**Atmosphere Learning Progression**

 **Grades 6-8: GLOBE Protocols Aligned with NASA Resources and NGSS Standards**

**NGSS Disciplinary Core Ideas Progression of Learning**: Building on the concepts developed in grades 3-5 that looked at the relationship between climate and patterns of typical weather conditions over different time scales, students in grades 6-8 will take this a step further as they examine how complex interactions determine local weather patterns and influence climate, including the role of the ocean. Using GLOBE and My NASA Data users will access NASA satellite data to examine a variety of interactions within the atmosphere and how these interactions affect the Earth system as a whole. Through the implementation of the learning activities and GLOBE protocols, teachers will bring authentic data collection into their classrooms.

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| **NGSS Performance Expectations:**· **MS-ESS2-5:** Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions.· **MS-ESS2-6:** Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.· **MS-ESS3-5:** Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century. |
| **NGSS Science Practices:****Asking Questions and Defining Problems** – Ask questions to identify and clarify evidence of an argument. (MS-ESS3-5)**Planning and Carrying out Investigations** - Collect data to serve as the basis for evidence to answer scientific questions. (MS-ESS2-5)**Developing and Using Models**- Develop and use a model to describe phenomena. (MS-ESS2-6) | **NGSS Disciplinary Core Idea:****ESS2.C The Roles of Water in Earth’s Surface Processes:** The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns.(MS-ESS2-5)**ESS2.D Weather and Climate:** Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (MS-ESS2-6)**ESS3.D Global Climate Change:** Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth’s mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. (MS-ESS3-5) | **NGSS Crosscutting Concepts:****Stability and Change**Stability might be disturbed either by sudden events or gradual changes that accumulate over time. (MS-ESS3-5)**Cause and Effect**Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS2-5)**Systems and System Models**Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. (MS-ESS2-6) |
| **GLOBE Application: Environmental observations, data collection and learning activities to develop Earth science concepts.** |
| **Atmosphere Protocols:*** [Air Temperature](https://www.globe.gov/documents/348614/93d4bb3c-79e3-4255-9fc8-537fc4f870dc)
* [Clouds](https://www.globe.gov/documents/348614/7b79ee82-ebd6-4382-9283-181a412f063f)
* [Surface Temperature](https://www.globe.gov/documents/348614/7537c1bd-ce82-4279-8cc6-4dbe1f2cc5b5)
* [Precipitation](https://www.globe.gov/documents/348614/97b9939c-7fb5-4b12-8113-59f988781bf5)

**Data Investigation Sheets:*** [Atmosphere Investigation Integrated 1-Day](https://www.globe.gov/documents/348614/81a42f5e-8f77-4d23-8fb0-9006b0b27063)
* [Atmosphere Investigation Clouds 1-Day](https://www.globe.gov/documents/348614/624fab53-4159-438e-b974-4a79c402c3cb)
* [Atmosphere Investigation Surface Temperature](https://www.globe.gov/documents/348614/57388c8d-4774-422c-a104-ba72012d7a66)
 | **GLOBE Learning Activities:** (Learning activities can be used to develop concepts associated with the NGSS Performance Expectations.)1. [Climate and Latitude: A GLOBE Data Exploration](https://www.globe.gov/documents/348614/353086/Climate%2Band%2BLatitude-%2BA%2BGLOBE%2BData%2BExploration/d0eb755f-2b68-4bf9-a61c-68001af3f1cb) (MS-ESS2-5, MS-ESS2-6, MS-ESS3-5)
2. [Modeling the Reason for Seasonal Change](https://www.globe.gov/documents/356823/e40fed2f-4476-4d27-b062-74a684d583db) (MS-ESS2-6)
3. [How do Seasonal Temperature Patterns Vary Among Different Regions of the World](https://www.globe.gov/documents/348614/de815d37-79f7-4f97-93a9-57df1fab6e8d) (MS-ESS2-6)
4. [What are Some Factors That Affect Seasonal Patterns?](https://www.globe.gov/documents/348614/d2cb0054-5c7b-4d83-809e-7f2546f97665) MS-ESS2-5, MS-ESS2-6)
5. [GC1: Your Regional to Global Connection](https://www.globe.gov/documents/356823/3aca815f-1bd4-4cd1-a5f9-0f6646cd3ee7) MS-ESS2-5, MS-ESS2-6)
6. [Learning to Use Visualizations](https://www.globe.gov/documents/348614/c5849563-f40b-4e89-9204-a44aa1cacdbe) (All)
7. [Draw Your Own Visualization](https://www.globe.gov/documents/348614/ea1af5aa-1082-4014-a287-f44ddea270e7) (All)

**Cross-Curricular Connections:** GLOBE Learning Activities· Math Connection: [Calculating Relative Air Mass](https://www.globe.gov/documents/348614/b10a107b-3f24-476f-818a-f26835e6e0b7)· Geography Connectio**n**: [Making a Contour Map](https://www.globe.gov/documents/348614/7becec5e-4638-4cd7-b76f-8deb9290bbf3)· Geography Connection: [Weather Tourist: A GLOBE Data Exploration](https://www.globe.gov/documents/348614/b9818aec-f82f-4cf4-a2c3-ecf34462267d) | **Guiding Question(s):**1. How can satellite data combined with ground truth observations be used to identify trends and patterns associated with interactions that occur between the atmosphere and other Earth systems?2. How are regional climates determined by patterns of atmospheric and oceanic circulation? What causes these patterns to occur?3. Based on evidence that has been collected what factors are associated with the rise in global temperatures over the past century? Which of these factors can be attributed to human impacts? To natural hazards? |
| **NASA Resources: Data and lessons drawn from NASA’s Earth science research program.** |
| **Extension Learning Activities/Resources:*** [NASA Climate Change Educational Modules](http://esseacourses.strategies.org/module.nasa.html)
* [NASA Earth Observatory World Maps](http://earthobservatory.nasa.gov/GlobalMaps/?eocn=topnav&eoci=globalmaps)
* [NASA Wavelength 6-8 List of Learning Resources](http://nasawavelength.org/list/1744)
* [MY NASA DATA-GLOBE Digital Earth System Poster](https://mynasadata.larc.nasa.gov/globe/)
 | **My NASA Data Live Access Server Data Visualization Tool:**[**Earth System Data Explorer**](https://mynasadata.larc.nasa.gov/EarthSystemLAS/UI.vm):**My NASA Data Variable Suggestions:****Air Temperature:** [Monthly Surface Air Temperature](https://mynasadata-d.larc.nasa.gov/EarthSystemLAS/UI.vm#panelHeaderHidden=false;differences=false;autoContour=false;xCATID=87E3BC5AAD11DE233211CDC3F416F9C0;xDSID=atmos_temp;varid=T2M-id-63ca87ebbe;imageSize=auto;over=xy;compute=Nonetoken;tlo=01-Jan-1980%2000:00;thi=01-Jan-1980%2000:00;catid=87E3BC5AAD11DE23321)**Clouds:** [Monthly Total Cloud Coverage](https://mynasadata-d.larc.nasa.gov/EarthSystemLAS/UI.vm#panelHeaderHidden=false;differences=false;autoContour=false;xCATID=E5DD6D486F31045515670FD1E9C0298A;xDSID=clouds;varid=cldarea_total_mon-id-81d9752396;imageSize=auto;over=xy;compute=Nonetoken;tlo=15-Mar-2000%2000:00;thi=15-Mar-2000%2000:00;catid=E5DD6D486)**Surface Temperature**: [Daytime Skin Temperature](https://mynasadata-d.larc.nasa.gov/EarthSystemLAS/UI.vm#panelHeaderHidden=false;differences=false;autoContour=false;xCATID=0A456C6EE1BEE5AC8A2D7BD0386C1A1F;xDSID=skinTemp;varid=SurfSkinTemp_A-id-4c24211c9a;imageSize=auto;over=xy;compute=Nonetoken;tlo=01-Sep-2002%2000:00;thi=01-Sep-2002%2000:00;catid=0A456C6EE1)**Precipitation**: [Monthly Precipitation](https://mynasadata-d.larc.nasa.gov/EarthSystemLAS/UI.vm#panelHeaderHidden=false;differences=false;autoContour=false;xCATID=917C7CEA2EE5654B6013BA0809005D77;xDSID=Precip;varid=precipitation-id-32889af644;imageSize=auto;over=xy;compute=Nonetoken;tlo=01-Jan-1979%2000:00;thi=01-Jan-1979%2000:00;catid=917C7CEA2EE56) | **MY NASA DATA Lessons/Activities:**(My NASA Data Lessons can be used to develop concepts associated with the NGSS Performance Expectations)* [Using Models in Climate Change Research](https://mynasadata.larc.nasa.gov/lesson-plans/using-models-climate-change-research) (MS-ESS2-2, MS-ESS3-2)
* [Comparing Temperature and Solar Radiation for Common Latitudes](https://mynasadata.larc.nasa.gov/lesson-plans/comparing-temperature-solar-radiation-common-latitudes) [(MS-ESS2-5, MS-ESS2-6)](https://mynasadata.larc.nasa.gov/lesson-plans/lesson-plans-middle-school-educators/?page_id=474?&passid=67)
* [Seasonal Science: Building Claims from Evidence](https://mynasadata.larc.nasa.gov/lesson-plans/seasonal-science-building-claims-evidence) (MS-ESS2-6)
* [Using Precipitation and Vegetation to Study Climate Zones](https://mynasadata.larc.nasa.gov/lesson-plans/using-precipitation-and-vegetation-study-climate-zones)(MS-ESS2-4)
* [How Does the Earth’s Energy Budget Relate to Polar Ice?](https://mynasadata.larc.nasa.gov/lesson-plans/lesson-plans-middle-school-educators/?page_id=474?&passid=101) (MS-ESS3-5)
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