

Cara Gilligan
STEM Leadership Seminar
Professional Development Final Report
Spring 2019

I. **Title: Climate Change- Incorporating Current and Real-Time Data**

- II. **Curriculum Content:** During the professional development that I implemented the curriculum content addressed was Stability and Change on Earth with a focus on Climate Change in the Arctic Region (and mention of the Antarctic region). I teach at Randolph Middle School, which currently has approximately 1100 students and a staff of sixteen educators within the Science department. We are a medium sized school in northern New Jersey and a school that has a strong focus on incorporating STEAM concepts throughout the curriculum as well as a deep concentration in developing global citizens. Due to our focus on encouraging our students to be aware of and empathetic to the world around them I chose to focus my PD on content that would support teachers in reaching these goals.

In attendance at my professional development were five teachers from the Science department as well as three educators from the Special Education department who support the general education teachers in both Science and Math classes in the three grade levels (6th-8th) within our school. The Science teachers in attendance teach Science in various grade levels and one also teaches a 6th grade course on Sustainability. Unfortunately, due to the rescheduling of a department meeting (due to a snow day), some of the department was unable to attend.

III. **NGSS Standards Addressed:**

MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

HS-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity

HS-ESS3-5. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems

HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards and changes in climate have influenced human activity.

Science and Engineering Practices Addressed:

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence (*minimal in this PD*)
8. Obtaining, evaluating, and communicating information

IV. **Goal of PD:** ‘ ‘Roughly three in four middle and high school science teachers are discussing recent global warming in their classes, but there is no cumulative curriculum for children, ’’ stated Penn State Professor of Political Science, Eric Plutzer, in Penn State News (February 2016) following a nationwide survey of 1500 teachers that revealed surprising results. After reading this, I realized that my colleagues and I are just like those in the survey, teaching climate change without a clear path of how and when to teach the information. This professional development session was designed to alert, engage, and educate my colleagues on the most recent data and information available on changes in climate while also sharing resources that can be used when teaching climate change. My goal was to show my fellow educators the alarming rate of change in the climate particularly at the polar regions and to support this with teaching resources for them to bring this knowledge to their students. By bringing this information to the forefront using NASA data and applications as well as the SPRINTT curriculum, I was able to present the PD participants with tangible and useful resources.

V. **Pre-Survey: Teaching About Climate Change**

1. Have you ever taught the topic (or related subtopics) of climate change? If you have, what was the focus of your teaching?
2. If you have taught students about aspects of climate change, what was your comfort level when teaching this content (check appropriate box)?

Very Uncomfortable	Somewhat comfortable	Comfortable	Very comfortable	Comfortable and confident

3. Did you feel that you had adequate resources when teaching about climate change or its related subtopics? Please explain with some detail.
4. Do you feel that climate change is a difficult topic to teach due the political aspects that have been applied to the science?

*Example Participant Pre-Survey Answers:
(survey question #3 highlighted)*

- “For most topics yes but for some the technology and data weren’t available or always working”
- “We have some resources but I don’t feel that we have enough. There are not enough resources for subtopics or in-depth detail”
- “I feel that the resources I have used in the past come from the internet (in the absence of textbooks with enough accurate information) and we have to be careful that they are from reliable resources”

VI. **Professional Development Training Teaching Plan**
(5E Lesson Plan Structure Used):

1. **Engage:** I opened up the professional development workshop with a brief portion of a video explaining the Paris Climate Agreement (<https://www.youtube.com/watch?v=3tnDjCA4peY> up to minute 2:10) and discussed the current status of the plan with workshop participants with a focus on the United States' current role. Being that our current President has withdrawn the US from the agreement, questions were posed as to where do we go from here and what have governors and legislators done at the state level of government if they are in disagreement with the federal decision to remove the United States from the Paris Agreement. Participants were asked to talk with those at their table and discuss anything they currently knew about what is being done and if the US is still being held to the standards set forth in the Paris Agreement. This sparked great discourse among participants and educated some on the four-year withdrawal process. With the energy in the room being great at this point from our discussion, I transitioned into exploring climate change itself and how it relates to each grade level curriculum.

- 6th: Weather and Climate
- 7th: Earth Systems
- 8th: Stability and Change

2. **Explore: Climate change** – Participants at each table were given a picture of earth and asked: What is climate change? What aspects of Science fall under the umbrella of climate change? Discuss with tablemates and together write your groups' thoughts around the earth. I then solicited answers & directed participants to log on to the NASA.gov website as a resource for both themselves and their students to reference when determining a clear definition and understanding of all that climate change encompasses. (<https://climate.nasa.gov/resources/global-warming/>- see appendix)

- Global warming
- Sea level rise
- Ice mass loss
- Shifts in flower/plant blooming
- Extreme weather events

I then introduced everyone to the Earth Now App, a NASA resource highlighting sea level, global temperature, water vapor, ozone, CO₂ levels, current weather events (<https://climate.nasa.gov/effects/>). Participants enjoyed exploring this app and seeing close to real-time data available at their fingertips! We brainstormed methods of incorporating the data from this app into our climate change lessons. Use of this NASA app fits into the SPRINTT curriculum very well especially during the Frozen Land- Lesson III: Greenhouse Gases chapter that I incorporated next.

3. **Explain:**

During the next portion of the PD, the handouts I created were distributed. These provided the educators with many resources including the ones I used in the workshop as well as access to the SPRINTT curriculum. I have attached copies of the handouts in the Appendix section.

Next, I had everyone log on to the SPRINTT website for teachers and walked them through the various sections of the curriculum. I had prepared a permafrost model from Lesson II of Frozen Land to explain the features (primarily active and inactive layers) of permafrost and the importance of it remaining frozen for the majority of the year. My colleagues passed it around as I showed them the pictures and graphs from this lesson.

We then moved into Frozen Land: Lesson III- Greenhouse Gases. I had participants pair off and work through this lesson together on their computers. They were able to access the graphs, pictures, and readings. As a large group, we then went through some of the portions of the lesson and the teachers were very impressed with the level of the readings, the additional information such as thermokarst lakes, aerobic and anaerobic decomposers, and the sediment cores.

4. **Elaborate:** To provide my colleagues with further evidence of climate change in the arctic and its effects on the permafrost layer, I showed the video clip of a NASA study done by NASA scientist, Dr. Charles Miller at NASA's JPL. This video entitled, "Drunken Forests" in Alaska is disheartening and very eye-opening (see appendix for link).
5. **Evaluate-** Participants of the PD were evaluated throughout as they worked through the lesson and had assistance with any questions when needed.

VII. **Outline of Activities in the Pick-Up Unit (materials provided in appendix)**

- A. Paris Climate Change Video and Discussion
- B. Climate Change Around the World- What Exactly Is Climate Change?
- C. NASA's Earth Now App Introduction & Exploration
- D. Climate Change throughout our curriculum (focus in each grade level)
- E. Distribute SPRINTT resources and additional list of related climate change content including NASA resources to be used when teaching
- F. SPRINTT Frozen Land III- Greenhouse Gases lesson and portions of previous lesson, Frozen Land II- Permafrost
- G. Viewing of "Drunken Forests", NASA scientist Dr. Charles Miller in Alaska

VIII. **NASA Data Included:**

1. What's In a Name? Weather, Global Warming and Climate Change
<https://climate.nasa.gov/resources/global-warming>
2. Global Climate Change: Vital Signs of the Planet
(<https://climate.nasa.gov/resources/education>)
- 3.** NASA's app Earth Now- real time data for participants to analyze and compare;
(<https://climate.nasa.gov/effects/>).
- 4.** NASA Summer Arctic Sea Ice Extent simulation
(<https://www.nasa.gov/feature/goddard/2017/end-of-summer-arctic-sea-ice-extent-is-eighth-lowest-on-record>)
5. "Drunken Forests"- a video recorded in Alaska by researchers at NASA's Jet Propulsion Lab

IX. **Follow-Up Activities and Post-Survey Question List**

At the end of the professional development session, I left a few minutes for questions and additional thoughts. I was so pleased because the teachers who teach in the eighth grade were very enthusiastic about trying to incorporate the SPRINTT curriculum and several of the

NASA resources into the current Stability and Change unit that we developed over the last two years in the absence of textbooks as a guide. The unit we have created is strong but would greatly benefit from the viewpoint of the indigenous communities in Alaska and from more real-time data available through NASA.

Each week, we have PLC meetings and as we get towards the end of the year we will be discussing which units we would like to improve on for next year. That will be a good time for me to bring up the resources I shared and for us to work together to incorporate some of them into our curriculum.

Below are examples of the questions I placed on the post survey and some sample answers from both the pre-survey and the post-survey by educators in the professional develop workshop:

Post-Climate Change PD Survey

1. Did you find any of the resources presented to be useful and materials that you could easily incorporate into your classroom? If so, please note which ones.

Paris Climate Agreement Video	NASA.gov climate change website	SPRINTT resources	List of Additional Resources

2. Has your comfort level in teaching climate change and its related subtopics changed after this workshop? If yes, please note how.
3. Do you have additional methods for teaching content that has been viewed as controversial although there is scientific data to support it? If so, please note methods (i.e. debate, argument-driven inquiry, cooperative controversy, etc.)

X. Outcomes: Final Data Collection and Analysis:

a. & b.

*Example Participant **Pre-Survey** Answers Included the following responses:
(survey question #3 highlighted)*

- “For most topics yes but for some the technology and data weren’t available or always working”
- “We have some resources but I don’t feel that we have enough. There are not enough resources for subtopics or in-depth detail”
- “I feel that the resources I have used in the past come from the internet (in the absence of textbooks with enough accurate information) and we have to be careful that they are from reliable resources”

*Example Participant **Post-Survey** Answers Included the following responses:
(survey question #2 highlighted)*

Comments on the content and pedagogy combined in this workshop:

- “Much more comfortable. Lots of resources to help enhance their (students) understanding on many levels.”
- “Great resources- love how it (SPRINTT) is broken down into phases I-II-III. We teach how climate change impacts the Antarctic ecosystem- it would be great to add an Arctic version and enhance the unit!”
- “Yes, I feel that there are a variety of sources with current data from reliable places”

c. **Success of PD:** After reading my colleagues’ responses, I feel that the participants were able to walk away feeling more empowered and confident in teaching this vital content that our students need to understand and act on in their own lives. The success of the professional development was evident to me as my colleagues were excited and already discussing how we can change our current unit plans by incorporating the resources provided to them. Two of the special education teachers who attended the workshop were so happy with the differentiation possibilities that were provided through various levels of data and content resources.

d. **Relate to Readings:** This professional development related to many of the readings we were exposed to in this course but to these two in particular: *Science Teacher Leadership: Learning from a Three-Year Leadership Program* by Luft, et al and *Learning to Lead with Purpose*, Sato, et al. Julie Luft states, “Unfortunately, science teachers may not have extra time to spare when it comes to professional development programs...Most science teachers would like access to different types of professional development programs,” (Luft, Ortega, & Wong, 2009). When I was thinking of what to focus the professional development on I had these thoughts on the forefront of my mind, that teachers have very little time to engage in professional development so I better make it worth their while! Often, the PD we attend are not of our choosing and are not directly related to our day to day teaching or our curriculum. Luft recognized this and points out that teachers want the opportunity to attend a variety of workshop types. By allowing teachers to choose the type of PD they attend and the topic of the PD, educators will be more inclined to wholeheartedly participate and more likely to leave having learned something immediately useful and applicable to their teaching. Knowing this information, I chose to focus my PD on climate change as this is a part of our curriculum we all feel is a bit weak and one that needs improvement through current resources.

In Luft’s three year leadership program, she and her team also make the point that successful professional development opportunities are not those that are what I call “one and done” workshops but rather sessions that can continue to engage teachers weeks and months later through making changes in their curriculum or teaching styles and when I heard my colleagues discussing how we can use the resources I provided to change and enhance our unit, I knew it was a successful PD.

Mistilina Sato conducted a study on teachers pursuing National Board Certification and studied how they decide what leadership work to engage in. I am a teacher that uses my leadership skills in a more quiet way and usually with clubs and projects involving students rather than my colleagues. This year, through my Endeavor studies, I have gained more confidence to be more of a teacher leader. “Leadership can encompass a broad range of responsibilities and actions. For example, you can hold particular positions of leadership...or you might participate in activities that you consider to be leadership...or you might engage in behaviors that influence others or set an example,” (Sato, et al Fall

2014). This reading opened my eyes to all of the leadership roles we can take on as teachers and by implementing this professional development, I feel that I have grown as a teacher leader.

e. **Will teacher repeat PD:** As a teacher of climate change, I will definitely provide this professional development again if I have the opportunity to. If new teachers join our departments, I would be happy to provide the lessons and resources to them so that they can enhance their knowledge base of climate change and incorporate engaging lessons and real-time data. In our school we have the opportunity to offer a PD to the staff as a whole so if there are interdisciplinary opportunities then I would be interested in offering this session to staff in other departments.

f. **Reflection:** As I reflect on the professional development session that I developed and implemented I am fulfilled in knowing that I successfully increased my colleagues' STEM pedagogical content knowledge as I presented various STEM resources. With many other responsibilities, teachers often have months go by when we are unable to share resources and have ample time to discuss how the resources could enhance our curriculum and teaching efforts. Although I was nervous teaching my colleagues for that long of a time period, I was also comforted within a few minutes when I could see that my colleagues were engaged and interested in the information. I feel that I have grown through this process as both a teacher and a teacher leader.

XI. **Appendix: Classroom Activities/Unit with Assessment:**

1. Paris Climate Change Video and Discussion
2. Climate Change Around the World- What Exactly Is Climate Change?
3. NASA's Earth Now App Introduction & Exploration
4. Climate Change throughout our curriculum (focus in each grade level)
5. SPRINTT resources and additional list of related climate change content including NASA resources to be used when teaching
6. SPRINTT Frozen Land III- Greenhouse Gases lesson and portions of previous lesson, Frozen Land II- Permafrost (distribute pre-made permafrost model to groups)
7. GHG Chart; determination of Methane release from permafrost
8. Viewing of "Drunken Forests" to substantiate lesson conclusions

XII. **Participant Contact Information:**

1. Angela Chang- achang@rtnj.org
2. Kathy Russell- krussell@rtnj.org
3. Maraline Ashley- mashley@rtnj.org
4. Melanie Lombardo- mlombardo@rtnj.org

References:

1. *SPRINTT (Student Polar Research with IPY National and International Teacher Training)*; U.S. Satellite Laboratory, Inc.; Schuster, et al.
2. *Global Climate Change: Vital Signs of the Planet*

(<https://climate.nasa.gov/resources/education>)

3. NASA's app Earth Now- close to real time data for participants to analyze and compare
- 4.** NASA Summer Arctic Sea Ice Extent simulation
(<https://www.nasa.gov/feature/goddard/2017/end-of-summer-arctic-sea-ice-extent-is-eighth-lowest-on-record>)
5. "Drunken Forests"- a video recorded in Alaska by researchers at NASA's Jet Propulsion Lab, <https://www.youtube.com/watch?v=-2TUQxpQmaU>
6. Next Generation Science Standards. (2018). *Read the Standards*. Retrieved from <http://www.nextgenscience.org/search-standards>
7. Next Generation Science Standards. *APPENDIX F – Science and Engineering Practices in the NGSS*. <https://www.nextgenscience.org/>

XI. Appendix: resources provided to educators



What's in a name?

Weather, global warming and climate change

Taken from <https://climate.nasa.gov/resources/global-warming/>

"Climate change" and "global warming" are often used interchangeably but have distinct meanings. Similarly, the terms "weather" and "climate" are sometimes confused, though they refer to events with broadly different spatial- and timescales.

Weather vs. climate

"If you don't like the weather in New England, just wait a few minutes."

- Mark Twain

Weather refers to atmospheric conditions that occur locally over short periods of time—from minutes to hours or days. Familiar examples include rain, snow, clouds, winds, floods or thunderstorms.

Climate, on the other hand, refers to the long-term regional or even global average of temperature, humidity and rainfall patterns over seasons, years or decades.

What is global warming?

Global warming refers to the long-term warming of the planet since the early 20th century, and most notably since the late 1970s, due to the increase in fossil fuel emissions since the Industrial Revolution. Worldwide since 1880, the average surface temperature has gone up by about 1 °C (about 2 °F), relative to the mid-20th-century baseline (of 1951-1980). This is on top of about an additional 0.15 °C of warming from between 1750 and 1880.

What is climate change?

Climate change refers to a broad range of global phenomena created predominantly by burning fossil fuels, which add heat-trapping gases to Earth's atmosphere. These phenomena include the increased temperature trends described by global warming, but also encompass changes such as sea level rise; ice mass loss in Greenland, Antarctica, the Arctic and mountain glaciers worldwide; shifts in flower/plant blooming; and extreme weather events.

Additional Resources provided to educators attending the professional development-



Some additional resources for teaching climate change □

Lesson Resources:

1. *NASA Resources*- <https://climate.nasa.gov/resources/education> - this site has many links and data driven lessons
2. *Carbon Connections*: www.carbonconnections.bscs.org - funded by NASA; designed for grades 9-12

3. *Invasive Species due To Climate Change*
<https://climate.nasa.gov/news/2306/in-alaskas-last-frontier-climate-change-provides-new-horizons-for-invasive-species/>
4. *Northern Permafrost & Climate Change*-
<https://www.nasa.gov/feature/jpl/far-northern-permafrost-may-unleash-carbon-within-decades>
5. *Article & Video Greening of the Arctic*-
<https://climate.nasa.gov/news/2447/nasa-studies-details-of-a-greening-arctic/>
6. *Sea Level Rise Article & Video*-
<https://climate.nasa.gov/news/2680/new-study-finds-sea-level-rise-accelerating/>
7. *Climate Kids*- <https://climatekids.nasa.gov> - user friendly site for grades k-6 with many lessons, labs, and activities
8. *Indigenous Population Perspective*-
<https://www.theguardian.com/environment/2016/dec/19/alaska-sea-ice-vanishing-climate-change-indigenous-people>
9. www.epa.gov/climate-indicators - not updated as of 1/19/17 but full of useful lessons and information
10. www.trocaire.org/creating-futures - the official overseas development agency of the Catholic church in Ireland
11. *Climate Generation*: www.climategen.org - this site has great lessons for all ages on both climate change and energy

Webinars:

1. *NOAA Archived Webinars (a great resource!)*-
<https://oceanservice.noaa.gov/education/planet-stewards/webinars.html>

Videos:

1. Strange Days on Planet Earth
2. At the Core of Climate Change: PBS Learning Media
3. PBS Global Warming Three Signs and the Science
4. Bill Nye's Global Meltdown by National Geographic Explorer

5. Before the Flood- Leonardo DiCaprio investigates climate change (produced by National Geographic)
6. Between Earth and Sky: An Arctic Soils Perspective

App:

1. **Earth Now**- NASA's Earth Now provides users with current vital signs of the Earth;
<https://climate.nasa.gov/earth-now/>