling	+20%
Humid	+10%

Today's Forecast

_____%

Date：_____ Time：_____

Cloud Cover：_____

Cloud Type：_____

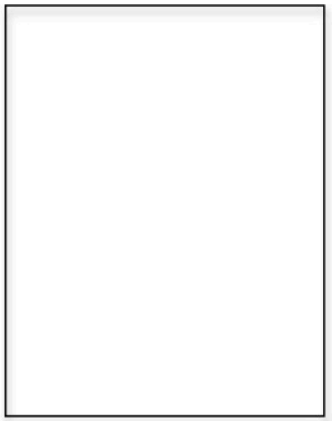
Temperature：_____°F

Feels like：_____

Wind Speed：_____

Wind Direction：_____

Cloud Sketch



Precipitation：

No Precip Drizzle Fog Hail Rain Sleet Snow Thunderstorm

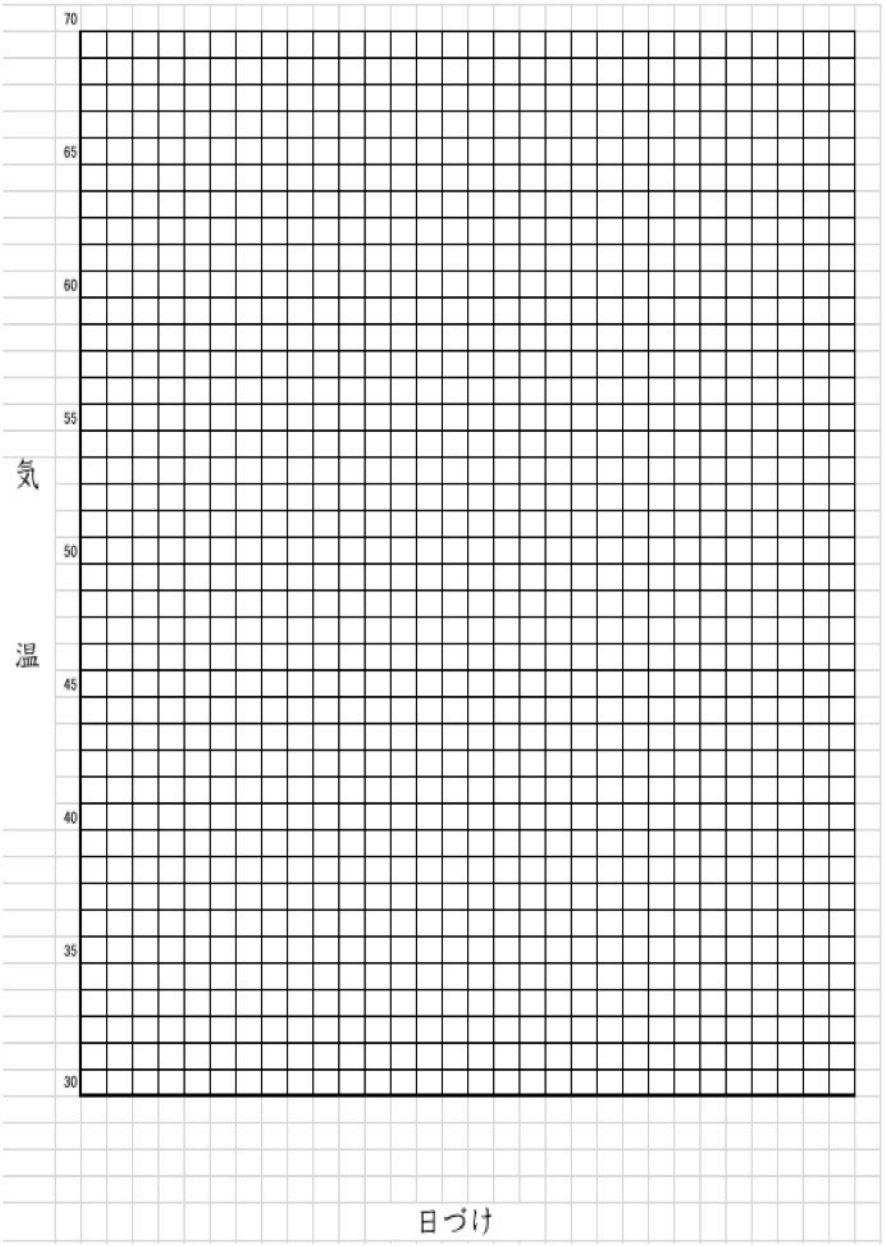
Air Pressure：_____mb

Humidity：_____% Feels like：_____

Mostly Cloudy	+10%
Overcast	+20%
Tall Cumulus	+30%
Cumulonimbus	+50%
Stratus	+10%
Nimbostratus	+50%
Barometer Falling	+20%
Humid	+10%

Today's Forecast

_____%



天気よほう

5.E.1.4 Students are familiar with manual and electronic weather instruments, sensors, and computers as well as how they can produce a 'running record' of weather changes that occur over time by collecting and recording data. This collection of data can be analyzed as a basis for predicting weather trends.
天気をよそくする道ぐのつかい方を学んで、天気のデータを取ることができる。データを分せきして、天気をよそくできる。

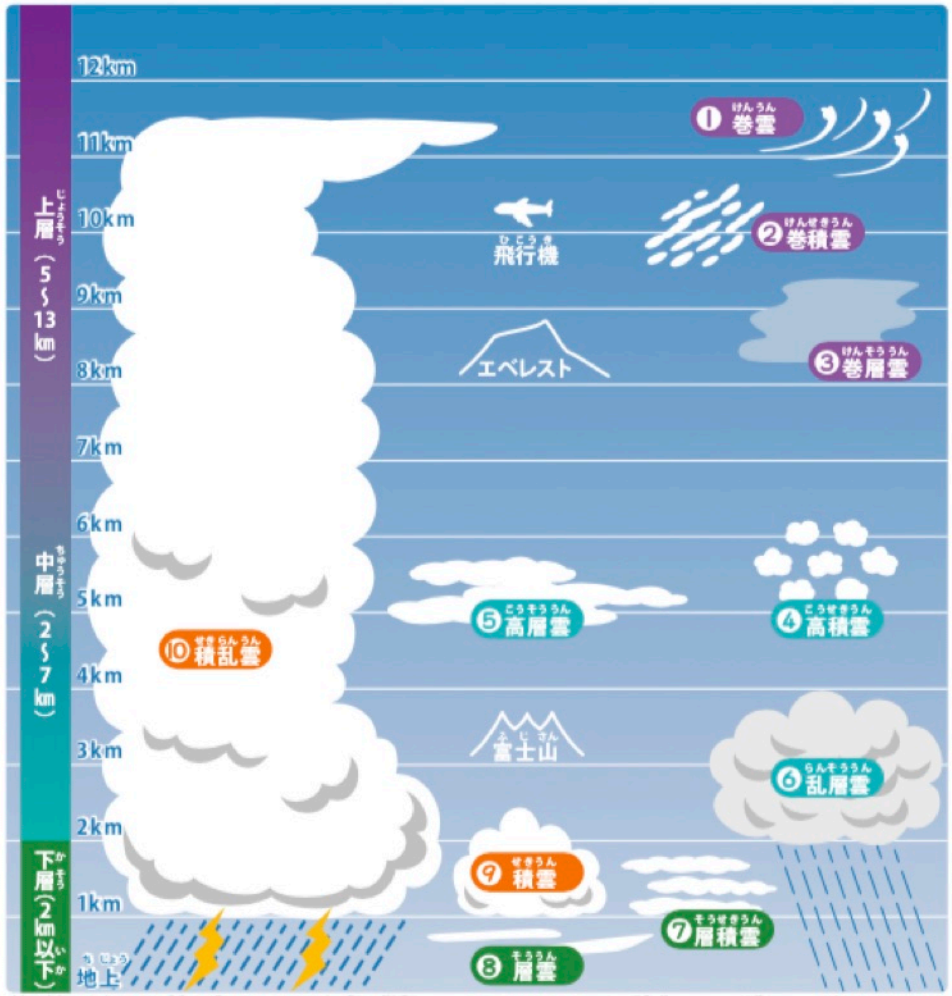
名　前：_____

さん考

雲のわり合 (cloud cover)

0-10%	はれ
11-50%	はれときどきくもり
51-90%	ほとんどくもり
91-100%	くもり

雲のしゅるい



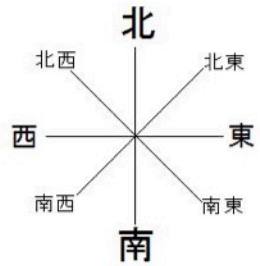
体感気温 (temperature feels like)

0-20°F	とてもさむい
21-40°F	さむい
41-60°F	すずしい
61-80°F	かいてき
81-90°F	温かい
91-100°F	あつい
101-110°F	とてもさむい

風速 (wind speed)

- 強い (strong)
- 弱い (weak)
- なし (N/A)

風向 (wind direction)



こう水 (precipitateon)

No precipitation	なし
Drizzle	きり雨
Fog	きり
Hail	ひょう
Rain	雨
Sleet	みぞれ
Snow	雪
Thunderstorm	あらし

体感しつ度 (humidity feels like)

0-30%	かんそうしている
31-70%	ふつう
71-100%	しめっている

日づけ：_____ 年____月____日　　時　間：_____

雲のわり合：_____

雲のしゅるい：_____

気　　温：_____℉

体感気温：_____

風　速：_____

風　向：_____

雲のスケッチ

こう水：なし　きり雨　きり　ひょう　雨　みぞれ　雪　あらし

気あつ：_____mb　上がっている　そのまま　下がっている

しつ度：_____%　　体感しつ度：_____

ほとんどくもり	+10%
くもり	+20%
大きいせき雲	+30%
せきらん運	+50%
そう雲	+10%
らんそう雲	+50%
気あつが下がっている	+20%
しめっている	+10%

今日のこう水かくりつ

_____%

日づけ：_____ 年____月____日　　時　間：_____

雲のわり合：_____

雲のしゅるい：_____

気　　温：_____℉

体感気温：_____

風　速：_____

風　向：_____

雲のスケッチ

こう水：なし　きり雨　きり　ひょう　雨　みぞれ　雪　あらし

気あつ：_____mb　上がっている　そのまま　下がっている

しつ度：_____%　　体感しつ度：_____

ほとんどくもり	+10%
くもり	+20%
大きいせき雲	+30%
せきらん運	+50%
そう雲	+10%
らんそう雲	+50%
気あつが下がっている	+20%
しめっている	+10%

今日のこう水かくりつ

_____%

Endnotes

[1] USGCRP. "Climate Science Special Report." Accessed October 5, 2019. https://science2017.globalchange.gov/chapter/1/.

[2] "Global Climate Report - January 2019 | State of the Climate | National Centers for Environmental Information (NCEI)." n.d. Accessed November 18, 2019. https://www.ncdc.noaa.gov/sotc/global/201901.

[3] "Arctic Sea Ice News and Analysis | Sea Ice Data Updated Daily with One-Day Lag." n.d. Accessed November 18, 2019. http://nsidc.org/arcticseaicenews/.

[4] "Accountability Services." n.d. Accessed June 8, 2019. http://www.ncpublicschools.org/accountability/reporting/.

[5] Gunter, Michelle. *North Carolina READY EOG Assessment for Grade 5 Science: 2015-2016 Edition*. American Book Company, 2015, page 63.

[6] Ibid

[7] Dessler, Andrew. *Introduction to Modern Climate Change*. 2 edition. New York, NY, USA: Cambridge University Press, 2016. Page 22.

[8] Ibid, Page 30.

[9] Ibid, Page 31.

[10] USGCRP. "Climate Science Special Report." Accessed October 5, 2019. https://science2017.globalchange.gov/chapter/1/.

[11] Zeebe, Richard E., Andy Ridgwell, and James C. Zachos. "Anthropogenic Carbon Release Rate Unprecedented during the Past 66 Million Years." *Nature Geoscience* 9, no. 4 (April 2016): 325–29. https://doi.org/10.1038/ngeo2681.

[12] Hansen, J., D. Johnson, A. Lacis, S. Lebedeff, P. Lee, D. Rind, and G. Russell. "Climate Impact of Increasing Atmospheric Carbon Dioxide." *Science* 213, no. 4511 (August 28, 1981): 957–66. https://doi.org/10.1126/science.213.4511.957.

[13] USGCRP. "Climate Science Special Report." Accessed October 5, 2019. https://science2017.globalchange.gov/chapter/1/.

[14] Dessler, Andrew. *Introduction to Modern Climate Change*. 2 edition. New York, NY, USA: Cambridge University Press, 2016. Page 68.

[15] Daniel, Lucy H. *Macmillan McGraw-Hill Science North Carolina* [ed.]. New York, NY: Macmillan/McGraw-Hill, 2006. Page B 52-53.

[16] Dessler, Andrew. *Introduction to Modern Climate Change*. 2 edition. New York, NY, USA: Cambridge University Press, 2016. Page 128.

[17] NPR.org. "Transcript: Greta Thunberg's Speech At The U.N. Climate Action Summit." Accessed October 12, 2019. https://www.npr.org/2019/09/23/763452863/transcript-greta-thunbergs-speech-at-the-u-n-climate-action-summit.

[18] "Beyond Ecophobia By David Sobel — YES! Magazine." Accessed May 5, 2019. https://www.yesmagazine.org/issues/education-for-life/803.

[19] US Department of Commerce, NOAA. n.d. "Current Surface Maps." Accessed October 17, 2019. https://www.weather.gov/oun/sfcmaps.

[20] "実況天気図." n.d. tenki.jp. Accessed October 11, 2019. https://tenki.jp/guide/chart/.

Annotated Bibliography

"Accountability Services." n.d. Accessed June 8, 2019. http://www.ncpublicschools.org/accountability/reporting/.
Date provided by the North Carolina Department of Public Instruction about individual public school demographics.

"Arctic Sea Ice News and Analysis | Sea Ice Data Updated Daily with One-Day Lag." n.d. Accessed November 18, 2019. http://nsidc.org/arcticseaicenews/.
Scientific analysis on Arctic sea ice conditions. The site provides an update during the first week of each month, or more frequently as conditions

"Beyond Ecophobia By David Sobel — YES! Magazine." Accessed May 5, 2019. https://www.yesmagazine.org/issues/education-for-life/803.
This article suggests educators what kind of approach we should take for certain age of students. In the article, author says that students from age eight to eleven are "bonding with the Earth" stage, in which they explore the landscape.

"Cloud-Types_WMWFN.Pdf." n.d. Accessed November 16, 2019. https://www.superteacherworksheets.com/weather/cloud-types_WMWFN.pdf?up=1466611200.
This worksheet is downloaded from supterteacherworksheets.com. You need to log in to fully access to the worksheet. There are also various resources on the website that you can use for class.

Daniel, Lucy H. *Macmillan McGraw-Hill Science North Carolina* [ed.]. New York, NY: Macmillan/McGraw-Hill, 2006.
This is a textbook that is provided to use in classrooms. It comes with a variety of supplemental resources such as worksheet and activity book.

Dessler, Andrew. *Introduction to Modern Climate Change*. 2 edition. New York, NY, USA: Cambridge University Press, 2016.
This is an invaluable textbook for any introductory survey course on the science and policy of climate change, for both non-science majors and introductory science students.

"Global Climate Report - January 2019 | State of the Climate | National Centers for Environmental Information (NCEI)." n.d. Accessed November 18, 2019. https://www.ncdc.noaa.gov/sotc/global/201901.
This is a global annual average temperature in 2019. It gives a snapshot of data with comparison to previous data.

Gunter, Michelle. *North Carolina READY EOG Assessment for Grade 5 Science: 2015-2016 Edition*. American Book Company, 2015.
This book is a great resource to get your students prepare for the science EOG test. The book contains pretest and post test, and covers all of the units with narrowed down explanation.

Hansen, J., D. Johnson, A. Lacis, S. Lebedeff, P. Lee, D. Rind, and G. Russell. "Climate Impact of Increasing Atmospheric Carbon Dioxide." *Science* 213, no. 4511 (August 28, 1981): 957–66. https://doi.org/10.1126/science.213.4511.957.
This is an old science report proving the impact of carbon dioxide on climate.

NPR.org. "Transcript: Greta Thunberg's Speech At The U.N. Climate Action Summit." Accessed October 12, 2019. https://www.npr.org/2019/09/23/763452863/transcript-greta-thunbergs-speech-at-the-u-n-climate-action-summit.
This is a transcript of Greta Thunberg's speech at the U.N. Climate Action Summit this year.

"NWS JetStream - NWS Cloud Chart." n.d. Accessed October 10, 2019. https://www.weather.gov/jetstream/cloudchart.
A cloud chart for the English weather journal. It shows 27 categories of cloud examples.

US Department of Commerce, NOAA. n.d. "Current Surface Maps." Accessed October 17, 2019. https://www.weather.gov/oun/sfcmaps.

A collection of current surface weather maps for Oklahoma, the Southern Plains, and the United States.

USGCRP. "Climate Science Special Report." Accessed October 5, 2019. https://science2017.globalchange.gov/chapter/1/.
This report is from the Climate Science Special Report (CSSR), designed to be an authoritative assessment of the science of climate change, with a focus on the United States, to serve as the foundation for efforts to assess climate-related risks and inform decision-making about responses.

Zeebe, Richard E., Andy Ridgwell, and James C. Zachos. "Anthropogenic Carbon Release Rate Unprecedented during the Past 66 Million Years." *Nature Geoscience* 9, no. 4 (April 2016): 325–29. https://doi.org/10.1038/ngeo2681.
The site gives a synapsis of climate change for students to research.

"実況天気図." n.d. tenki.jp. Accessed October 11, 2019. https://tenki.jp/guide/chart/.
Live surface weather map for the next three days in japan.

"小学理科【雲と天気（雲の種類・特徴、雲のでき方と雨が降るしくみ）】学習ポスター＆クイズテスト＆やってみよう！." n.d. [ちびむすマンスリー]学習ポスター・テストクイズ【3ステップ学習】. Accessed October 11, 2019. https://happylilac.net/sk1807250945.html.
Posters and tests for learning about types and features of clouds, how the clouds are formed, and the mechanism of rain.