there once was an **island**
te **henua** e nnoho

educational packet

Dear Educators,

The documentary There Once was an Island: Te Henua e Nnoho has been a labour of love for us for over six years now and we're excited for students to hear the story of the unique community of Takuu atoll and its struggle with climate change.

We've attended many screenings of TOWAI, and each time audiences have been moved by Takuu's story and have reached a deeper understanding of climate-related problems. It is our hope that in watching the film, your students will gain an increased interest in and awareness of what's happening in the world around them.

In addition to watching the film, we want students to engage with the wonderful lesson plans created by curriculum consultants Amy Laubenstein and Laura Kudo. These are designed to create links between social and scientific processes and the impacts of climate change being experienced on Takuu and at home. Like everywhere in the developed world, America has a large carbon footprint. After completing these curriculum guides, we hope students will be better able to understand their own contribution to climate change and also how they can mitigate it.

The lesson plans are also designed to improve students' understanding of humanity and culture, and their own place in it. The Takuu community lead very different lives to those of us in the developed world, but their struggles – to hold onto their homes, livelihoods language and culture - have resonance for all of us.

We hope that you find There Once was an Island: Te Henua e Nnoho to be a perfect starting point for discussions and activities that link your students to the environment and communities around them, both those right on their doorsteps and those further afield. We also warmly welcome any feedback that you have to offer about the film and your students' responses to it.

All the Best,

There Once Was an Island Team

Briar March, *Director* & Lyn Collie, *Producer*
takuufilm@gmail.com

Dear Educators,

When we first viewed the movie "There Once Was An Island," we were struck by the plight of the Takuu – in particular by the immensity of the decisions they faced regarding their culture and traditions. These peaceful, thoughtful people exist almost in the eye of a metaphorical hurricane – with the winds, in the form of water, rising around them, threatening the very basis of their civilization.

When we embarked on the development of curriculum for this poignant film, we designed lessons that not only align with the US National Curriculum Standards, but we also strived to create provocative lessons that cause students to critically think about themselves as participating members of society, and how their small actions can lead to larger consequences or larger gains. We also attempted to have our students walk in the shoes of the Takuu. While our way of living is so different from theirs, it is important for students to understand that at our very core, we are all very similar organisms who depend on food, water, family and traditions for survival. The lessons are set up with a variety of activities and extensions. It is our hope for teachers to use either part or the whole lesson, whatever works best, in a given classroom.

It is up to us, as educators, to guide our students to higher levels of awareness, and this curriculum was developed for this very purpose: to critically analyze our actions, our previously-held beliefs and to see that we are ultimately part of a whole. Our smallest actions, and attempts to think and analyze situations critically, could bring about solutions for the greater good. These lessons are simply a beginning, and through them, we hope that you will find ways to incorporate thoughtful living through a smaller carbon footprint, as well as consideration for cultures that exist on a much different level and inspire your students to do the same.

All the Best,

Laura Kudo, MA & Amy Laubenstein, EdM
Edumentary Curriculum Consultants

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sea-level rise & saltwater intrusion

lesson one

grade level:

Grades 9–12

subject area:

Science (flora, salination, salt water intrusion, and adaptation), Math (conversions)

setting:

Classroom

national standards:

Science NS.9-12: .1.4.6
CO. Math Standards: 3,4,5

resources/links

noaa:

http://www.noaa.gov/ocean.html

national geographic:

http://ocean.nationalgeographic.com/ocean/critical-issues-sea-level-rise/

introduction/background

Our vast oceans conjure many different meanings to the myriad people around the world. To some, the ocean is a vast vacation destination. To others, the ocean is a fishery from which they are able to generate a livelihood. Still to others, the ocean is a distant, mysterious body of water that stretches out as far as the eye can see.

The oceans, which cover over 71% of the Earth and contain 97% of the planet's water, are an enormous resource to humans for food, travel, power generation, and with the depletion of usable, non-contaminated freshwater resources, as a potential source of usable freshwater. However, the salty waters of the ocean can be a challenge for terrestrial ecosystems. For, while many organisms are well-suited to living in and around saline coastal and oceanic environments, other organisms are not equipped to survive in these settings.

In the movie, "There Once Was An Island," you can see the many ways the residents on Takuu interact with the ocean. Activities that they use it for include bathing, swimming, fishing, and travel. The ocean is very central to their culture and identity but they use it in many of the same ways as many other people around the globe. However, because their island rises only about one meter above the highest tide, the resource they depend on for so much has also become a threat to their homes, their food supply, and their sustainable lifestyle as a result of rising sea levels and saltwater intrusion.

objectives

Students will gain an understanding, through discussion, of the science of saltwater intrusion, where it occurs throughout the world, why it is occurring for Takuu and why it is detrimental. Students will use conversions to understand the rate of sea-level rise over time. Students will study, through experimentation, how water affected by saltwater intrusion can affect living organisms in both positive and negative ways. Students will devise, through experimental design, a study that monitors the effects of saltwater on flora, and investigates the ability of particular plants to adapt to increased salinity.

key concepts

Climate change, sea-level rise, saltwater intrusion, adaptation, ability to survive in various environments, environmental change.

vocabulary

Saltwater intrusion, Giant swamp taro

warm-up (20 minutes)
a changing environment

Materials needed:

- Meter stick
- Calculator (optional)

In "There Once Was An Island," at the end of Chapter 2, there is a conversation between two of the Takuu men. One man asks his neighbor about his production of giant swamp taro, a plant used for food and in over 150 ceremonies among the Takuu people. He asks his neighbor if he is having a good yield, or supply. He then asks his neighbor for some giant swamp taro, since his crop has died. It has been affected by salt water intrusion.

Vocabulary minute:

intrusion

Synonyms: encroachment, invasion, impingement, disruption.

Definition: (v.) the act of intruding, the replacement of one resource by another.

Hypothesize about the meaning of "saltwater intrusion" based on the synonyms and definition above.

Salt water intrusion often occurs in coastal areas, where underground supplies of freshwater (commonly called groundwater aquifers) are depleted due to people's usage. As the volume of freshwater in an aquifer declines salt water from the ocean may leak into vacated space, including around wells that previously supplied freshwater to people. Freshwater is less dense than saltwater (since it contains less minerals), therefore it floats on top of the salt water. As space is evacuated within the aquifer, the heavier or more dense water pushes into the space to occupy any voids.

Pose the following questions to students:

1. What are the possible sources of freshwater for the Takuu people?
(Answers include: underground (underground aquifers), rainwater collection devices like tanks (this is where the majority of freshwater is obtained by the Takuu people) and coconuts.)

2. The island of Takuu has an elevation of only 1 meter above mean sea level, and the current average rate of global sea level rise is estimated at 0.14 inches (3.5 millimeters) per year (NOAA, 2011). Since most of the freshwater for the Takuu people is collected through rainfall and runoff from rooftops into tanks, and is not supplied from groundwater, why do you think the Takuu people are being affected by saltwater intrusion? *(Answer: Sea level rise due to climate change causes saltwater to intrude through the coral at the bottom of the atoll and into the freshwater lens or layer that sits below the soil and sand of the gardens. This freshwater normally floats above any sea-water. When the sea-water gets into the freshwater lens, salty water then gets into the bottom of the giant swamp taro pits and causes problems with the giant swamp taro growth.)*

3. If the rate of sea level rise remains constant at 0.14 inches or 3.5 millimeters per year, how much could the sea level rise in the next 5 years? In the next decade?

4. Calculate the amount of sea level rise in the next 5 years, then the next 10 years, and convert into meters to understand what fraction of a meter the ocean will rise. Using a meter stick, plot the rise over time. How long will it take the ocean to rise 1 foot? (304.8mm = 1 foot)

5. In Chapter 3, we travel to the garden island with Teloo Fakatutufenua where he shows us his garden, from which he harvests giant swamp taro. The giant swamp taro is intolerant of the saltwater. In areas where it once grew, there is now none. Teloo sadly says, "There is nothing we can do now."
Do you agree with this statement?

activity one (45 minutes)
salt effects on flora

When Teloo took us to his garden, not only was the production of giant swamp taro down in his plot, but there were areas that had become too salty for the giant swamp taro to even begin to grow. These brown, dead areas were looked at with frustration by Teloo and his family, and are a concern for the entire Takuu population.

To illustrate the effects of saltwater intrusion on the giant swamp taro, 3 different solutions with varying salinities can be used to model the impact.

*This activity can be done as a demonstration if there are not enough resources for each student, or the activity can be completed in groups to cut down on materials required.

Materials needed:

- Seeds for germination (4 per student)
- Containers for plants to grow in (4 per student)
- Potting mix or soil
- Salt
- Triple beam balance (a method for measuring mass)
- 4 x 1000mL beakers (or containers that hold 1L of water)
- Stirring rod (or spoon)
- Ruler
- 4 solutions with varying salinity levels (these levels can be determined by class or teacher, or use the following concentrations):
  - 1000mL (1L) water, 35g salt *(approximate seawater salinity)*
  - 1000mL water, 25g salt *(lower concentration, potentially has some inflow from a groundwater source or precipitation)*
  - 1000mL water, 15g salt *(lower concentration, potentially has inflow from a groundwater source)*
  - 1000mL water, no salt *(no saltwater intrusion)*

Procedure:

It will be very important for all conditions to be kept constant to see the effects of only the saline concentrations on the plants. Choose an area in the classroom that has consistent temperature and light. The only variable in the experiment should be the water given to each plant with varying salt concentrations. Everything else should remain controlled.

Procedure (continued):

1. If your container does not already have one, make a hole in the bottom to allow for drainage.
2. Fill each pot to the same level with soil.
3. Place a seed into each pot at the same depth (approximately 1 inch depth – consult seed package), cover with soil.
4. Label each pot according to the solution you will be watering it with each day (i.e. 35g/L, 25g/L, 15g/L, no salt).
5. Fill each beaker to the 1000mL mark, or use a 1 L bottle of water.
6. Using the triple beam balance, measure out 35g of salt, add to one container. Measure out 25g, then 15g, and add to other beakers. Stir until salt is dissolved.
7. Water plants with the same amount of water at the same time everyday or every other day, depending on the moisture content of the soil.
8. Record data in table (page 5), measuring height of plant once seed germinates as well as observations each day in table.

Conclusions:

What were the differences in plant height, color, leaf number, leaf size and other properties of the plant depending on the concentration of salt in the water?

Hypothesize about ways to reverse the effects of saltwater contamination – is it possible?

Extensions:

Continue the experiment, watering each plant with only freshwater. Are the plants that were previously contaminated by saltwater able to recover? Is there another substance that can be added to the water to improve the plant's vigor?

Using the internet or other resources, identify several plants that are tolerant of high salinty. Do these plants offer a possible solution to reduced food production due to increased soil water salinity for the Takuu people?

observations

seeds affected by solutions with varying salt concentrations

**Observations should be made everyday. Begin recording day when plant appears in at least one cup.*

	35g/L	25g/L	15g/L	no salt
Day _____: height/obeservations				
Day _____: height/obeservations				
Day _____: height/obeservation				
Day _____: height/obeservations				
Day _____: height/obeservations				
Day _____: height/obeservations				

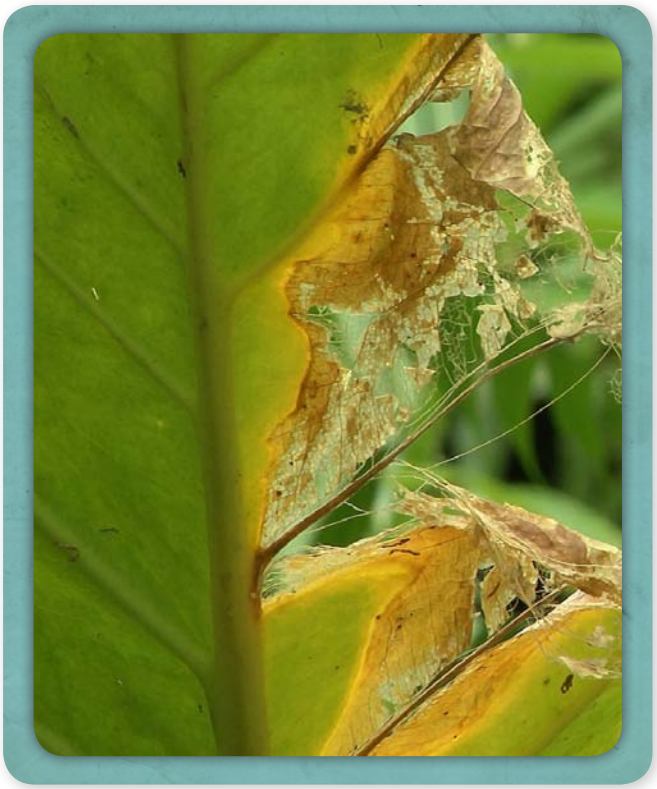
**Growth will vary based on temperature, seed type, and other factors. Experiment can be carried out for a longer period of time than 11 days.*

activity two (45 minutes)
adaptation over time

Some plants have adapted to living in a saline environment. For example, plants that live in estuaries are flooded by both saltwater and freshwater. These plants have adapted to survive in brackish water - water that is a mix of salt and freshwater - influenced by the push and pull of the tides.

Create an experiment with a plant or seed of your choice, watering it each time with a solution that has a slightly higher salt concentration than when it was watered previously. Be sure to contrast this growth with a control, or a plant that is watered with pure freshwater each time so that you can compare differences in growth. Monitor the growth of the plants over 10+ days. Was the plant watered with increasing amounts of salt able to adapt?

For more information on research concerning the growth of plants in a saline environment, visit the Society for Experimental Biology's article, "Salt of the Earth – How Do Plants Cope?" at: http://www.sebiology.org/publications/Bulletin/July05/salinity.html



community extension (20 minutes)
road/salt desalination

Students do not have to live in a coastal area to observe flora impacted by salt. In snowy regions, where snow plowing is a regular occurrence, many plowing operations drop salt on roads to cause the snow and ice to melt. While this allows communters a safer drive, the trees and shrubbery that line roadways often have a brownish hue to them, if they are not killed by the salt that washes from the roads. It is important to recognize, however, that some places and environments have naturally high salt levels. For example, an exceptionally large amount of salt occurs at the Bonneville Salt Flats in Utah, where little to no plant life grows.

Whether you live by the coast, in a temperate area that experiences so much snow that salt is used on the roads, or if you live in an area that has salt naturally occurring, you are impacted by salt in the environment.

To learn more about salt in the environment, more specifically in students' local environment, have students search "salt in the environment" and add their state to the search line to see how their state may be impacted by salts in the environment.

assessment (2 hours)
giant swamp taro case study

Read about the giant swamp taro, in a report published by Harley I. Manner at: http://www.agroforestry.net/scps/Giant_swamp_taro_specialty_crop.pdf

Based on the results from your experiments, develop a recommendation that you would give the Takuu people on how to deal with the loss of a plant that is central to their culture, the Giant Swamp Taro.

waves: energy for erosion

sea-level rise & engineering sea walls

lesson two

grade level:

Grades 9–12

subject area:

Science (oceanography, erosion, tides), Engineering, Experimental Design, Math

setting:

Classroom/community

national standards:

Science NS.9-12:.1.4.6
Technology NT.K-12: .1.2.3.4.5.6
CO. Math Standards: 1,2,3,5,6

resources/links

new york times:

http://www.nytimes.com/2011/10/26/nyregion/king-tide-to-raise-sea-level-on-atlantic-coast.html

noaa ocean data education:

http://www.dataintheclassroom.org/node

introduction/background

Waves have tremendous power to change coastal landscapes. Depending on their size and energy, waves can reshape entire coastlines - especially those composed of sandy beaches - in a relatively short period of time. Today, many people living at or near the coast are dealing with the problem of coastal erosion. While coastlines have always been shaped by ocean waves, we are now much more aware of these forces since it is desirable to locate homes, resorts, and infrastructure near the sea. But, despite our structures, ocean waves continue their shaping work, whether these forces occur in a way that we want them to or not.

In “There Once Was An Island,” the Takuu people notice the effects of rising ocean levels more keenly since they are located at such a low elevation, between mean sea level and 1 meter above it. Some of their kitchen buildings, located only a few paces from the edge of the sea, have been washed away during larger king tides - possibly the result of higher sea levels due to climate change. Takuu is an atoll, so the majority of wave energy is generally dissipated on the seaward edge of the reef, or jagged area of rock or coral located just below the surface of the sea, offshore of the island. However, when a king tide occurs, the water depth over the reef is sufficient to allow waves to pass over the reef flat and wash ashore, on Takuu. Wave action coupled with rising ocean levels, is a recipe for disaster for people located very close to sea level. Not only is the elevation of Takuu very low, there is no higher ground to move to.

objectives

Students will develop an understanding of engineering solutions through research of appropriate and inappropriate sea wall designs. Students will develop a recommendation for the Takuu people about how they can potentially protect the island of Takuu from the powerful erosive forces of king tides. Students will develop a critical eye for coastal protection structures and their effectiveness.

key concepts

Waves, wave energy, erosive forces, engineering of solutions through experimental design, sea wall construction

vocabulary

Wave, tide, king tide, sea wall, qualitative and quantitative observations.

warm-up (30 minutes)
think like an engineer

Positive and negative aspects of sea wall contruction.

Materials needed:

- Internet
- Worksheet

In “There Once Was An Island,” a scientist observes and analyzes the sea walls the Takuu people have built. He applauds their efforts, but also points out that the walls are actually adding to the problem of erosion of the island. He mentions some alternative measures that could be taken to prevent erosion, but also says that these are expensive steps to take.

How does a good sea wall prevent the sea from eroding land? Are there alternatives to sea walls that can be used to prevent shoreline erosion (construction measures, natural solutions)?

Before commencing Activity 1, students will do some research. By searching the internet for “sea walls,” “coastline protection structures” and “coastline erosion prevention” (and any other words they choose related to this subject), they will find different tried and tested (with varying levels of success) sea walls and other barricades that have been used in a desperate effort to prevent coastline erosion.

The construction of seawalls interferes with coastal processes acting on the coast, and will have consequences on the coast at and away from the structure. Using the table on the next page, have students take note of the positive and negative engineering aspects of sea wall construction. Then, view the portion of the movie where scientist Scott and Takuu-islander Satty are taking a critical look at the sea walls, how they are constructed, and their efficiency. After students complete their research, they will write a recommendation about how Takuu’s sea walls might be improved.

sea walls: postive & negative effects of shoreline erosion control

positive engineering techniques	negative engineering techniques
Example: curved sea walls dissipate and reflect wave energy back into the ocean	*Example:* smooth, vertical sea walls do not dissipate energy as efficiently

Based on my research, my recommendation to the Takuu people would be...

activity one (1 hour)
model the takuu sea wall

In this activity, students will build a model of a shoreline to understand how waves can shape a coast. Based on the movie, students will: a.) re-create the sea walls that the Takuu people have built to protect their island; b.) test the efficiency of the wall; and c.) look for ways to improve on this wall based on their research and recommendation from the warm-up exercise.

Materials needed:

- Clear (tupperware-type) container
- Sand
- Paint stirrer or block of wood (cut to about 5" in length)
- Water
- Toothpicks or other material to model Takuu sea walls
- String or glue
- 2 rulers
- Approximately 1 stick of clay
- Small houses made out of cardboard or cardstock
- Other materials of student's choosing to experiment with alternative wall or barricade methods

Procedure:

1. Fill one side of container with sand, mounding it to simulate the island, and sloping it toward the middle of the container.

2. Create a reef (about 4 inches in length) out of clay, approximately 2 inches from where the sand meets the bottom of the container. Build the reef such that, when you fill the container with water, the water line is just above the top of the reef.

3. Slowly add water to the opposite side of container (the side opposite the "island"), filling it until the sand is about an inch above the water surface.

4. Place small piece of clay on the bottom of the container, halfway between the "shoreline" and the side of the container that represents the open ocean, next to the side of the container (so it can be read). Place (0") end of ruler into clay, standing it upright, so that it is perpendicular to the bottom of the container, and serves as a measurement tool for water depth and wave height. Record the height of the still water.

5. Using toothpicks or small sticks tied or glued together, create a sea wall that models the Takuu sea walls. Place your sea wall into the sand, just above the water line.

6. Create houses (2-dimensional or if students are feeling creative, small cubes that represent 3-dimensional houses) out of the cardstock or cardboard. Place these in the sand just above the sea wall.

7. Measure the depth of the sand between the sea wall and the houses by sticking a ruler into the sand until it hits the bottom of the container. Record this depth in the table.

8. Hold the 5" paint stirrer or block of wood at the opposite end of the container – out in the ocean – and move it back and forth to create gentle, small waves. Create waves for 10 seconds.

9. Write down observations in the table, and again, measure the depth of the sand.

10. Add a half of an inch of water to the container to simulate higher water levels that occur during a "king tide." The term king tide is defined as an especially high tide caused by the alignment of the sun and the moon, resulting in an especially strong gravitational pull on oceans. Most wave-based damage on Takuu occurs during king tides, when deeper water allows waves to pass across the reef flat and to reach the island. Students will now model the effects of these higher king tides on the shores of Takuu.

11. Based on the research conducted in the warm-up of this lesson, and using other materials, reconstruct the sea wall, or create a different kind of barrier to see if the rate of erosion can be decreased.
*If sand becomes overly saturated, you may need to replace it with new, dry sand.

12. Record viable sea wall structures and/or changes made that decreased the rate of erosion on the island of Takuu.

takuu sea wall modeling experiment

Traditional sea wall:

Trial 1: *(typical wave action on the island of Takuu)*

Initial depth of water:

Depth of sand between sea wall and homes:

Description of sea wall:

Wave height: _____ *(for a duration of 10 seconds)*

Qualitative damage to shoreline:

Other qualitative and quantitative observations: *(i.e. Where did the sand go? Did the depth of the sand on the bottom of the "ocean" change, etc.)*:

Trial 2: *(larger waves)*

Initial depth of water:

Depth of sand between sea wall and homes:

Description of sea wall:

Wave height: _____ *(for a duration of 10 seconds)*

Qualitative damage to shoreline:

Other observations:

Re-vamped sea wall:

What changes did you make to the existing structure?

Trial 1: *(smaller waves)*

Initial depth of water:

Depth of sand between sea wall and homes:

Description of sea wall:

Wave height: _____ *(for a duration of 10 seconds)*

Qualitative damage to shoreline:

Other qualitative and quantitative observations:

Trial 2: *(larger waves)*

Initial depth of water:

Depth of sand between sea wall and homes:

Description of sea wall:

Wave height: _____ *(for a duration of 10 seconds)*

Qualitative damage to shoreline:

Other observations:

Based on your qualitative and quantitative observations and the changes you made to the existing sea wall built by the Takuu people, what conclusions can you draw?

community extension one

To have students read and understand more about king tides, visit this link to an article in the New York Times:

http://www.nytimes.com/2011/10/26/nyregion/king-tide-to-raise-sea-level-on-atlantic-coast.html

community extension two

Visit the NOAA Ocean Data Education (NODE) Project's website (http://www.datainthecclassroom.org/content/sea-level/tide-model.html) where students can model the rise and fall of tides along the seashore, increasing wave amplitude, viewing the effects of a storm surge, increasing wave frequency as well as creating other variations that show the impacts of greater and smaller volumes of water.

activity two (1 hour)
presentation of sea wall solutions

Armed with research from the Warm-Up, as well as simulations from Activity 1, it is time for students to present findings to the scientific community. While the root of the problem in this real-life scenario is climate change and the increased wave energy reaching the shores of Takuu, the immediate reaction of the island people is to try to live, adapting to their new environment, which includes higher tides, increased erosion, and what appears to be a disappearing island.

Pose the following question to students:

What recommendations would students make to the Takuu people, and what proof do they have that the solutions presented will allow villagers to sustain life on their island?

Students will develop a presentation that will be submitted to an engineering board (the class) that states the direction the Takuu people should take with regard to the sea walls that are already in existence. The presentation should consider how they can be improved upon, the costs and benefits associated with these changes, and why their wall would be a viable solution.

community extension three (45 minutes)
support structures in your community

Walls of all kinds are used throughout the country to support and create artificial boundaries on land and also to prevent water from going where we do not want it to go (dams, dykes, etc.). As students travel around their community, how many walls do they see that are created in an attempt to support or even change the environment? How would students assess the condition of these structures based on the knowledge gained?

assessment (20 minutes)
coastline erosion: make a recommendation

Students will develop a recommendation for the woman in the picture below. This woman is looking to take steps in an effort to control coastal erosion and prevent her home from being washed into the ocean. Picture taken from: http://www.msnbc.msn.com/id/17042910/ns/world_news-world_environment/t/coastlines-frontline-warming/

climate change: causes, effects, & solutions

climate change & greenhouse effect

lesson three

grade level:

Grades 9–12

subject area:

Science (climatology, atmospheric science), Environmental change (carbon production, global climate change, sea level rise, greenhouse effect)

setting:

Classroom, community

national standards:

Science: NS.9-12.4.6
Technology NT.K-12: .1.2.3.4.5.6
CO. Math Standards:1,2,3,5

resources/links

environmental protection agency:

http://epa.gov/climatechange/glossary.html

nasa global climate change:

http://climate.nasa.gov/causes/

zerofootprint kids calculator:

http://www.cooltheworld.com/kidscarboncalculator.php

noaa:

http://oceanservice.noaa.gov/facts/sealevel.html

introduction/background

Climate change is literally and figuratively a hot topic today, with many people, from scientists to politicians, arguing over scientific studies pointing to possible causes and solutions. Some people claim this phenomenon is a myth, while most others claim it is a real and present danger to all organisms. If you ask anyone on Takuu they would tell you that climate change is a real threat to their culture, their homes and their lives.

Climate change is defined, according to the Environmental Protection Agency (EPA) as, “any significant change in the measures of climate lasting for an extended period of time. In other words, climate change includes major changes in temperature, precipitation, or wind patterns, among others, that occur over several decades or longer.” Many scientists would agree that climate change occurs naturally, that our planet goes through natural warming and cooling cycles. However, the unprecedented acceleration in the rate of climate change is a function of another scientific phenomenon that contributes to global warming, known as the greenhouse effect.

The greenhouse effect is defined, according to the EPA, as the trapping and build-up of heat in the atmosphere (troposphere) near the Earth’s surface. Some of the heat flowing back toward space from the Earth’s surface is absorbed by water vapor, carbon dioxide, ozone, and several other gases in the atmosphere and then re-radiated back toward the Earth’s surface. If the atmospheric concentrations of these greenhouse gases rise, the average temperature of the lower atmosphere will gradually increase.

objectives

Students will become familiar with the greenhouse effect and understand what a carbon footprint is. Students will gain an understanding of what their contribution to the greenhouse effect is and steps that can be taken to reduce individual and community or school emissions. Students will model sea level rise & understand what landforms are contributing most to this phenomenon.

key concepts

Carbon footprint, emissions, global warming

vocabulary

Climate change, greenhouse effect, water vapor, carbon dioxide, methane, nitrous oxide, chlorofluorocarbons, fossil fuel

warm-up
global climate change discussion

What are the factors contributing to the greenhouse effect? Send students to NASA's website devoted to Global Climate Change: http://climate.nasa.gov/causes/

When students have completed the reading, list causes of climate change either as a group, or individually.

When students have compiled a list of the contributing factors (water vapor, carbon dioxide, methane, nitrous oxide, chlorofluorocarbons), begin a discussion about which of these factors students contribute to on a daily basis. An example would be: I drove to school today. Then, ask students to think of ways that they could reduce their contribution to the problem of the enhanced greenhouse effect. An example would be: I could walk or cycle to school, or I could carpool with friends.

activity one (30 minutes)
calculate your carbon footprint

Students will log into the Zerofootprint Kids Calculator at http://www.cooltheworld.com/kidscarboncalculator.php to determine what their contribution is to the problem of global warming. They will assess their fossil fuel usage through a series of questions that take them through a typical school day.

Then ask students to think like a student of the same age living on Takuu. Ask students to go through the carbon calculator, walking in the shoes of a student on Takuu. Was there a difference in the carbon footprint created by themselves and the student on Takuu?

After students have completed the assessment, refer back to the list of contributing factors compiled in the warm-up to tie their activities to the greenhouse gases that are produced through their activities. What are some of the potential benefits for people in low-lying areas if people in the developed world reduce their greenhouse gas emissions?

activity two (20 min set-up, 2 hrs observing)
model sea-level rise

In this activity, students will model the effects of sea-level rise due to rising global temperatures causing the heating of the oceans (and consequential expansion) and the melting of land-based ice formations (rather than ice that is found in the ocean (i.e. icebergs)).

After looking at the causes of global warming through the build up of greenhouse gases, it is time to look at the effects of rising temperatures around the globe.

Pose the following question to students:

Do students think the sea level is actually rising? The Takuu people do, but when you live at such a low elevation (1 meter above sea level), it is easy to see differences in water level. If you live in a land-locked state, you may not be as aware of these large-scale changes.

Begin by having students visit NOAA's website entitled, "Sea level is rising at an increasing rate" (http://oceanservice.noaa.gov/facts/sealevel.html).

Pose the following question to students:

Why is the level of the sea increasing only as a result of ice that is found on land, rather than ice found in the oceans?

Materials needed:

- Two clear cups
- Water
- Ice cubes – freeze the night before with food coloring (ice cubes represent floating ice and land bound ice)
- Salt
- Triple beam balance (a method for measuring mass)
- Clay
- Sharpie

Procedure:

1. To make sea water, measure out 35 grams of salt, add to 1000mL of water. (This is the approximate ratio of salt to water in sea water – more sea water may have to be made for larger class sizes.)

2. Give each student (or group) 2 clear, plastic cups.

3. Give each student a golf ball sized piece of clay.

4. In one cup create a "mound" out of clay and affix as much as possible to the bottom of the cup. Flatten the top of the mound so it can support an object (ice cube). This cup will be representative of land-based ice. Place an ice cube on top of the mound.

5. In the other cup: place 1 ice cube.

6. Fill each cup with the exact same amount of sea water.

7. Mark the height of the water on outside of each cup with Sharpie. *Students now have a cup that models just the ocean with ice floating in it, representative of an iceberg, and a cup with land in the middle of it, representing land-based ice.

8. Place cups in a location with a similar environment (next to a window and receiving sunlight or in a dark corner).

9. Leave cups until both ice cubes melt.

10. Draw a line at the new level of the sea.

11. Take note of the location of the layer of freshwater (colored water) and the layer of ocean water (clear).

Pose the following questions to students:

1. Based on your model, what did each part represent?
   a. Ice cubes: (in each cup) *(land-based ice (on clay) and water-based ice (floating))*
   b. Saltwater: *(sea water)*
   c. Mound of clay: *(land)*

2. How did your initial water line compare with the water line drawn after the ice melted in each cup? *(Water line will rise in cup with land-based ice, will remain relatively the same in water-based ice.)*

3. Why was the colored water located where it was after the ice cube melted? *(Sea water is slightly more dense than freshwater, so the freshwater remains more at the top of the water line.)*

4. Based on your model, as worldwide temperatures rise, what will contribute more to overall sea level rise – land-based ice, or ice floating in the ocean? *(land-based ice)*

5. What activities do you participate in that accelerates the rate of land-based ice melt? What can you do to reverse this trend? How can you convince others to reverse this trend? How might these changes impact what's happening on Takuu and in other low-lying or coastal areas?

community extension (30 minutes)
greenhouse gas production in the school or community

Students can record all contributors of greenhouse gases they see in their school over the course of one day. How could your school cut down on the amount of carbon it emits into the atmosphere?

Break students into groups to investigate different parts of the school: cafeteria, principal's office, gymnasium, etc. to make a list of all factors contributing to the burning of fossil fuels, the greenhouse effect and subsequently, climate change. Then, develop a solution for how to reduce, or eliminate this usage.

assessment (15 minutes)
rising ideas

Armed with your knowledge of global warming, interpret the cartoon above, including the irony depicted in the drawing. Why is this kind of "solution" not going to work for the Takuu community?

Image found at:
http://masg.org.au/2010/12/dec-16th-newsletter/

anthropology of a people
culture & tradition

lesson four

grade level:
Grades 9–12

subject area:
Science (anthropology), Language Arts, Current Issues, Debate

setting:
Classroom, school library

national standards:
Social Studies NSS-C: .1 – .6 .9.10
Language Arts: NCTE.IRA 1, 3, 4, 6, 7, 8, 9, 12

resources/links

sweden:
http://www.sweden.se/eng/Home/Society

wikipedia:
http://en.wikipedia.org/wiki/Egalitarianism

types of societies:
http://web.mesacc.edu/dept/d10/asb/anthro2003/glues/societyintro.html

convict creations:
http://www.convictcreations.com/culture/egalitarianism.html

kwintessential:
http://www.kwintessential.co.uk/resources/global-etiquette/netherlands.html

seattle times:
http://seattletimes.com/html/opinion/2002516538_sundayfinland25.html

introduction/background

Culture and tradition are part of every society and ingrained in the unique fabric of each civilization. For instance, the people of Takuu have an active inventory of more than a thousand songs that some can sing from memory; songs passed down from generation to generation. Islanders spend 20 to 30 hours each week in group singing and dancing. Storytelling is also part of a strong island tradition. The songs and stories celebrate Takuu culture and traditions, familial relationships and the bonding of island people, voyages between islands, and the spiritual link of the Takuu people with their ancestors in times of personal need or emergency. Not only are the rhymes and themes original, but the sound and rhythms are also unique within the Polynesian Triangle. It is thought that the retention of these songs is directly linked to the isolation of the island and its peoples.

Not only do the people of Takuu place great value on their songs, but also the retention of their indigenous practices and religious sites and ceremonies. To protect Takuu from outside influences, the Ariki (chief) banned Christian missionaries in the 1970's. The ban was lifted only in the last ten years, as young islanders who had lived and studied on the Papua New Guinea mainland returned to their homeland. A number of churches have now been established on Takuu. This could be a point of discussion/debate. How does the introduction of an outside and competing religion affect the Takuu people, their culture, and traditions? The participation of teenage students in off-shore education and church activities is probably contributing to the decrease in the numbers of people practicing traditional religion and culture, including dances and songs. There is now a strong church presence on the island and women in particular are adherents to the various denominations. However, traditional life does continue to this day on Takuu. Traditional thatched houses stand in crowded rows, so close to each other that the eaves almost touch. There are few trees on the island apart from coconut palms, and the main street serves as a marae, a space for ritual activities. There are five clans on Takuu and one paramount chief (Ariki). Everyone on the island is closely related, usually more than once, especially if marriage or "in-law" ties are counted. There are strict cultural rules about who a person can marry, according to clan membership.

This lesson will also investigate the phenomenon of egalitarian culture. According to Webster, this is "...advocating full political and social equality for all people." Anthropologists think about egalitarianism in a similar but different way. They classify a society according to how much access to power, prestige or resources different groups in the society have. Egalitarian societies downplay these differences so they become insignificant. Takuu, Australia, and many Scandinavian countries embrace this concept, particularly within their governmental and social fabric. The question then arises...considering how closely this definition applies to our constitution, does the United States embrace egalitarianism? How little? How much?

objectives

Students will understand key concepts and terms listed below; Students will define and investigate egalitarian culture; Students will participate in formal debate.

key concepts

Importance of culture and tradition, egalitarian societies.

vocabulary

Anthropology, culture, tradition, egalitarian, subsistence lifestyle.

warm-up
what is anthropology?

Step 1: Define the term "anthropology" for the class.
(n.) an·thro·pol·o·gy / Show Spelled [an-thruh-pol-uh-jee]

1. The science that deals with the origins, physical and cultural development, biological characteristics, and social customs and beliefs of humankind.

2. The study of human beings' similarity to and divergence from other animals.

3. The science of humans and their works.

Step 2: Watch the movie "There Once was an Island". Tell the students they are "anthropologists" during the movie, and you want them to take special note of any mention or evidence of culture or tradition in the movie.

activity one (1 – 2 hours)
culture & tradition

What do you know?

Materials needed:

- Magazines (that can be cut up)
- Large poster paper
- Glue
- Markers
- Computer access

Let's find out what our students know about culture and tradition. Without prior prompting about the definition of these words, hand out various magazines (recommended: National Geographic, Newsweek, Time) and ask the students to cut out pictures that depict cultural practices and traditions. Have the students then bring their pictures together and create one giant collage of culture and tradition. Ask them to explain why they chose their pictures. Decide as a class on your official definition of "culture" and put it at the top of the collage. (pictures could include dance, traditional costume, body painting or tattoo, architecture, religious ceremony, language, art, food, etc.) Display this artwork of "culture & tradition" in the classroom.

activity two (1 hour)
egalitarian culture

Ask the students what specific facts they learned in the movie about the culture and traditions of the Takuu people. List these on the board. Then focus on the definition of "egalitarian culture". Discuss what this means. Have the students use classroom resources (dictionary, encyclopedia, online search engines) to define egalitarian. Then have students do online research and take notes on other egalitarian cultures and countries (see list of web-sites). Divide the class into teams of 4 and ask them to share their research notes within each team. Ask each team to create a pros and cons list regarding egalitarian cultures.

Have each team present their pros and cons to the class. Create a master list of pros and cons. Ask the students to create an "Egalitarian Grade Card" for countries. What grade would they give the United States?

community extension
our community culture

Ask the students what culture and traditions are present in your community. How are these important to their everyday lives? Discuss with students that culture is not simply traditional or "high culture" – everything that we say, make, use and much of what we do is part of culture in an anthropological sense. (*"Culture, or civilization, taken in its broad, ethnographic sense, is that complex whole which includes knowledge, belief, art, morals, law, custom, and any other capabilities and habits acquired by man as a member of society."* (Tylor 1958 [1871]: 1) Culture is living and changing all the time. Ask students to consider what they like most about their own culture/s – food, movies, art, books, songs, dance, clothes, slang, things they do together (for example -hanging out is a strange cultural phenomenon from a non-western perspective!) and anything else you can think of that might be relevant. Have them list and even investigate ways that they personally might keep these cultures and traditions alive. Finally, ask students to reconsider the cultural aspects they originally noted on Takuu. What more could they include in the list? What activities did they see which are helping the Takuu community to preserve their culture? *(Answers include but are not limited to – Teloo training the children in dancing, performances at the school concert, house-building, construction of out-rigger canoes, gardening.)*

assessment (1 – 2 hours)

Divide the class in two debate teams; one team to debate the pros of an egalitarian society, the other team the cons. Use the classroom debate worksheet on page 19 to structure the debate.

Debate assessment:
http://myweb.lmu.edu/tshanahan/nt-debatescoring.html

debate

Debate Roles: *(Source:http://web.archive.org/web/20060503194518/http://w3.tvi.edu/~cgulick/roles.htm)*

Opening Statement Presenter:

Gathers the main arguments into an introductory statement. Does not give specific information; just says "this is true because of A and B and C."

1. _____

Topic Presenters:

Present the main arguments for the team. Each presenter gives specific details that prove A and B and C.

1. _____

2. _____

3. _____

Rebuttal Presenters:

Answer the arguments of the other team. These presenters must take notes as the other team is presenting their arguments and respond to every argument, using specific information to disprove them.

1. _____

2. _____

Closing Statement Presenter:

Presents the closing arguments for the team. Repeats the main idea for this and this and this reasons.

1. _____

Debate Rules:

1. No put downs.
2. You must raise your hand if it's not your time to speak.
3. Teams lose 1 point for each interruption.
4. Teams lose 1 point for whispering when another speaker is talking.

Time:

Opening statements for both sides = 3 minutes each
Arguments for both sides = 3 minutes each
Rebuttal conference = 1 minute
Rebuttals = 2 minutes each
Closing statements for both sides = 3 minutes each

how would you feel?
transplant & relocate

lesson five

grade level:
Grades 9–12

subject area:
Science (Anthropology), Language Arts, Current Issues

setting:
Classroom, community

national standards:
Science NS.9-12: .1.4.6
Language Arts: NCTE.IRA 1-7, 9, 12
Social Studies (Civics) NSS-C.9-12: .1
Science (Geography) NSS-G.
K-12: .1.2.3.4.5.6

resources/links

fountain valley high school spilled ink:
http://fvhswritersblock.weebly.com/creative-writing-rubric.html

wikipedia:
http://en.wikipedia.org/wiki/Takuu_Atoll

ecology global network:
http://www.ecology.com/2012/03/05/effects-sea-level-rise

bookrags:
http://www.bookrags.com/articles/5.html

introduction/background

It is sometimes difficult to think about people and cultures on the other side of our country, let alone on the other side of the world. Miles, oceans, climates and general topography separate us from our global neighbors. The island of Takuu can seem very far away, particularly to a young person who has never been to that part of the world. Takuu is the ancestral home to 600 Polynesian people living a subsistence lifestyle that draws significantly on the sea. It is part of Papua New Guinea and 250 kilometers north-east of Bougainville. Its position is 4°45'S 157°2'E / 4.75°S 157.033°E / -4.75; 157.033. Takuu is made up of a string of islets on a reef around a central lagoon, also known as an atoll. The people live on an islet called Nukutoa which has two sections, known locally as Taloki and Sialeva. The largest island in the atoll is just next door, and is known as Takuu. This is where the giant swamp taro gardens are. Takuu is the southernmost and largest of the islands on the eastern side of the atoll. The atoll consists of 13 islets with a combined land area of less than a square kilometer (.38 sq. miles), none of it now more than one meter (3.3 feet) above mean sea level. Local rise in sea level has been noticed by the people of Takuu and by Richard Moyle, an anthropologist who has been visiting for the last two decades. The Takuu people have experienced significant effects of salination in their gardens, and the islanders increasingly supplement the local giant swamp taro in their diets with rice purchased from off the island.

objectives

Students will learn the definitions of latitude and longitude; Students will locate specific sites on a map; Students will investigate the geography and geology of a specific place; Students will use the creative writing process to express an idea or thought.

key concepts

Latitude, longitude, atoll, archipelago, transplanted societies, academic writing

vocabulary

Papua New Guinea, Mortlocks, Nukutoa, atoll, archipelago, island, topography, latitude, longitude

warm-up

Watch the film, "There Once Was An Island".

activity one (2 – 6 hours)
where is takuu?

Materials needed:

- Atlas
- Classroom computer

Ask the students to find Takuu on a physical map or atlas; find it on Google Earth; and find it using one other resource. Have the students fill out the fact sheet on page 26 about Takuu and its location.

activity two (2 – 6 hours)
say goodbye

Materials needed:

- Journaling materials

Ask the students how they would feel if they were told that they needed to leave their home, their culture, and the only way of life they have ever known. Putting themselves in the place of a Takuu boy or girl of their same age, have them create a series of journal entries beginning with the day they are told they must leave, to the day that they enter their new school and life. (About 7 entries in all.) Keep in mind the scene where the young man (Jack) is told by his parents that he must now go to school, get a job, leave the life he has always known. The journal entries can include words, poems, drawings, etc. Be as creative as you can!

Have the students share some of their entries. Make a list of words that come up in student entries more than once (like scared, mad, upset, etc.)
If the literature extension is completed, compare words that stand out from the book *Walk Two Moons* and the list prepared above.

Ask the students to imagine moving to an urban area if you are located in the suburbs or country, or vice-versa. Lead a class discussion on how their every day lives might be different. How would they get to school; spend their free time; etc.?

literature extension (1 – 2 hours)

Materials needed:

- Book: *Walk Two Moons*

Have the students read the book *Walk Two Moons* by Newbery Medal winning author Sharon Creech. One of the main themes of the book is cultural identity. Ask the students to compare and contrast the main characters feelings (Sal) of being transplanted to their perceived ideas of the feelings of the Takuu islanders, in particular the young people.
Lead a class discussion about these feelings, and how this contributes to a universal theme.
Academic Writing: Have the students write a compare/contrast essay. Use this as part of the assessment.
Source for Essay: http://www.bookrags.com/articles/5.html

community extension (1 hour)
newcomers to our community

Now ask the students to find your city or town on a physical map or in an atlas; find it on Google Earth; and find it using one other resource. Ask them to think about groups of people in your community that might have had to leave another home and life. You may have students right in your classroom that have personal experience with this. Lead a class discussion on how this affects these people, and what a community can do to welcome them in. What can you do right there in your own school?

assessment

Using your standard classroom creative writing rubric, grade the journals on content and creativity. (See example for rubric on page 27.)

finding takuu & nukutoa

1. What is the exact latitude and longitude of Takuu?

2. To what country does Takuu belong?

3. What is the capital of this country? Where is it located?

4. What continent is this country located in?

5. Define atoll. Name the bodies of water surrounding the Takuu atoll.

6. Name the bodies of water surrounding the country.

7. Define archipelago. Name an archipelago nearby.

8. Name at least two other groups of islands nearby.

9. What are the main resources of this country? Of Takuu?

10. Explain the geologic origin of these islands.

creative writing rubric

A gleam in a Publisher's Eye! (5 points)	**Almost ready for publication** (4 points)	**A work in progress** (3 points)	**A gleam in your eye** (2 points)
Captures reader's attention from first riveting sentence, paragraph, or line; reader cannot help but continue reading.	Gets reader's attention with first sentence, paragraph, or line, drawing reader into rest of piece.	First sentence, paragraph, or line lacks dramatic tension necessary to draw reader into piece; reader may not keep reading.	First sentence, paragraph, or line lacks dramatic tension and contains a cliché idea/image (or worse, no ideas or images).
Dazzles reader from beginning to end through original & interesting use of ideas, language, plot, character development, dialogue, imagery, etc. Contains no clichés or stereotypes	Interests reader most of the way through the piece because of mostly original and interesting use of ideas, language, plot, character development, imagery, etc. Contains few clichés or stereotypes.	Offers little originality in ideas, language, plot, imagery, etc. May contain many clichés and/or ste-reotypes. Reader may lose interest..	Lacks originality in ideas, language, plot, imagery, etc. Filled with clichés and/or stereotypes. Reader will not get past first few sentences or lines.
Possesses a startling dramatic tension that keeps reader riveted -- possibly, grounded in a significant problem, dilemma, or paradox that needs to be addressed and gets reader involved.	Possesses a dramatic tension that keeps reader reading--possibly, grounded in a problem, dilemma, or paradox that needs to be addressed.	Lacks dramatic tension necessary to keep reader reading; problem, dilemma, or paradox presented may seem trivial. Reader is detached from work.	Lacks dramatic tension; fails to present problem, dilemma, or paradox. Writer may seem as uninterested in the work as the reader no doubt will be.
Although challenging and perhaps not easily understood, work has a clarity that leaves no surface questions (i.e. "What happened in this part?") in reader's mind.	Has a clarity that leaves few surface questions (i.e. "What happened in this part?") in reader's mind.	Leaves several surface questions (i.e. "Why is the character named Myrtle on page 1 and Jill on page 4?") in reader's mind.	Is downright murky because of significant & unintentional gaps or contradictions in logic, plot, character, imagery, voice, point of view, setting, etc.
Contains no errors in grammar, its usage, or mechanics (unless used for artistic purposes)	Contains few minor errors in grammar, its usage, or mechanics (aside from those used for artistic purposes)	Contains many and/or serious errors in grammar, usage, or mechanics; may interfere with reading.	Contains so many errors in grammar, usage, and mechanics that errors block reading.

can you make a difference?
climate change & greenhouse gases

lesson six

grade level:
Grades 9–12

subject area:
Science (Climatology), Language Arts, Current Issues, Technology

setting:
Classroom, home

national standards:
Science NS.9-12: .1.4.5.6
Technology NT.K-12: .1.2.3.4.5.6
Language Arts: NCTE.IRA 1,2,3,6,7,8,9,12
Social Studies (Civics) NSS-C: .3

resources/links

there once was an island:
http://www.thereoncewasanisland.com/what-you-can-do/

epa:
http://epa.gov/climatechange/ghgemissions/

noaa:
http://www.ncdc.noaa.gov/oa/climate/gases.html

the greenhouse effect:
http://www.ucar.edu/learn/1_3_1.htm

global climate change:
http://epa.gov/climatechange/kids/basics/today/carbon-dioxide.html

introduction/background

When the sea covers the land with water, the consequences are devastating – for both people and nature. This century, an estimated eight million people will have to abandon their homes along the coasts of the 1200 largest islands in South-East Asia and the Pacific Region if global sea levels rise 1 meter. According to researchers, this is the minimum sea-level rise (SLR) we can expect (D. Kissling). It is now widely accepted that SLR due to climate change is real. The International Panel on Climate Change's most optimistic calculations predict a minimum rise of 38 cm (1.25 feet) by 2099. But according to Dasgupta et al in World Bank Policy Research Working Paper 4136, "The impact of sea level rise on developing countries: a comparative analysis," the continued growth of greenhouse gas (GHG) emissions and associated global warming could well promote SLR of 1-3m (3-10 feet) in this century. The most pessimistic scenarios would have GHG emissions and ice shelf melting passing a tipping point and resulting in a rise of five metres (15 feet). Many low-lying regions of the world have cause for concern. The Papua New Guinea (PNG) Carteret and Takuu Atolls are among several Pacific islands to be severely affected by salination of their aquifers and increased tidal storm damage.

How are the carbon cycle and climate change related? "The atmosphere isn't the only part of the Earth that has carbon. The oceans store large amounts of carbon, and so do plants, soil, and deposits of coal, oil, and natural gas deep underground. Carbon naturally moves from one part of the Earth to another through the carbon cycle. But right now, by burning fossil fuels, people are adding carbon to the atmosphere (in the form of carbon dioxide) faster than natural processes can remove it. That's why the amount of carbon dioxide in the atmosphere is increasing, which is causing global climate change." (Environmental Protection Agency. (2012). A students guide to global climate change. Updated September 12, 2012, from http://epa.gov/climatechange/kids/basics/today/carbon-dioxide.html)

objectives

Students will learn how to take effective notes; Students will investigate the concepts of greenhouse gases and climate change; students will be informed on current issues related to climate change; Students will participate in an exercise to reduce greenhouse gases.

key concepts

Greenhouse gases, climate change, cause & effect, carbon cycle

vocabulary

sea level rise, greenhouse gases, climate change, king tide, carbon cycle

warm-up
climate change

Materials needed:

- Notebook
- Plastic sleeves for paper
- Note-taking supplies

Ask the students to review what they know about the carbon cycle, greenhouse gases and the direct affect with climate change. (If this is a new concept in your classroom, they may want to look at a few of the online resources listed under resources/links. This is not a full investigation, but rather a way to begin to build background knowledge.) Make a class list of relevant points. Watch the movie "There Once was an Island". Ask the students to specifically take note during the movie of evidence of direct affect of climate change.

activity one (2 – 3 hours)
climate change resources

Have the students work in teams of two. Ask each team to review their notes taken during the movie. Now have the students do an in-depth investigation on the carbon cycle, greenhouse gases and climate change, and take team notes on key points and issues, especially those related to the effects they viewed in the movie (see sources in resources/links). Ask the students to widen their online search to sources beyond those listed, and to record and print as much information as they can. (There are example web-sites listed in the reference section.) Be sure to print two-sided!

activity two (2 – 3 hours)
greenhouse gas news!

Ask each team to type up their greenhouse gas notes in a thorough, bullet-pointed list. Ask them to also compile any pertinent photos, graphs, illustrations, etc. that they printed during their research. Ask the students to create a list of how greenhouse gases and the broader subject of climate change might directly affect the area in which they live. Then have them prepare a separate list as to how greenhouse gases and climate change might affect low-lying or coastal areas. (This list may be the same if you live in a coastal area.) Ask them to specifically look for news articles related to these two lists. Put the notes and each item of information in its own plastic sleeve. Have the students bring all of these together and as a class create a "greenhouse gas" notebook that can be used for reference in the classroom throughout the year.

*Tech Note: Instead of a notebook using paper resources, the class could create their own on-line "wiki" of all the information compiled. Information can be added to the wiki throughout the year. This information can also be shared with the entire school.

http://www.wikispaces.com

wrap-up
update information

As the year progresses, ask the students on a regular basis to look through newspapers, magazines, etc. for current event articles pertaining to greenhouse gases or climate change in general. Cut these out and put each in a sleeve and add it to your classroom notebook. (This will open the door for this to be an ongoing theme in your classroom…not just a quick, short lesson.)

*Tech Note: The students should regularly update the "wiki" with the above information.

assessment

Assess the students on their note-taking skills. (See rubric on page 32.) Assess the students on their team-work and contribution to the class notebook.

Ask the students to reproduce a drawing of the carbon cycle with explanations as to how this cycle operates.

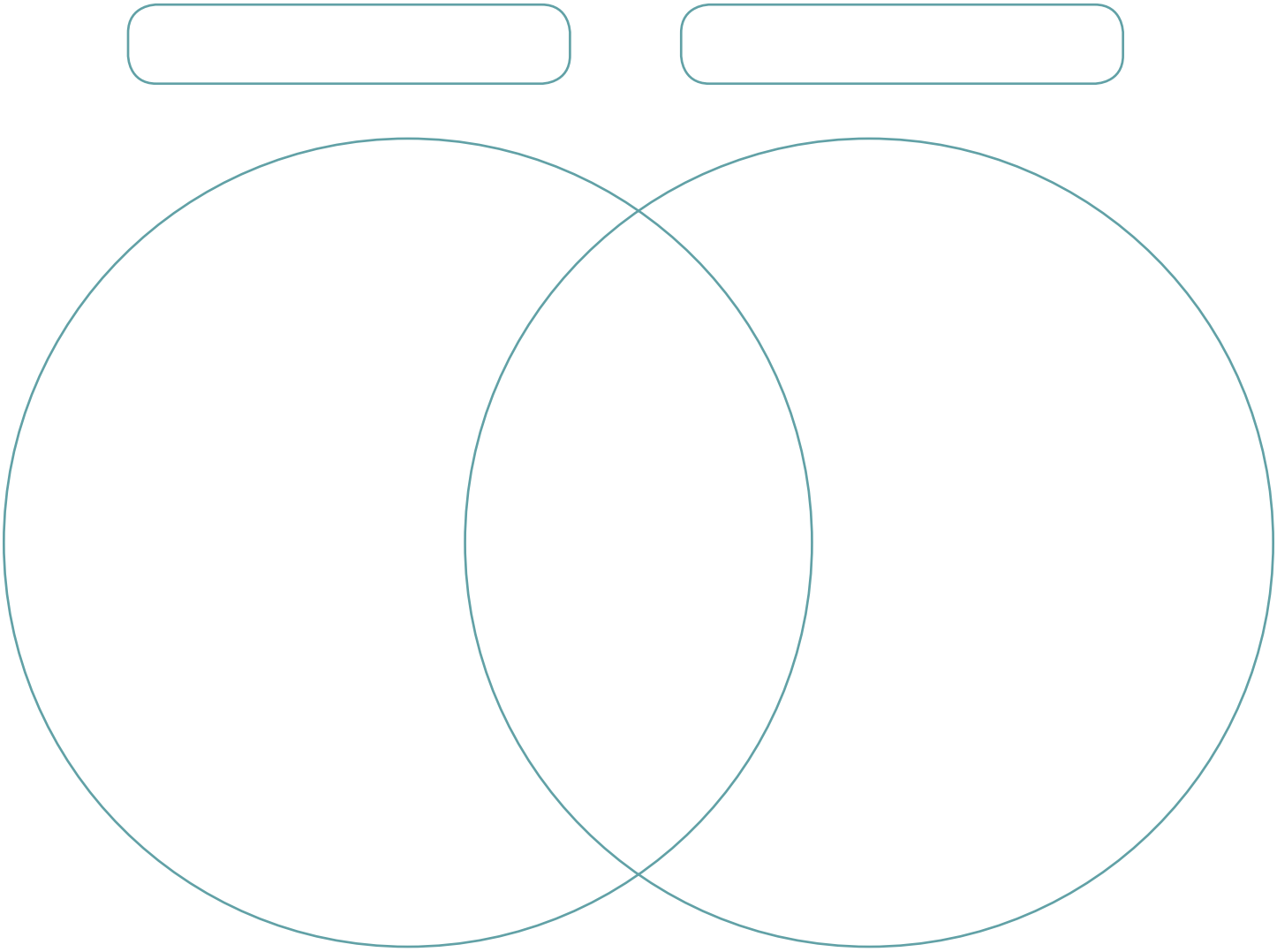
community extension
my carbon footprint

Using the Venn Diagram on page 31, ask the class to compare their carbon footprint with what they think the carbon footprint of a school-age child on Takuu would be. Have the students put their own name in the left-hand box, and "Student from Takuu" in the right-hand box. In the larger areas of the circles, list the separate potential carbon footprint impacts. In the cross-over area, list the potential carbon footprint impacts that are the same for them and the Takuu student. Encourage them to think about the overall size difference between the 600 people on Takuu and the many millions of people in the developed world, including the United States, who have large carbon footprints. Now, have the class create a carbon contract using the suggestions below. They may also add their own suggestions. How can they shorten the list of impacts on their side of the Venn Diagram? Ask them to commit to at least two items on the list for one week. At the end of the week, have a class discussion.

Leading Questions for Class Discussion:

1. How easy or difficult was it to keep the contract.
2. Will they continue with their contract? Why or why not?
3. Will they add to their contract. What will they add?
4. Why is it important to think about your carbon footprint?
5. Who is most responsible for climate change? Least responsible?
6. In their opinion, what can we do about climate change?
7. What is one positive outcome from doing the carbon footprint contract exercise?

venn diagram



note-taking rubric

Keywords vs. Copying	Relevance	Organization	Quantity
4 Points: Notes are recorded as keywords and phrases in students words.	4 Points: Notes relate to the topic and show the main ideas, enough examples.	4 Points: All notes are organized logically and effectively.	4 Points: Notes include all relevant key data and little excess material, to create an effective product.
3 Points: Notes are primarily recorded as keywords and phrases in mostly students words.	3 Points: Notes primarily relate to the topic, some main ideas, some examples.	3 Points: Most notes are organized with some logic, notes are orderly and legible.	3 Points: A sufficient number of notes are taken to create the product.
2 Points: Notes are primarily copied from the source. Some evidence of keywords and phrases in own words.	2 Points: Some notes relate to the topic, but many don't, few main ideas, few examples.	2 Points: Some evidence that notes are organized, with little order, somewhat legible.	2 Points: Nearly enough notes are taken to create the product.
1 Point: Notes are copied directly from the source.	1 Point: Notes are not related to the topic, few main ideas, no examples.	1 Point: No evidence of notes that are organized, logical, or legible.	1 Point: Not enough notes are taken to create a product, or excessive notes are taken.
Total:	Total:	Total:	Total:

Rubric Source:
http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=0CCkQFjAB&url=http%3A%2F%2Fco-opartsandhumanities.org%2Fdepartments%2Ftechnology%2Ffiles%2F2012%2F03%2FNote-Taking-Rubric.docx&ei=wlBwUOH5M_OEygHoo4GADA&usg=AFQjCNFdjpeZnDElTq8pR6gjfojVbjyCaQ&sig2=w7bCW-B0ZaxTvVXyRlxNoQhttp://climatex.org/articles/climate-change-info/carbon-cycle-and-climate-change-beginners-guide/

contract: reduce your carbon footprint!

Source: www.thereoncewasanisland.com

Make a commitment to some commonsense changes in behavior.

Rather like getting fit and healthy, the little things can make a difference.

1. Use public transport.
2. Don't travel to an event if you can reasonably attend remotely.
3. Get rid of your car, trade down to something smaller or get a smart car, hybrid, motorbike or Segway instead.
4. Buy less stuff – a large quantity of what we buy is made of or with petro-chemicals.
5. When you do buy stuff look for locally made, environmentally concious products or try second hand.
6. Install low-energy lightbulbs and switch them off when you're not in the room.
7. Switch off appliances at the wall when they're not being used.
8. Install energy efficient appliances in your house and buy a laptop over a desktop computer.
9. Wear more or fewer clothes and leave heaters and air-conditioning off.
10. If you have the money and you own your own home, insulate the building to protect against cold and heat, and install a solar energy system.
11. Get a water-saving shower head and/or take shorter showers – hot water is the second major use of power in a home after space heating.

Sign the contract and help people around the world.

I, _____ promise to take a pro-active role in reducing my carbon footprint.

Source: May, R. (2010). Baloo's political cartoon blog.

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