PRESENTATION TO CLN
PACIFIC ISLANDS CLIMATE EDUCATION PARTNERSHIP
October 7, 2014
http://pcep.prel.org
PCEP is a collaboration of over 60 partners working together toward a new vision of climate education.

We are schools, colleges, community organizations, and government agencies.
We serve the U.S.-affiliated Pacific islands

Pacific islands
Climate Education Partnership
Climate education in the Pacific is about:

- Place
- Projects
- Solutions
- Collective Action
Carbon Dioxide and the Carbon Cycle

Click on the name of each reservoir for more information.

- **Carbon Cycle Reservoirs**
  - **Fossil Fuels**: 10,000 Gt
  - **Ocean**: 41,000 Gt
  - **Atmosphere**: 840 Gt
  - **Land Biomass**: 2500 Gt
  - **Rocks**: 60,000,000 Gt

Note: Units are gigatons of carbon. One gigaton = one billion tons
Carbon Dioxide and the Carbon Cycle

Carbon Cycle Reservoirs

- Fossil Fuels
- Changes to Ecosystems
- Human Activities
- Ocean
- Atmosphere
- Rocks

CO₂ and the Atmosphere

300 Years Ago
- 9 Gt/Yr
- 1 Gt/Yr

Present Day
- 80 Gt/Yr
- 77.5 Gt/Yr

Temperature and CO₂

- 120 Gt/Yr
- 122.5 Gt/Yr

Note: Units are gigatons of carbon. One gigaton = one billion tons.
Carbon Dioxide and the Carbon Cycle

Three hundred years ago, the amount of CO₂ flowing into the atmosphere was equal to the amount flowing out of the atmosphere. It was not affected by human activity.

### CO₂ into the Atmosphere

**Natural (Not Human-caused)**

- Escapes from ocean: 62 Gt/yr
- Respiration: 107 Gt/yr

**Total**: 169 Gt/yr

### CO₂ out of the Atmosphere

**Natural (Not Human-caused)**

- Dissolves into ocean: 60 Gt/yr
- Into plants (photosynthesis): 109 Gt/yr

**Total**: 169 Gt/yr

### Human Activity

- No significant addition of CO₂ into the air

**Total**: 0 Gt/yr

### Human Activity

- No significant removal of CO₂ from the air

**Total**: 0 Gt/yr

**Net Change to Atmosphere**: 0 Gt/yr

**Note**: Units are gigatons of carbon. One gigaton = one billion tons.
Today more CO₂ is going into the atmosphere than is coming out of the atmosphere.

The amount of CO₂ in the atmosphere is increasing.

It would increase even more, except that the ocean and plants currently absorb about half of the CO₂ from human activities.

### CO₂ into the Atmosphere

<table>
<thead>
<tr>
<th>Source</th>
<th>Amount (Gt/Yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural (Not Human-caused)</td>
<td></td>
</tr>
<tr>
<td>Escapes from ocean</td>
<td>77.5</td>
</tr>
<tr>
<td>Respiration</td>
<td>120</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>197.5 Gt/Yr</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Human Activity</th>
<th>Amount (Gt/Yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fossil fuels</td>
<td>9</td>
</tr>
<tr>
<td>Ecosystem changes</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10 Gt/Yr</strong></td>
</tr>
</tbody>
</table>

### CO₂ out of the Atmosphere

<table>
<thead>
<tr>
<th>Source</th>
<th>Amount (Gt/Yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural (Not Human-caused)</td>
<td></td>
</tr>
<tr>
<td>Dissolves into ocean</td>
<td>80</td>
</tr>
<tr>
<td>Into plants (photosynthesis)</td>
<td>122.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>202.5 Gt/Yr</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Human Activity</th>
<th>Amount (Gt/Yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No significant removal of CO₂</td>
<td>0</td>
</tr>
<tr>
<td>from the air</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>0 Gt/Yr</strong></td>
</tr>
</tbody>
</table>

**Net Change to Atmosphere**: +5 Gt/Yr

*Note: Units are gigatons of carbon. One gigaton = one billion tons*
**Temperature and CO₂ over the Past 1,000 Years**

Starting around the year 1800, human activities, especially the burning of fossil fuels, have increased the amount of CO₂ in the atmosphere. The amount is increasing rapidly and is now higher than it has been at any time in the past million or more years.

Since 1980, the global temperature has increased rapidly. Earth is now significantly warmer than it has been in the past 1,000 years. The CO₂ released into the air by human activities is the major cause of this global warming.
ENERGY FLOWS AND THE EARTH SYSTEM

Visible and short wave IR light from the Sun \textit{radiates} to planet Earth.

About one third of sunlight does not heat the Earth system.

Outer Space

Some long wavelength IR \textit{radiates} to outer space without being absorbed in atmosphere.

Earth’s surface heats the atmosphere by conduction and by radiating long wavelength IR that is absorbed by GH gases.

GH gases radiate long wavelength IR within atmo, back to surface, and to outer space.

Sunlight energy changes to heat energy

Winds and ocean currents move heat energy within the Earth system from equatorial regions toward the poles.

Most of the absorption of light energy happens at Earth’s surface. Absorbed light energy is transferred to heat energy. Areas nearer to the equator absorb much more sunlight and are much warmer than areas nearer the poles.
Our Story: Webs of Sustainability

Science benchmarks on human + climate impacts and climate adaptation
Lesson sets focus on benchmarks and essential questions

Guidance for bilingual instruction with focused language features

### Standards-Based Unit Template, adapted from Clementi & Terrill. (2013). Keys to planning for learning, ACTFL

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<table>
<thead>
<tr>
<th>Grade(s)</th>
<th>Approximate Length of Unit</th>
<th>Approximate Number of Minutes Weekly</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-5</td>
<td></td>
<td>1 class 45 minutes</td>
</tr>
</tbody>
</table>

| Theme/Topics | Insack Lasr: Insack Fin Acm Kosrae (Our Mangroves: Mangroves of Kosrae) |

<table>
<thead>
<tr>
<th>Essential Questions</th>
<th>Why are mangroves important?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>What do humans and other living things get from mangrove ecosystems?</td>
</tr>
<tr>
<td></td>
<td>What kinds of things can harm mangrove ecosystems?</td>
</tr>
</tbody>
</table>

| Benchmarks | Sci.4.3 Recognize factors that cause or contribute to rapid changes in the environment and describe the impact of such rapid changes on animal and plant life |

<table>
<thead>
<tr>
<th>Goals What should learners know and be able to do by the end of the lesson?</th>
<th>Students will be able to:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Explain importance of mangroves to themselves and their families</td>
</tr>
<tr>
<td></td>
<td>Explain how certain things and actions can harm mangrove ecosystem</td>
</tr>
<tr>
<td></td>
<td>Share new learning on mangrove ecosystem with others</td>
</tr>
</tbody>
</table>

| Summative Assessment | Poster of a favorite mangrove area with responses to questions about how we benefit from the mangroves and how people may be harming the mangroves. |

<table>
<thead>
<tr>
<th>Formative Assessment Tools</th>
<th>Student drawings of mangrove environments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&quot;Temperature check&quot; questions</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Focused Language Features: Kosraean + English</th>
<th>Language Functions</th>
<th>Related Sentence Structures / Patterns (Examples)</th>
<th>Vocabulary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Describe characteristics, uses, or physical features</td>
<td>Mweet uh orokmakhia insack uh nuhke_________.</td>
<td>People use mangroves for_________.</td>
<td>ma wo benefit</td>
</tr>
<tr>
<td></td>
<td>Suru luhk ah orokmakhia insack uh nuhke_________.</td>
<td>My family uses mangroves for_________.</td>
<td>edlac change</td>
</tr>
<tr>
<td>Explain importance of mangroves/how things and actions can cause harm (cause + effect)</td>
<td>Mweet uh_________, sac ahkololuke insack uh.</td>
<td>People are_________ which harms the mangroves</td>
<td>insack mangrove</td>
</tr>
<tr>
<td></td>
<td>Mweet uh aikhien / liye lah_________.</td>
<td>People are noticing_________.</td>
<td>ahkololuke harm</td>
</tr>
<tr>
<td>Ask and answer questions about mangroves</td>
<td>Who/What/When/Where/Why questions (samples from videos)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>State information to others (e.g., location, activity, relationship)</td>
<td>Nga luhsng b_______ ke an se inge.</td>
<td>I like to_________ in this place.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nga luhs n_______</td>
<td>I can_________.</td>
<td></td>
</tr>
</tbody>
</table>

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MANGROVES
LIFE ON THE EDGE
A school resource book for the Pacific Islands

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Pacific islands
Climate Education Partnership
Our Story: Webs of Sustainability

Science benchmarks on human + climate impacts and climate adaptation

LEK through elder interviews
According to our elders, the mangrove clams become plentiful during breadfruit season.
Our Story: Webs of Sustainability

Science benchmarks on human + climate impacts and climate adaptation

LEK through elder interviews

New resources and lessons to support learning & teaching
Other places sheltered from waves include bays (places where the shoreline curves and partly encloses a body of water) and estuaries (places where rivers reach the ocean and their fresh water mixes with seawater). The mixing of waters and plenty of mud found in the estuaries makes them very suitable places for mangrove growth. That is why we see many mangroves in the lower reaches of rivers.
Is Landward Migration Possible?

- NO
  - Can soil build-up keep pace with sea level rise?
    - NO: Drop Site
    - YES: Maybe OK for MPA

- YES
  - Is mangrove recruitment strong?
    - NO: Drop Site
    - YES: Good choice for MPA

Pacific islands Climate Education Partnership
Our Story: Webs of Sustainability

Science benchmarks on human + climate impacts and climate adaptation

LEK through elder interviews

New resources and lessons to support learning & teaching

Resources developed in partnership with the Local Professional Learning Community

Pacific islands Climate Education Partnership
Partnership supports success
http://pcep.prel.org

http://www.facebook.com/pcep.connect

http://www.pbslearningmedia.org/
Search for PCEP carbon cycle