Discover Your Changing Climate

Rangers in the Classroom— *Lesson Plan*

Grade Levels : 6th, 7th, & 8th

Setting: Classroom

Duration: 1 hour

Standards Addressed:
6th—8th Grade

Science—History of Earth

MS-ESS1-4.
MS-ESS1.C

Science—Weather and Climate

MS-ESS2-5
MS-ESS3-5
MS-ESS2.D

Vocabulary:

- Analysis
- Adaptation
- Atmosphere
- Change
- Climate
- Cryo-
- Dendrochronology
- Greenhouse effect
- Hypothesis
- Objectivity
- -ology
- Paleoclimatology
- Phenology
- Sediment
- Subjectivity
- Weather

Introduction:

Welcome to the Rangers in the Classroom—Discover Your Changing Climate presentation. This program introduces the basics of climate, weather, and the greenhouse effect then invites students to explore past and present climates through a mock *Climate Science Summit* small-group activity. Each group analyzes either a tree core, ice core, or sediment core and shares its results with the class. Throughout the program students explore *objectivity* as a tool for understanding complex change.

Essential question: What is climate change and what other changes will it bring to our ecological and cultural landscapes?

Goal: By objectively investigating climate change, we can understand what changes might affect our communities (ecological and societal) to determine how we may adapt.

Objectives:

After completing this program, 5th and 6th grade students will be able to:

1. Explain the difference between climate and weather
2. Explain the role greenhouse effect in determining global temp.
3. List two human activities that contribute to the amount of carbon dioxide in the atmosphere
4. Describe at least one method scientists use to study past climates
5. Identify at least one local impact of a changing global climate

Materials:

° Power point climate change presentation
° Tree core mock ups (marked pencils)
° Real tree cores for examples
° Laminated ice core mock ups (NASA rulers)
° Laminated sediment core mock ups
° Real sediment core sample for example
° Activity packets, including worksheets and answer key
° Laptop (if the classroom is not equipped)
° Projector
° Extension cord
° Park maps and student fee waivers

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PRESENTATION

<u>**ASK TEACHERS IF THEY HAVE DONE THE PRE-ACTIVITIES. If teachers have done the activities you can briefly go over Greenhouse Effect and key vocabulary words. If teachers HAVE NOT done the pre-activities then do the program as is.</u>

Notes in parentheses are suggestions to presenter, bracketed notes are technical directions.

Slide 1– Title Slide / Introduction: Introduce self, role as a Ranger in the Classroom and representative of the National Park Service. If students have had *Meet Your National Parks/Life Zones*, ask them what they learned (emphasize climate, differences between life zones, and change) If students haven't, ask what they know about park rangers and the Park Service.

Transition: I'm proud to be here today representing your National Parks, of course because of all the amazing things we protect—the animals, history, and landscapes of the park. I'm especially proud to represent your National Park Service, because we are about to celebrate a very important birthday in 2016. *Does anyone know how old the Park Service will be?*

Slide 2– Historic photos showing how the Park Service has changed [The purpose of this *brief* presentation/discussion of how the Park Service has changed is to introduce the concept of change.]

The National Park Service is turning one hundred years old. *Do you think things are different today then they were in the parks one hundred years ago?*

- We've seen some big changes. (People come to the park by cars and planes more than horseback, steamboats, and trains; there are also many more people visiting the parks)
  [Click one– stagecoach at Yellowstone Hotel and early visitors with ranger on Morro Rock]
- And we've made some big changes (We actually used to *let* bears eat out of dumpsters and throw bonfires over cliffs in Yosemite!)
  [Click two– bear begging for food at Yosemite and wolf pelts from predator eradication program]

Example Transition: So the National Park Service is about to have our big birthday, what are some changes happening in your life—is anyone here celebrating a birthday this month?

Slide 3– Change: What does it mean to you? [Brief sharing session to discuss change—reinforcing that change is always happening—and introduce objective and subjective ways of looking at change]

Open brief discussion/sharing session with students.

- Change is important (The cells in our bodies are constantly changing. We're constantly learning and adapting…)
- Subjective lens, what makes change "good" or "bad" it's how you feel.
- Objective lens, just the facts that everyone recognizes without feelings (no good or bad, it's neutral).

Well the Park Service knows that (just like how things change as *you* get older) in our next hundred years there will be *a lot* of changes, and we want to be ready for them.

Transition to Slide 4: There's a really big change we're facing—so big the whole world is facing it, too. *Does anyone know what global change that might be?*

Slide 4 – Our planet's climate is changing.

Transition to Slide 5: Before we talk about how our climate is changing, we need to know what climate is.

Slide 5 – Weather and Climate: *Climate is what you expect.* [Explain climate by looking at different climates in California. Descriptions of each climate are written below but keep presentation of this section short. This section should just offer a sample of *climates.*]

What is climate?

- Is every place in the world the same? No, of course not. And one of the biggest differences between places around the world is *climate*, the patterns of temperature, precipitation, and weather that we expect—patterns that also define what kinds of plants, animals, and landscapes we see in an area.

So we can say, "*climate is what you expect*."

- And California is an awesome place to look at different climates, because it has so many! [Use questioning here to see what students already know about different climates in California. (If you were going on a vacation in the Pacific Northwest, what kinds of clothes would you pack with you?)]
    - ◊ **The Northern Coast of California** is pretty wet and green. Cold water from the north comes down the coast and makes it cooler.
    - ◊ Inland you'll find California's spine, a ridge of mountains called the **Sierra Nevada.** Elevation is higher here, and you'll find precipitation in the form of a lot of snow.
    - ◊ In the southeast corner of California, all of the moisture coming from the east has been dumped on the mountains. Here you'll find **deserts** where it is hot and dry.
    - ◊ And in California's **central valley** its also pretty hot and pretty dry, but not as hot and dry as the desert. And because the climate is mild—not too hot or cold, not too wet or dry—it's a really great place to grow food.
- Now which of these climates do you live in?
- And which climate best describes Sequoia and Kings Canyon National Parks?
    - ◊ [Click to reveal where Fresno, Visalia, and SEKI are.]

Transition to Slide 6: So climate is what we expect a place to be like (what we'd think about when packing our suitcase to go there), but do you think these places are *always* like that?

Slide 6 – Weather and Climate: **Weather is what you get.** [This slide shows that weather doesn't always do what "it's supposed to," but when we average weather, we get the patterns of climate.]

If climate is what you expect, weather is what you *get*.

- (Climate and weather is like personality and behavior. Maybe you have a friend who's really nice and talkative but on some days will get a little mood. Personality is what you expect, but behavior is what you get.)
- So here in the Central Valley, the climate tends to be hot and dry in the summer and mild and rainy in

the winter, but is that *always* true? Let's pull up some sample weather [Click one]

- Here is a week of weather for Visalia in January 2014. (Do you see any rain? I don't. This was during a drought when weather wasn't behaving the way we'd expect based on climate)

But when we look at weather does over the long term, and *average* it, we get back to the climate of _____.

- (And just like when you look at a person's overall behavior to get personality, here this is what we get.) [Click two reveals picture of Visalia]

Transition to Slide 7: Earth has it's own climate, global patterns of temperature and precipitation that we expect.

Slide 7– The Green House Effect [This brief explanation of Greenhouse Effect gives students the background knowledge needed to think critically later on.]

Earth has it's own climate. [click one reveals earth]

- And one reason ours is special compared to other planets because we have our own blanket of gasses that keeps us warm. *Do you remember what this blanket of gasses is called?* [click two reveals atmosphere]

Let's see how this blanket works.

- We get our heat and energy from what? The sun. [click three reveals sun and solar radiation]
- Some of this energy bounces off, and some of it escapes the blanket. [click five]
- But the rest get's trapped as heat [click six]
- Why do you think this trapped heat is important? It keeps us warm! [click seven]
- Our atmosphere does a great job keeping our current climate stable and warm.

Transition to Slide 8: Has Earth's climate always been like it is today? (No, there used to be a time where much of what's now the United States was covered in ice, a time when saber tooth tigers and wooly mammoths roamed.) *How do we know*?

Slide 8– Studying Earth's climate history [Give students a brief introduction to each of the sciences they will be exploring in the following activity. The names of each scientists aren't important as vocabulary words—they're just cool titles to get students excited about science]

We use science to study Earth's past climate.

- **Dendrochronology-** We can look at the growth rings in trees to see what their growth record says about how wet or dry climate was. [Click two- sequoia tree rings]
- **Paleoclimatology, ice core scientists-** We can drill *thousands* of years into the ice, and pull out ice cores with trapped air molecules that act like time capsules. [Click three- sampling ice in Antarctica]
- **Paleoclimatology, sediment scientists-** We can even read rocks to figure out what climate was like *millions* of years ago. [Click four- refrigerated sediment core storage room in Antarctica]

Transition to Slide 9/ Group Activity: Why do you think its important to use science to get the best picture of past climates? Science is really important to us in the Park Service, because we have important decisions to make and we need to base those decisions on the best science possible. That's why today you all are going to help us learn about climate change by participating in the first ever ***National Park Service Climate Science Symposium***!

Slide 9– Climate Science Investigation: *Group Activity (25 minutes for activity, 5 minutes for summit)*

- **Describe activity set up to students**
  - ◊ Each group must work together as a team
  - ◊ Each team will get a laminated "mission sheet" that describes their mission on the front and gives them the tools to accomplish it on the back. Tell students to take turns reading the mission sheet.
  - ◊ Each team has a worksheet and data set/sample (tree ring, ice core, or sediment sample). Instruct students to use their data set/sample and the information on their mission sheet to complete their worksheet
- **Break students into groups** and **assign each group** an ice core, tree-ring, or sediment mission.
- **Help students complete the activity.** [You may want to give the teacher the answer key so he or she can also help. If some groups finish first—e.g. the sediment scientists whose activity is a little easier— invite those groups to have a "conference" with their peers—e.g. other sediment scientists— and check that their results match before presenting to the larger scientific community—e.g. the rest of the class.]

- **Once the students are done with the tree ring and sediment missions. Bring them back together to do the ice core analysis together as a whole class. This will be Ranger led. Walk the students through the mission. Stopping to ask questions and checking for understanding throughout the mission.**

- **When students have finished with BOTH missions, facilitate a mock summit meeting (Slide 10)** in which each group of scientists debriefs the class on what they've learned. This make sure that all students are experts in two missions. Have students from tree-ring or sediment missions explain what they have found and possible reasons for the hypothesis on what has occurred.

MAIN QUESTIONS FOR EACH GROUP:

- ◊ **Dendrochronologists**: What did your tree-ring samples tell you about our climate history? How do you know that? What would you expect our future climate to look like?
- ◊ **Ice core scientists:** How far back in time does our sample go? What two main variables did we study? Did you notice a correlation between CO2 and temperature?
- ◊ **Sediment scientists:** How far back does your sample go? What did your sediment sample tell you about our climate history?

QUESTIONS TO BRING IT ALL TOGETHER

- ◊ What about these missions are so challenging?
- ◊ What are some of the major findings from our missions and summit?
- ◊ As Ice core scientists, we interpreted a graph of current CO2 levels. How high is CO2 today? What was the highest level of CO2 in your 400,000 years sampled? Is CO2 going up, down, or staying the same?
- ◊ Scientists: if CO2 is almost 400ppm today and is continuing to rise, what might that mean for our climate? What would you predict?
- ◊ What would you do if you wanted to predict what might happen next?
- ◊ How are these missions different? How are these missions similar?
- ◊ How can you connect all three missions together?

Slide 10—Continued

[**Adaptation when time allows:** Have each group make a thirty second "commercial," in which they argue why their research is important and why they should have more funding.]

Transition to Slide 11— One of the things that intrigues scientists the most right now is the speed at which climate is changing; as far as we know, it's never changed this fast before. Scientists: What would you guess is making our atmospheric blanket trap more heat? Right, CO2. Now why is CO2 higher now than ever before?

Slide 11 – The Green House Effect: How we are changing the atmosphere? [This slide reinforces the concept of CO2 as a greenhouse gas and shows how humans add more to the atmosphere.]

Carbon dioxide is an important gas in the atmosphere—it's great at trapping heat. We produce CO_2 by burning fuel. What can you think of that burns fuel to make energy?

- **Cars and busses** emit CO_2 as they burn fuel [Click one- Highway 99]
- **Most of our electricity** requires burning fossil fuel [Click two- power plants in China and Pennsylvania]
- What uses the sun and sucks of CO_2 to grow? Trees! So when we cut down trees to make room for our homes, industry, and farms, more CO2 gets into the atmosphere.
  [click three- **deforestation** in South America]
- **Almost everything** we use, from the food at the grocery store to the computers in your classroom had to be manufactured and delivered—and that also puts more CO2 in our atmosphere.
  [click four- airplane and supermarket]

Transition to Slide 12: What do we think would happen with more CO2? Let's see.

Slide 12 – The Green House Effect: What happens when we make our blanket thicker?
[Four clicks animate this slide. Back click to reanimate]

[1] Let's see what happens when we put more CO2 in our atmosphere, and make this blanket thicker.
[2] We still have the same radiation from the sun, except this time less of it can escape our atmosphere.
[3] More of it is trapped inside by the CO_2 and other greenhouse gasses.
[4] What do you think will happen? *The earth gets warmer.*

Transition to Slide 13: And that's exactly what scientists have found. While different climates around the world are undergoing their own unique changes, our whole planet is getting warmer. Let's look at these changes.

Slide 13– Connected by Change: Our neighborhoods, parks, and planet

[1] This map from NASA shows how climate is changing around the globe, where the darker the red is the bigger the temperature change is. Where is temperature change the most dramatic? *The poles*. And what would you find up at the poles? *Ice*.
[2] We have our own glaciers, snow, and ice in our parks. What do you predict will happen to our ice and

snow? It will melt faster and with more rain than snow.

[3] What might happen in forests if climate is warmer and drier? If there is less snow melt to keep the forest floor wet the risk for more frequent and severe forest fires will increase.

[4] How else might we be impacted by disappearing snow and ice? We rely on the slow melting snow and ice to release the water we need like a water tower. Without this ice and snow, we might have water shortages. (Students who have had watershed program will say ahah!)

[5] Besides using water to shower, cook, and drink, what industry here in the central valley uses a lot of water? **Agriculture.** How might agriculture change here? (Water shortages and unpredictable temperatures could stress crops.) How could it change around the world? (Maybe places that were once too cold to grow to grow food will now be warm enough.)

Transition to Slide 14: In the face of these changes, and knowing that the next two hundred years will be different still, the National Park Service is trying to make the best decisions it can. And we know that the best decisions come from the best science, that objectively paints the *truest* picture of what we face.

Slide 14– What we are doing at Sequoia and Kings Canyon National Parks

Sequoia Kings Canyon National Parks and the rest of the Park Service is collecting as much information as it can.

- [Click one] We're monitoring the health of our sequoias, the quality of our air, the timing of phenophases, and the frequency and intensity of our fires—to name a few things.
- [Click two] Then Sequoia and Kings Canyon Scientists come together—just like you did in your summit— to share results and think about what those results mean. (We run scenario planning sessions, where we try to predict what would happen for different scenarios. Volunteers come up to the park to help us with this monitoring.)
- Then it comes time for tough decisions. And after we've thought **objectively,** and gathered the facts, we can start to make **subjective** judgment calls. In a changing climate, we might only be able to "save" certain things. So we have to ask ourselves what do we care about the most? Giant sequoias? Our park access?

Transition to Slide 15/Conclusion: There's no right or wrong answer to these questions—we can be subjective and say one change is either good or bad, or we can be objective and notice that it's just *change*. Every generation has had its challenges to face. Many of *these* changes will be challenging to your generation.

What *is* awesome, is that *you* get to decide how to respond to these changes. *You* can make decisions. Y*ou* can find opportunities to adapt. *You* can help decide what the *next* hundred years of Earth's history looks like.

Slide 15– Change: You decide what it means to you.

And you can do that by thinking about change and deciding what it means to you.

[Potential Facebook forum activity]

We don't expect you to decide now. But what you can do is keep thinking about change, keep objectively searching for the truth about your world and discuss what you find with your friends and family. Once you've reflected on climate change, we'd love to know what you think. We're leaving your teacher instructions for posting your questions and thoughts on Facebook. We're excited to keep this discussion going. Thanks for having us today!

Discover Your Changing Climate

Rangers in the Classroom—*Additional Resources*

Post-visit Activity Primer

On the following page is a post-visit activity you can use to help your students reflect on the lesson. The activity asks students what they think about their changing planet and invites them to express their thoughts creatively. If you would like to share your students work, feel free to post to our Sequoia and Kings Canyon National Parks Facebook Page. You can also always contact us at SEKI_RITC@nps.gov.

Lesson Plan Vocabulary

Analysis— noun—the process as a method of studying the nature of something or of determining its essential features and their relations.

Adaptation—noun—a change or adjustment in structure or habits that allow a species or individual to improve its condition in relationship to its environment.

Atmosphere—noun—the whole mass of gas surrounding the earth

Change—verb—to make the form, nature, content, future course, etc., of (something) different from what it is or from what it would be if left alone.

Climate—noun—the average condition of the weather at a place over a period of years

Cryo—a combining form meaning "icy cold" or "frost"

Dendrochronology— the study of tree rings to reveal history

Greenhouse Effect—noun—warming of the surface and lower atmosphere of a planet that is caused by the conversion of solar radiation into heat in a process involving selective transmission and short wave solar radiation by the atmosphere, its absorption by the planet's surface, and radiation as infrared which is absorbed and partly reradiated back to the surface by atmospheric gases.

Hypothesis—noun—a tentative assumption made in order to draw out and test its logical or empirical consequences.

Objective—adjective—without bias or criteria , not influenced by personal feelings or opinions in considering and representing facts

Ology– noun— any science or branch of knowledge. The study of something.

Paleoclimatology—noun—the study of ancient climates

Phenology—noun– the science dealing with the influence of climate on the recurrence of such annual phenomena of animal and plant life as budding and bird migrations.

Sediment—noun—a material like sand, pebbles, or plant and animal matter

Subjective—adjective—based on or influenced by personal feelings, tastes, or opinions.

Weather—noun—the state of the atmosphere in respect to heat or cold, wetness or dryness, calm or storm, clearness or cloudiness.

Discover Your Changing Climate

Rangers in the Classroom—*Post Visit Activity*

Change: What does it mean to you?

Reflection Activity

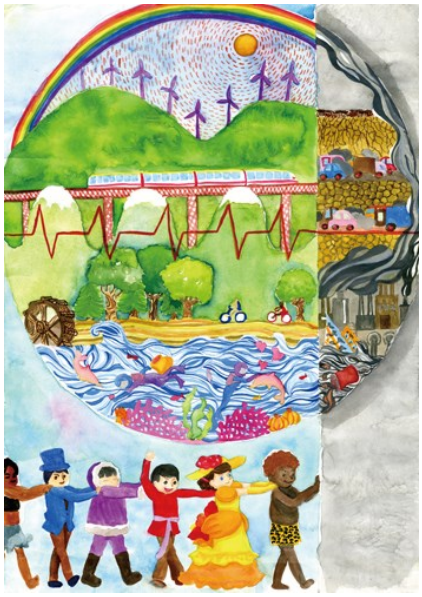
In our program, we talked about changes big and small—changes around the world and changes in your community, changes in our climate and even changes in *your life*.

WHAT DOES *CHANGE* MEAN TO YOU? The park rangers at Sequoia and Kings Canyon National Parks would love to find out. **Write a poem, song, or essay, draw a picture, take a picture**—whatever you need to do to express how you feel about our changing world. Need ideas? ***Check out our suggestions below:***

Write a letter to your future self—twenty years from now. What troubles you? What are you excited about? What will do you think the future be like? What do you want to make sure your future self never forgets?

My Future Self
20 years from now
Wherever I am

Draw a comic strip to show a friend or family member what change means to you. You could create a climate change super hero, or show how your feelings about climate change have changed. It's up to you!



Speak with art. A sixth grader in China made this artwork to express how she felt about "our cities, our life, and climate change." *What do you think the artist was trying to say?*

Now imagine you want to tell this Chinese student how *you* feel. **Draw your own picture to show what you think about your changing planet.**

UN 2011 World Habitat Day Children's Art Contest winner Chan Sze Beverly

Write a *cinquain*, a five-lined poem, about change. Use the format below, starting with change as your first line.

Line 1: "Change"
Line 2: Two words that describe "change" (adjectives)
Line 3: Three words ending with "ing"
Line 4: Four words, a phrase
Line 5: One word that gives "change" a new meaning (synonym)

Here's an example:

Change
Immense, intimidating
Looming, waiting, hoping
Look at it again
Opportunity