YOUTH TECHCAMPS US-JORDAN 2014

GLOBAL CONNECTIONS AND EXCHANGE

GCE

AMIDEAST

DEPARTMENT OF STATE UNITED STATES OF AMERICA

GLOBAL NOMADS GROUP

EDUCATOR HANDBOOK

Interactive Videoconference Scheduling

Use this page to record the days/times of your interactive videoconferences.

Please Note: A school **may not cancel** a videoconference unless extenuating circumstances arise (i.e. extreme weather, security threat).

	Day	Date	Tech Dial-in Time	Conference Start Time	Backup Day / Date
Sample	*Monday*	*6th Jan 2014*	*7:30 AM ET*	*8:00 AM ET*	*Monday, 13th Jan 2014*
IVC 1: Global Climate Change					
IVC 2: Sustainable Energy Sources					
IVC 3: Citizen Science					
IVC 4: Sustainable Design					
IVC 5: Environmental Action					

Table of Contents

Program Overview **4**
- **Learning Objectives and Learning Outcomes** **5**
- **Unit Overview** **5**
- **Scope and Sequence** **6**
- **Virtual Project Fair: Collaborative Innovation Project** **8**

Module 1: Global Climate Change **9**
- LEARN 10
- ACT 18
- REFLECT 20

Module 2: Sustainable Energy Sources **21**
- LEARN 22
- ACT 32
- REFLECT 34

Module 3: Citizen Science **35**
- LEARN 36
- ACT 41
- REFLECT 43

Module 4: Sustainable Design **44**
- LEARN 45
- ACT 50
- REFLECT 52

TechCamps! **53**

Module 5: Environmental Action **54**
- LEARN 55
- ACT 59
- REFLECT 61

Appendix A **62**
- **World Water Monitoring Challenge: Instructions** **62**

Program Overview

"Prepare now for the solutions of tomorrow." – Congolese Proverb

With the impacts of climate change circulating in headlines around the world, the need to find sustainable solutions is becoming ever more important for the future of the planet. Funded by the U.S. Department of State Bureau of Educational and Cultural Affairs and in partnership between AMIDEAST Jordan and Global Nomads Group, *Global Connections and Exchange: Youth TechCamps (TechCamps)* is a nine-month Science, Technology, Engineering, Arts, Math (STEAM) virtual exchange program, whose centerpiece is an in-person 8-day technology camp in Amman, Jordan. This program connects high school students in the United States with their peers in Jordan to answer, ***How do we, as youth, use technology to create solutions for climate change issues affecting our local and global communities?***

In collaboration, U.S. and Jordanian students will investigate local and global climate change issues and work in tandem to create projects addressing these in their communities. By the program's conclusion, students will showcase projects that are sustainable in design, harnessed by creativity, and powered by technology in a virtual project fair. *TechCamps* will inspire pursuit of science and technology-focused higher education and careers, producing a cadre of new professionals who can interact across cultures, utilize high-order thinking skills, and creatively address practical solutions to environmental challenges.

Global Nomads Group. Established in 1998, Global Nomads Group (GNG) is an international NGO that develops and implements interactive programs for young people around the world. Since it's founding, GNG has run programs in more than forty-five countries, on all seven continents, and reached more than one million young people. With offices in New York, US and Amman, Jordan, GNG has been recognized as a leader in the fields of global education and virtual exchange. For more than a decade, GNG has demonstrated a track record of building partnerships with education and media organizations in diverse contexts worldwide. GNG has been featured on news outlets including CNN International, The New York Times, Good Morning America, and Education Week, awarded the Goldman Sachs Prize for International Education, and selected by UNESCO to design a curriculum promoting respect for different cultures. In a 2011 Special Report[1], USIP highlighted GNG as a key Exchange 2.0[2] program that effectively promotes intercultural understanding.

AMIDEAST Jordan. AMIDEAST is a leading American non-profit organization engaged in international education, training and development activities in the Middle East and North Africa. Founded in 1951, AMIDEAST in its early years focused on promoting U.S. study to students in the MENA region and managing U.S. scholarships and exchanges such as the flagship Fulbright Foreign Student Program. While these important programs continue apace, AMIDEAST's work has expanded significantly. Today AMIDEAST programs and services touch the lives of half a million individuals a year – improving educational opportunities and quality, strengthening local institutions, and developing language and professional skills critical for success in the global economy.

U.S. Department of State, Bureau of Educational and Cultural Affairs. The Bureau of Educational and Cultural Affairs' (ECA) mission is to increase mutual understanding between the people of the United States and the people of other countries by means of educational and cultural exchange that assist in the development of peaceful relations.

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[1] Himelfarb, Sheldon and Idriss, Shamil. (2011, May). "Special Report: Exchange 2.0." *United States Institute of Peace.* Retrieved from: http://www.usip.org/files/resources/Exchange2.0.pdf.

[2] Exchange 2.0, according to the Himmelfarb and Idriss USIP report in footnote *i*, is defined as, "technology-enabled programs embedded in curricula and with a cross-cultural educational purpose" that have the ability to "improve the number, diversity, and experience of international exchange participants."

Learning Objectives and Learning Outcomes

The overall goal of *Global Connections and Exchange: Youth TechCamps* is for U.S. and Jordanian students to collaborate and create projects that utilize technology and sustainable design to addresses environmental challenges in their local and global communities. The program's specific learning objectives and learning outcomes include:

Program Goal: **To collaborate on projects that utilize technology and sustainable design to addresses environmental challenges in students' local and global communities**	
Learning Objectives	**Learning Outcomes**
To increase students' knowledge of the science and politics behind climate change, as well as their confidence to lead conversations with peers on these topics;	Students have a well-rounded knowledge of the science and politics of climate change, and are able to actively engage in conversations on climate change.
To establish channels of communication and collaboration between young people in the U.S. and Jordan;	Students build 21st century learning and innovation skills including: communication, collaboration, creativity and critical thinking.
To use a project model inspired by design thinking and project-based learning to problem-solve local and global climate change challenges.	Students use technology to investigate, research, and develop innovative and sustainable projects addressing climate change challenges.

Unit Overview

This project-based curriculum includes five modules. Each module goes through three steps, designed to help integrate and support student engagement. The following abbreviations refer to page numbers in the Educator Handbook and corresponding Student Workbook, respectively.

EH = Educator Handbook Page Number **SW** = Student Workbook Page Number

Green Shaded Boxes appear throughout each unit and indicate when students should visit Google+ to share information with their peers on the online platform.

Unit Overview	
LEARN	• Students dive into the topic at hand with background information and skills relevant to the curriculum module. • Students apply the skills and knowledge gained through a short activity to share with program peers in an IVC.
ACT	• Students use knowledge and skills gained in **LEARN** to prepare for an IVC with peers.
REFLECT	• Students debrief and reflect on their IVC dialogue. • Students continue conversations through the online platform. • Educators give feedback via an online survey on module and IVC experience.

Scope and Sequence

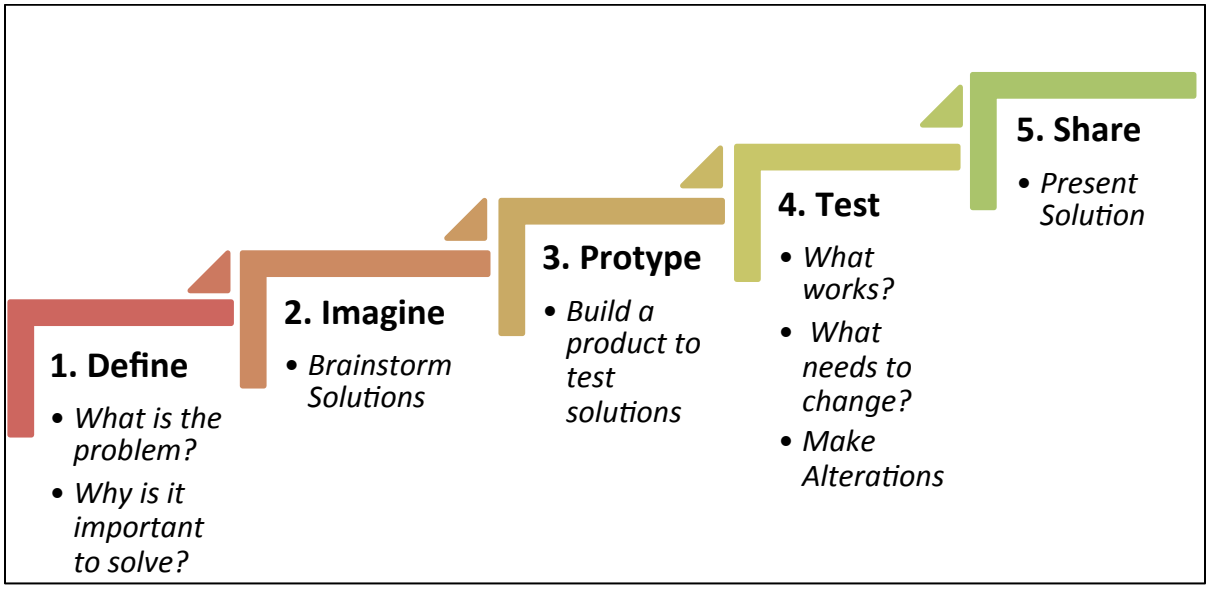
	Module 1: Global Climate Change	Module 2: Sustainable Energy Sources	Module 3: Citizen Science
Driving Question	***"How do we, as youth, use technology to positively impact climate change in our local and global communities?"***		
Guiding Question	What is global climate change? How does it impact your community and the world?	What are sustainable energy sources that can meet our needs?	What role can and does technology play in engaging everyday individuals in science?
Enduring Understanding	Ecosystems are dynamic and subject to change.	Every action impacts the environment, and the impacts of different energy sources have both short-term benefits and long-term consequences.	Technology innovations are occurring daily. Citizen science is one example of technology-enabled engagement of everyday individuals in scientific exploration.
Suggested Units	**Biology/Environmental Science:** Ecosystems, Biomes, **Chemistry:** Physical & Chemical Change	**Biology/Environmental Science:** Energy resources and consumption, resource sustainability, ecology, bio- geology, global climate change, pollution, natural and human- induced hazards **Chemistry:** Environmental chemistry and quality	**Biology/Environmental Science:** Global Change, Society, Ethics and World Views, Sustainability, Human behavior **Scientific Inquiry:** Use methods of scientific investigation, Know how scientists work, Process and communicate information
Timeframe	**February 2014**	**March 2014**	**April 2014**
Learn	• Understanding Global Climate Change through a Model • The Climate Change and Global Issues Connection	• What is renewable energy? • World Energy Debate	• Citizen Science: World Water Monitoring • Citizen Science and our Community • Collab. Innov. Project Prep: Introduction & Needs Assessment
Act	Interactive Videoconference #1	Interactive Videoconference #2	Interactive Videoconference #3
Reflect	Connect on Google +	Connect on Google +	Connect on Google +

	Module 4: Sustainable Design	Youth Tech Camps	Module 5: Environmental Action
Driving Question	***"How do we, as youth, use technology to positively impact climate change in our local and global communities?"***		
Guiding Question	How can technology be used to invent creative, sustainable designs to our environmental challenges?	How do we use the tools and knowledge gained during our TechCamp to answer our driving question?	What role can we play in combating climate change?
Enduring Understanding	Sustainable design focuses on solutions that are socially, economically and ecologically sustainable.	**In June 2014, TechCamps participants will turn knowledge into action!** Camp activities will include workshops, field trips and guest speakers to address: ○ *Climate Change Issues* ○ *Environmental Sustainability* ○ *Relevant Technologies in Science and Innovation* ○ *Data Collection* ○ *Design Thinking* ○ *Digital Storytelling* ○ *Project Development and Prototyping* ○ *Higher education and professional careers* TechCamps will culminate in a **Tech Torrent** showcase of students' **Collaborative Innovation Project** designs. The projects will be developed with support from technology mentors through summer 2014. Final projects will be showcased in a **Virtual Project Fair** in Sept. 2014.	As a global citizen, we can create change within our community and the world.
Suggested Units	**Biology/Environmental Science:** Global Change, Society, Ethics and World Views, Sustainability, Human behavior **Scientific Inquiry:** Use methods of scientific investigation, Know how scientists work, Process and communicate information		**Biology/Environmental Science:** Global Change, Society, Ethics and World Views, Sustainability, Human behavior **Scientific Inquiry:** Use methods of scientific investigation, Know how scientists work, Process and communicate information **Chemistry:** Environmental Chemistry
Timeframe	**May 2014**		**August 2014**
Learn	• What does it mean to be sustainable? • Measuring Sustainability: Design Abacus • Collab. Innov. Project Prep: Initial Research		• Innovator Case Studies • Sharing Our Story with the World
Act	Interactive Videoconference #4		Interactive Videoconference #5
Reflect	Connect on Google +		Connect on Google +

Virtual Project Fair: Collaborative Innovation Project

Global Connections and Exchanges: Youth TechCamps concludes with a **Virtual Project Fair**, during which student teams, composed of both U.S. and Jordanian youth, showcase **Collaborative Innovation Projects**, created in tandem with one another and addressing climate change issues in students' local and global communities. The goal is for students' projects to be sustainable in design, harnessed by creativity, and powered by technology.

The Collaborative Innovation Project **Guidebook,** which accompanies this Handbook, leads students through a five-step project development process, which is inspired by design thinking and project-based learning. The table below outlines the project steps, or milestones, that are explained within the Guidebook.



Students will be introduced to the Collaborative Innovation Project and supporting Guidebook in Module 3. During the in-person TechCamp, students will be teamed up with their international peers and tasked to begin conceptualizing projects addressing, "***How do we, as youth, use technology to positively impact climate change in our local and global communities?***" Throughout the TechCamp, students will move through the five-step project design process outlined in the Guidebook, while also participating in guest expert presentations, site visits, and hands-on workshops in order to turn project ideas into innovative and sustainable project designs.

The TechCamp will conclude with **Tech Torrent**, a showcase of students project designs to a panel of science and technology experts, for feedback and suggestions for further development. Four project designs will be recommended for continued development, and student groups will redistribute so that all maintain an active role in project development. Each group will be paired with a technology mentor, who will be based in either the US or Jordan, to offer continued support in project development through summer 2014 and in advance of the culminating **Virtual Project Fair** in September 2014.

Module 1: Global Climate Change

Overview

In **Learn**, students review the greenhouse effect and greenhouse gases and use a Global Climate Change model to understand how global temperature and carbon dioxide emissions are related. Students learn about global issues that are impacted by changes in the earth's climate and identify and share significant aspects of their own surroundings, and how they may be impacted by climate change.

In **Act**, students share the impacts of global climate change on their local community, and begin the process of cultural exchange with their peers.

Background

The Earth's climate is naturally dynamic and variable. The **greenhouse effect**, a natural phenomenon that insulates planet Earth, allowing it to be inhabitable by humans, has recently been affected by human activities. These activities, including the use of fossil fuels for energy and deforestation, increase the amount of **greenhouse gases** in the atmosphere. Greenhouse gases, such as carbon dioxide and methane, warm our planet by trapping increased amounts of solar radiation in our atmosphere. Warming produced by greenhouse gases accelerates the natural greenhouse effect and contributes to changes in climate worldwide. The consequences of global climate change include: more intensive storms, climate change related refugees and migrations, sea level rise, floods and food insecurity.

Module Objectives

- Understand the greenhouse effect and be able to identify greenhouse gases;
- Understand how a climate change model works, and use a climate change model to predict future impacts of carbon dioxide emissions on the earth's temperature;
- Learn about factors that cause global climate change, and their impacts on global issues;
- Take part in cross-cultural communication with peers, sharing perspectives between students' own communities and around the world.

	Activity	Estimated Time
LEARN	Understanding Global Climate Change through a Model The Climate Change and Global Issues Connection	60 Minutes 45 Minutes
ACT	Interactive Videoconference #1	45 Minutes Prep 60 Min. IVC + 30 Min. Dial-in
REFLECT	Connect on Google +	15 Minutes

LEARN

Understanding Global Climate Change through a Model	
TIME: 60 minutes	**MATERIALS:** Computer, Internet Access, "Heat-Trapping Gases in the Atmosphere" Reading (EH p. 12, SW p. 12), "The Greenhouse Effect" Reading (EH p. 13, SW p. 13), "The Very, Very Simple Climate Change Model" Instruction Guide (EH p. 14, SW p. 14)

OVERVIEW

Students learn about climate change, the greenhouse effect and greenhouse gases. Students understand the impact of carbon emissions on earth's temperature through a climate change model.

INSTRUCTIONS

1. **Introduction:** In pairs, have students play **"The CO_2 Effect:"** (*http://www.ecokids.ca/PUB/eco_info/topics/climate/co2effect/index.cfm*)
   - What is the relationship between human activity and the earth's temperature?

2. **Building Background Knowledge:** Divide the class into two groups. Assign each group one of the two attached articles to read: "Heat-Trapping Gases" or "The Greenhouse Effect." Discuss as a group to answer:
   - What role does the greenhouse effect play in making Earth habitable?
   - What are several greenhouse gases?
   - How do greenhouse gases impact climate change?

3. **Climate Change Model.**[3] Lead students in a discussion on models.
   - What are models and how are they used?
   - In what ways have you used models in the past?

   Distribute "The Very, Very Simple Climate Change Model" worksheet. Tell students that some models are used to predict how Earth's climate will change in the future. They will use a computer-generated model to see how carbon dioxide emissions impact earth's atmosphere and climate. Before launching the model, discuss:
   - What do you think would happen to Earth's temperature in the future if each year we released the same amount of carbon dioxide into the atmosphere as we did in the year 2000. In the year 2000, we released around 9 gigatons of carbon per year (9 GtC/yr).
   - What do you think would happen if we released more/less carbon dioxide per year?

4. **Model Launch.** Launch the "Very, Very Simple Climate Change Model" using the following link: http://spark.ucar.edu/simple-climate-model. Review the model's instructions (see p. 14) and allow students to set the "Timestep Size" and "Carbon Dioxide Emissions" to different numbers in order to get a feel for how the graph auto populates data. Once the students are comfortable using the graph, have students set the graph as follows and advance the "step forward" ten times:
   - Timestep size = 10 years
   - Carbon Emissions = 9

   This setting assumes that humans' carbon emissions for the next century will remain the same.

[3] Activity Adapted from: Lisa Gardiner and Randy Russell, "The Very, Very Simple Climate Change Model," *Spark Science Education,* 2014, http://spark.ucar.edu/activity/very-very-simple-climate-model-activity

After students have hit "step forward" ten times (that is, 100 years), discuss:

- What did you notice about the points that appeared on the graph as you "stepped forward"?
- Do you think this model will reflect what people will *actually* do over the 21st century?

5. **Making Predictions.** Brainstorm how and why carbon emissions may change in the future. For example, carbon emissions will go up if more power plants are created that burn fossil fuels, yet carbon emissions will go down if more technologies are invented that reduce the use of fossil fuels.

   Have students work in groups to come up with a scenario that they would like to test. (Example: carbon dioxide emissions rise through the middle of the 21st Century, and then decline after that.)

Have groups restart their model and then run the scenario they brainstormed. Each group should start their carbon emissions at 9GtC/yr, the average rate for the year 2000. After all groups have completed their scenario, discuss:

- What happened to temperature and carbon dioxide concentrations over time?
- Is some global warming inevitable?
- Which scenario had the least warming? Which had the most?

Resource Window: How is climate change affecting our planet?
Check out these resources to learn more!

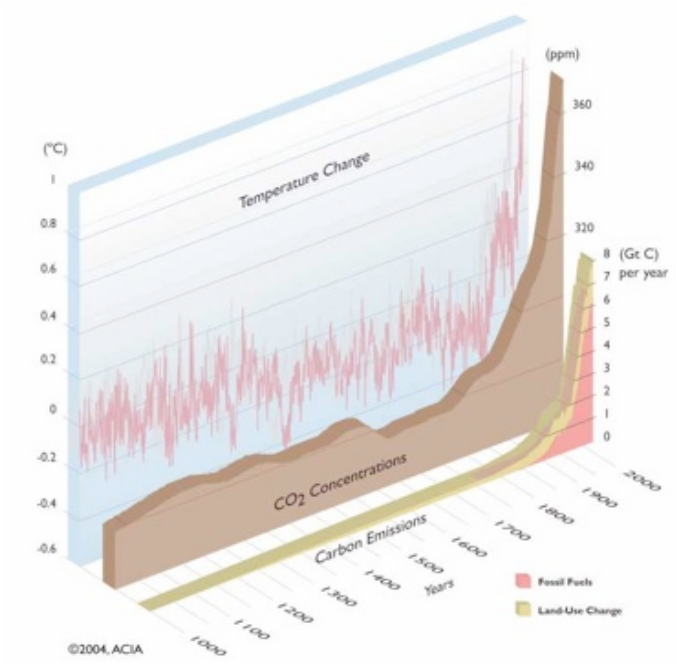
- *The Climate Change Time Machine: http://climatekids.nasa.gov/time-machine/*
- *Climate Connections: A Global Journey: http://www.npr.org/news/specials/climate/interactive/*
- *Mapping the Impacts of Climate Change: http://www.cgdev.org/page/mapping-impacts-climate-change*

"HEAT TRAPPING GASES IN THE ATMOSPHERE" Reading[4,5]

To study climate change, we need to understand certain gases in Earth's atmosphere that impact climate change. These gases act like a blanket in the atmosphere trapping heat and warming the planet. Scientists have called these gases "greenhouse" gases, because akin to an actual greenhouse made of glass and used to grow plants when it is too cold outside, these gases trap heat and help regulate the temperature on earth. When the amount of greenhouse gases in the atmosphere rises, temperatures on Earth rise as well, causing a change in the climate.

Some greenhouse gases occur naturally and some are human-made. Water vapor is a greenhouse gas that occurs naturally, as a result of Earth's water cycle. Other greenhouse gases such as chlorofluorocarbons (CFCs) are created entirely by humans. Many greenhouse gases that occur naturally are also released through human activities. For example, carbon dioxide (CO_2), nitrous oxide (N_2O) and methane (Ch_4) are all cycled through Earth's atmosphere naturally. Human activities that burn fossil fuels such as oil or gas, increase the amounts of greenhouse gases in Earth's atmosphere, affecting the balance of natural cycles.

Some gases are more effective at trapping heat than others and stay in the atmosphere longer than others. The better a gas is at trapping heat and the longer it stays in the atmosphere, the more potential it has for adding to global warming.



Scientists who study climate change often focus on CO_2 because the amount in the atmosphere is much greater than any other greenhouse gas produced by human activities. CO_2 accounts for 74% of global greenhouse gas emissions from human activities and can remain in the atmosphere for up to 200 years. The concentration of gases in the atmosphere is measured in parts per million (ppm), parts per billion (ppb) or parts per trillion (ppt).

For reference, concentrations of carbon dioxide are currently about 388 ppm and concentrations of methane are about 1800 ppb. [6]

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[4]Adapted from: "Global Warming Lesson Plan 6-12 Lesson Plan," *Will Steger Foundation*, 2010, http://willstegerfoundation.org/curricula-resources/grades-6-12

[5]Adapted from: "Climate Change: Connections and Solutions," *Facing the Future*, 2007, *,https://www.facingthefuture.org/K12Curriculum/BuyCurriculum/tabid/550/CategoryID/16/List/1/Level/a/ProductID/15/Default.aspx -.UiDQDmQ4W1M*

[6] To see the most up to date concentrations of carbon dioxide, visit: www.co2now.org

"THE GREENHOUSE EFFECT" Reading[7]

You have most likely seen or heard the term climate change in many places- it seems as if everyone is talking about it. But what exactly is climate change, and how does it relate to our lives?

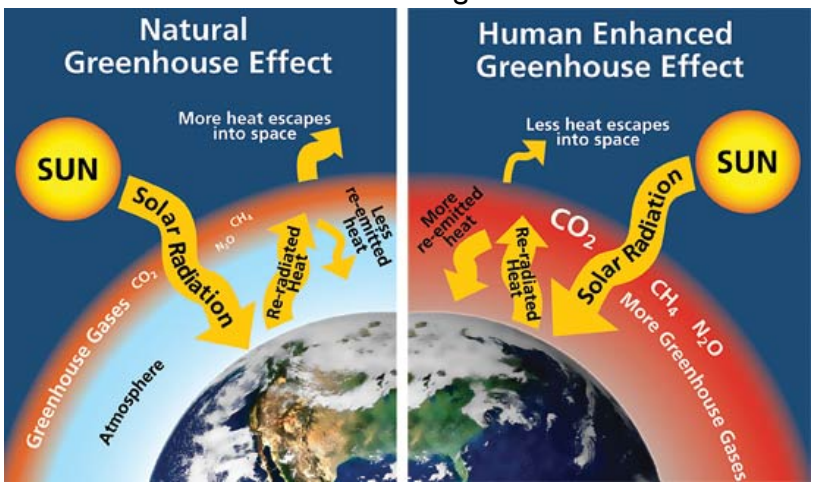
Climate change refers to any change in climate over time, whether caused by natural factors (such as volcanic eruptions) or human activities. Climate is average weather (including temperature, precipitation and wind) over a period of time (from months to millions of years). When we examine weather over many years, we can see climate patterns.

To study climate change, we need to understand Earth's greenhouse effect. The greenhouse effect is important because it makes conditions on Earth warm enough for many species to survive. Have you ever noticed that if, on a sunny day, a car has been parked in the sun with the windows rolled up the temperature is much higher inside of the car than it is outside? Or have you ever gone inside a greenhouse where plants are grown and noticed that the temperature is much higher inside than it is outside? If you have, then you've experienced a greenhouse effect.

The earth has gases within its atmosphere that act like the layer of glass on a greenhouse and trap heat that would otherwise be lost to space. Energy, in the form of light and heat, comes from the sun. That energy is either reflected by the earth or absorbed and then re-radiated back towards space. When this out-going energy hits the layer of heat-trapping gases, some of it passes through back out into space, but some of it gets trapped and re-reflected back to earth.

The atmosphere and this heat-trapping effect make life as we know it possible on earth. Without the heat-trapping gases in our atmosphere, temperatures on earth would average around 0° F (-18° C) and the surface of the earth would be frozen. The climate change issue that we are facing now is a result of human enhanced greenhouse effect.

Image: The Greenhouse Effect



Natural Greenhouse Effect:
This shows the naturally occurring phenomenon in which gases in our atmosphere act like a blanket to retain some of earth's heat.

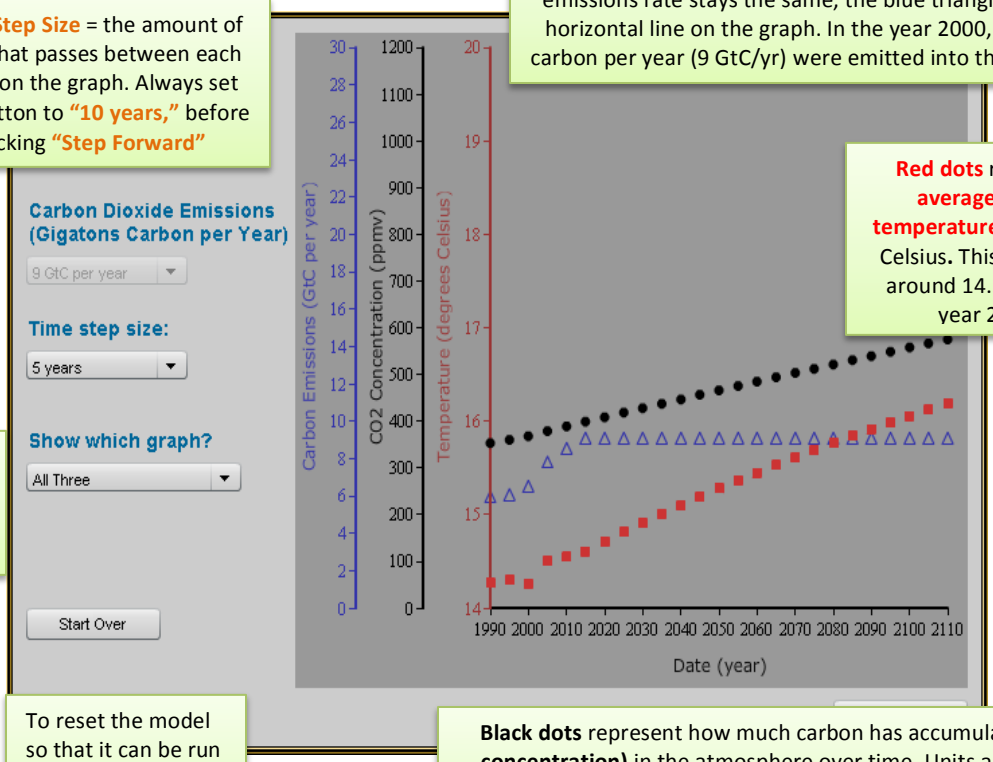
Human Enhanced Greenhouse Effect:
This shows how the increased greenhouse gases in our atmosphere as a result of human activities leads to the increased retention of heat on the Earth's surface causing global climate change.

[7] Ibid.

"The Very, Very Simple Climate Change Model" Instruction Guide[8]

The **blue triangles (carbon emissions rate)** represent how much carbon we add to the atmosphere each year. When the emissions rate stays the same, the blue triangles will form a horizontal line on the graph. In the year 2000, 9 gigatons of carbon per year (9 GtC/yr) were emitted into the atmosphere.

Time Step Size = the amount of time that passes between each point on the graph. Always set this button to **"10 years,"** before clicking **"Step Forward"**



Red dots represent **average global temperature** in degrees Celsius**.** This value was around 14.3° C in the year 2000.

Be sure **"All three"** is selected.

To reset the model so that it can be run again, click **"Start Over"**

Black dots represent how much carbon has accumulated **(carbon concentration)** in the atmosphere over time. Units are "parts per million by volume" (ppmv). The actual concentration of carbon in the atmosphere was around 368 ppmv in the year 2000.

How to use the model:

Step 1: Set the variables for **carbon emissions rate** and **time step size**.

Step 2: Click **"Step Forward"** to see how temperature and carbon concentration are affected by carbon emissions in a given year. If you set the time step size to 10, every time you tell the model to advance, it will move ahead 10 years of "model time."

Each time you click "step forward," three points will appear on the graph. The color of these points correlates with the colors of the three y-axis measures: **carbon emissions rate, carbon concentration and average global temperature.**

Step 3: Record how carbon concentration in the atmosphere and temperature will change over a 100-year span by clicking the "Step Forward" button 10 times.

[8] Lisa Gardiner and Randy Russell, "The Very, Very Simple Climate Change Model," *Spark Science Education,* 2014, http://spark.ucar.edu/activity/very-very-simple-climate-model-activity

The Climate Change and Global Issues Connection

TIME: 45 minutes	**MATERIALS:** "Climate Change and Global Issues" Worksheet (EH p. 16, SW p. 16) "Climate Change and Global Issues" Reference Sheet (EH p. 17, SW p. 17)

OVERVIEW

In this activity, students will explore how the impacts of a changing climate contribute to global challenges affecting nations around the world, including who is affected by change in climate, and how they are affected. **Upload activity pictures on Google+ and share during the IVC!**

INSTRUCTIONS

1. **Free Write / Draw.** Distribute and have students complete the "Climate Change and Global Issues" worksheet on the relationship between challenges facing our globe and change in the earth's climate. *(Note: Use the corresponding "Reference Sheet" for additional information).*

2. **Research.** In five groups, have each select a global challenge discussed in the "Climate Change and Global Issues" worksheet. In preparation for a class gallery walk, groups will conduct independent research to identify examples of their selected global challenge, answering:
   - **What region(s) of the world are affected** by this challenge? **How are they affected**?
   - **Who specifically (local populations, migrating populations) are affected**?
   - **How is nature and species other than humans affected**?
   - **What steps, if any, are being taken** to address this challenge?
   - **What consequences or risks** may result if this challenge is not addressed?

   Have groups **visually represent research on one-page posters** using key words, images, and maps. Have each group present their research in a three-minute summary, followed by a gallery walk.

3. **Local Connections.**[9] Students identify how their local community is affected by climate change.
   - Have students take/find two photos each that visually represent their local environment and either state or hypothesize climate change impacts on these environments.
   - Students write a descriptive *sentence* that describes each image, its importance in their life, and how it relates to global climate change.

   Climate Change Impact on Agriculture: United States. More than 70% of the Great Plains' land area in the United States is used for agriculture. The region's economy is historically heavily dependent on crops. If extreme heat events and droughts become more frequent and temperatures continue to increase, the suitability of the Great Plains region for growing particular crops may change. Additionally, livestock are likely to face increased risk from heat stress and disease.

   Climate Change Impact on Agriculture: Jordan. Prime areas for agricultural cultivation in Jordan, such as rain-fed areas, are shrinking, in part because of urbanization and development. Farmers have also noticed changes in weather in recent years. Along with a decrease in rainfall, temperatures have risen, leading to more pests and bugs and shifting growing seasons. Today, […] the water [of the Zarqa river] is so polluted that farmers cannot use it for agriculture.

   - If time permits, have students interview adult community members to learn more about how their environment has changed over time.

   CONNECT on GOOGLE+: Post pictures of your local environment and descriptions to Google+.

[9] TEXT BOXES: "Climate Change Impacts and Adapting to Climate Change," *US EPA*, 2013, *http://www.epa.gov/climatechange/impacts-adaptation/* and Elizabeth Whitman, "Jordan's Farmers Struggle to Weather Climate Change," *Inter Press Service*, 5 Nov 2013, http://www.ipsnews.net/2013/11/jordans-farmers-struggle-to-weather-climate-change/

"Climate Change and Global Issues" Worksheet

Note: Use the "Climate Change and Global Issues" Reference Sheet for additional support.

A. **Free-write / Draw** the relationship between the five global issues of the left-hand column and the news headlines of the center column from the table below.

- *What do these headlines suggest about the relationship between change in climate and challenges facing our globe?*

B. In column three, **circle the icon(s)** to indicate which impacts that result from a change in climate contribute to each global challenge.

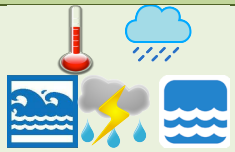
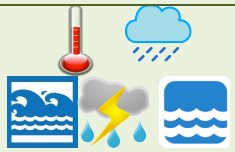
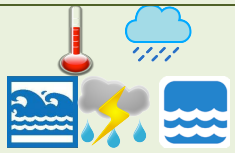
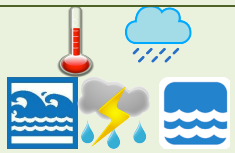
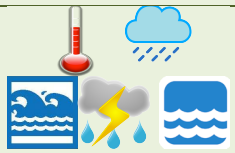
Increase in Air Temperature

Change in Precipitation

Increase in Ocean Temperature

Rise in Sea Level

Increase in Frequency of Extreme Weather

Global Issues	Climate Change in the News	
Food	***Warming May Cause Crop Failures, Food Shortages by 2013***, National Geographic News ***Global Food Crisis Will Worsen as Heatwaves Damage Crops, Research Finds***, The Guardian	
Water	***Global Warming and Our Shrinking Fresh Water Supply***, Mother Earth News ***Water Supplies Could be Strongly Affected By Climate Change,*** MIT News Office	
Human Health	***Extreme Weather Events Threaten Safe Drinking Water***, World Health Organization ***Climate Change Linked to Waterborne Diseases in Inuit Communities,*** National Geographic News	
Shelter	***Focus on Migration: Don't Scapegoat Climate Change***, Science &Technology for Development News & Analysis ***Climate Change Refugees: Coming Soon to a Country Near You***, The Huffington Post Blog	
Security	***Water More Important Than Oil for the Future of the Arab World,*** The Huffington Post Blog ***Water Wars: Climate Change May Spark Conflict,*** The Independent	

"Climate Change and Global Issues" Reference Sheet[10]

Many global issues are climate-related, including basic needs such as **food, water, health, shelter and security**. Changes in climate may threaten these needs with increased temperatures, sea level rise, changes in precipitation, and more frequent or intense extreme events.

Food

- Changes in climate could have significant impacts on food production around the world. Heat stress, droughts, and flooding may lead to reductions in crop yields and livestock productivity. Areas that are already affected by drought [...] will likely experience reductions in water available for irrigation. [...] In some African countries, for example, yields from rain-fed agriculture in drought years could decline by as much as 50% by 2020. This decline will likely be exacerbated by climate change.
- [...] Increasing ocean temperatures have shifted some marine species to cooler waters outside of their normal range. [...] Projected reductions in water flows and increases in sea level may negatively affect water quality and fish species in this region. This would affect the food supply for communities that depend on these resources.

Water

- Semi-arid and arid areas [...] are particularly vulnerable to the impacts of climate change on water supply. [...] The availability of water resources is strongly related to the amount and timing of runoff and precipitation. By 2050, annual average river runoff is projected to increase by 10-40% at high latitudes and in some wet tropical areas, but decrease by 10-30% in some dry regions at mid-latitudes and in the subtropics. As temperatures rise, snowpack is declining in many regions and glaciers are melting at unprecedented rates, increasing flood risks. Droughts are likely to become more widespread, while increases in heavy precipitation events would produce more flooding.
- Water quality is important for ecosystems, human health and sanitation, agriculture, and other purposes. Increases in temperature, changes in precipitation, sea level rise, and extreme events could diminish water quality in many regions. In particular, saltwater from rising sea level and storm surges threaten water supplies in coastal areas and on small islands. [...].

Human Health

- [...] Sustained increases in temperatures are linked to more frequent and severe heat stress. The reduction in air quality that often accompanies a heat wave can lead to breathing problems and worsen respiratory diseases. Impacts of climate change on agriculture and other food systems can increase rates of malnutrition.
- Climate changes can influence infectious diseases. The spread of meningococcal (epidemic) meningitis is often linked to climate changes, especially drought. [...] The spread of mosquito-borne diseases such as malaria may increase in areas projected to receive more precipitation and flooding. Increases in rainfall and temperature can cause spreading of dengue fever. [...].

Shelter

- [...] Extreme events displace many people, especially in areas that do not have the ability or resources to quickly respond or rebuild after disasters. Extreme events may become more frequent and severe because of climate change. This could increase the numbers of people migrating during and after these types of events.
- Coastal settlements are particularly vulnerable to climate change impacts, such as sea level rise and extreme storms. As coastal habitats (such as barrier islands, wetlands, deltas, and estuaries) are destroyed, coastal settlements can become more vulnerable to flooding from storm surges. [...].

Security

- Climate change impacts have the potential to exacerbate national security issues and increase the number of international conflicts. [...] Rapid population growth and changes in precipitation and temperature, among other factors, are already affecting crop yields. Resulting food shortages could increase the risk of humanitarian crises and trigger population migration across national borders, ultimately sparking political instability.
- Increased melting of ice in the Arctic Ocean is a very likely climate change impact with national security implications. [...] Declining sea ice coverage will improve access to these waters. [...] [I]ncreasing access to these waters means that issues of sovereignty (priority in control over an area), security (responsibility for policing the passageways), environmental protection (control of ship-based air and water pollution, noise, or ship strikes of whales), and safety (responsibility for rescue and response) will become more important.

[10] Adapted from: "Climate Impacts on Global Issues," *USEPA,* 2013, http://www.epa.gov/climatechange/impacts-adaptation/international.html

ACT

IVC #1 Presentation Preparation and Outline	
TIME IVC Outline Preparation– 45 minutes (before IVC) IVC #1 – 60 minutes	**MATERIALS** IVC #1 Outline (SW p. 18-19)
OVERVIEW The outline below will be used as a guide for discussion during the first IVC.	

INSTRUCTIONS

1. **Presentation Preparation: Climate Change in Our communities**
   In this IVC, **students introduce their community and environment to their peers through a picture slideshow** of photos gathered from "The Climate Change and Global Issues Connection" activity**.**
   - Students compile photos of their local environment and potential climate change impacts on these environments into a picture slideshow.
   - Students upload the picture slideshow to the Google+ Online Platform and prepare to present the slideshow to peers during the IVC.

2. **IVC Outline.** Have students use the outline below to prepare roles, responsibilities and presentation notes for **IVC #1: Global Climate Change**

	Day	Date	Tech Dial-in Time	Conference Start Time	Backup Day / Date
IVC 1: Global Climate Change					

I. Introduction to *Global Connections and Exchanges: Youth TechCamps* (5 minutes)
GNG facilitator introduces students to the *TechCamps* program. One representative from each school introduces him/herself and their classmates to their partner school.

- Name of Class Representative:
- Number of students participating in IVC #1:
- Local weather and temperature (in degrees Celsius **and** Farenheit):
- Interesting background about your school or community:

II. Presentation: Climate Change and our Communities (20 minutes) Groups introduce their school, local environment and potential climate change impacts through presentation of the picture slideshow.

Select three representatives to introduce the picture slideshow and share evidence and future predictions on climate change impact in your community:

Use this space to record questions:

III. **Debrief: The Impacts of Global Climate Change (20 minutes)** Groups share impressions on the causes and impacts of climate change from their knowledge gained and additional research.

Select five representatives (one per topic: food, water, health, security, shelter) to share research on how students' selected global challenge is impacting a region, nation, or local area.

- Global Challenge and Summary Example
- Did you learn anything that surprised you? If so, what?
- **What consequences or risks** may result if this challenge is not addressed?

Reflect on the outcomes of the Climate Change Model activity and think about your local community. Are there any actions your country is currently taking to address greenhouse gas emissions?

- Do you feel these measures are adequate to address human impact on their environment?
- In what areas do you think improvements can or should be made?
- How do you view your role, as youth, within dialogue on climate change in your community and the world?

Use this space to record questions:

IV. **60-Second Showcase! (10 minutes)** In each IVC, students will have the opportunity to share more about their personality through showcasing personal talents or interests for their peers. Students are encouraged to participate *only once*, until all classmates have shared with their peers. 60-Second Showcase! can include: playing a musical instrument, singing, dancing, reciting poetry, exhibiting art (paint, sculpture, etc.); showing any equipment, pictures or medals associated with a sports hobby; sharing any dress or dance associated with a custom or holiday; or explaining a family heirloom or other artifact of significance.

Select three student representatives to share a personal interest or talent for their peers in this IVC.

a. Name of Representative:
b. Name of Representative:
c. Name of Representative:

V. **Conclusion (5 minutes)**

GNG facilitator thanks all students and teachers for participating and reminds participants to prepare the next module for the upcoming IVC.

REFLECT

IVC #1 Debriefing Conversation	
TIME: 15 minutes *(Either immediately following or shortly after IVC meeting)*	**MATERIALS** Pen, paper, internet access to online platform

OVERVIEW

Following each IVC, educators are encouraged to engage their students in a short reflective conversation on the module topic, the module activities, and their IVC experience.

INSTRUCTIONS

Use the suggested reflection questions below to guide a conversation with your class.

1. **REFLECT on your Conversation:**
   - By preparing the picture slide show about your school/community, what did you realize/learn about your own environment?
   - Through engaging with your peers in real time dialogue, what did you learn about their environment? How does it differ from your own?
   - How will climate change impact your peers' environment similarly/differently than your own?
   - Of the topics covered in the IVC, which would you like to discuss further?
   - What questions do you have for the next IVC?

2. **CONNECT on Google+:**
   - On Google+, share your favorite revelation about your partner country peers and their personal ecosystems.
   - On Google+, post remaining questions you have for your peers. Make sure to check back and answer questions from your peers.

EDUCATOR FEEDBACK SURVEY: Following each IVC, educators are encouraged to complete the "Educator Feedback Survey." The survey should not take more than 10 minutes to complete, and will be e-mailed directly to educators immediately following the IVC.

Module 2: Sustainable Energy Sources

Overview

In **Learn**, students will gain an understanding of nonrenewable and renewable energy and identify examples of renewable energy sources being used in their community, country or around the world. Students will participate in a debate to strengthen their public speaking skills and deepen their understanding of energy sources in use.

In **Act**, students will share their knowledge gained on energy sources and their example of a renewable energy source in action during the second interactive videoconference.

Background

Energy sources can be classified into two types: nonrenewable and renewable. **Nonrenewable resources**, such as fossil fuels and nuclear material, are removed from the earth and can be depleted. These resources have been the most used type of energy in the modern era. **Renewable resources**, such as wind, water, solar, and geothermal, come from sources that regenerate as fast as they are consumed and are continuously available. Some, such as biofuel produced from food crops and other plants, are replenished every growing season.[11]

Module Objectives

- Identify differences in environmental impact between renewable and nonrenewable energy
- Strengthen research and public speaking skills through debate

	Activity	Estimated Time
LEARN	What is renewable energy? World Energy Debate	45 Minutes 60 Minutes
ACT	Interactive Videoconference #2	45 Minutes Prep 60 Min. IVC + 30 Min. Dial-in
REFLECT	Connect on Google +	15 Minutes

[11] Adapted from: "Introduction to Major Energy Sources," *Pennsylvania Historical & Museum Commission,* 2013, http://www.portal.state.pa.us/portal/server.pt/community/types_of_energy/4568

LEARN

What is Renewable Energy? [12]	
TIME: 45 minutes	**MATERIALS**: "The Climate Change and Energy Connection" Reading (EH p. 24, SW p. 25), "Energy Exploration" Worksheet (EH p. 25 – 28, SW p. 26 – 29)

OVERVIEW

Students learn about renewable energy sources and will distinguish them from nonrenewable sources.

Upload activity on Google+ and share during the IVC!

INSTRUCTIONS:

1. **Read** "The Climate Change and Energy Connection"
   - What is the relationship between climate change and energy?
   - Identify at least three activities mentioned in the reading.
     - What energy type is being used to complete this activity?
     - What greenhouse gases are emitted by this energy source?

2. **Define:** *energy*, *energy source, renewable and non-renewable.* If time allows, view "Renewable v. Nonrenewable Energy Sources"(http://www.youtube.com/watch?v=pBTnVoEIb98) for support:
   - **Energy** - the ability to do work, or the cause of all activity[13]
   - **Energy Source** - something that can be tapped to provide heat, chemical, mechanical, nuclear, or radiant energy
   - **Renewable** - a source of usable power that can be replaced as it is consumed.
   - **Nonrenewable** - a source of usable power that cannot be replaced within a human lifetime.

3. Distribute and have students complete the "Energy Exploration" worksheet, indicating whether each energy source is renewable or non-renewable and the benefits, consequences, contribution to climate change, and the future of each energy source.

4. **Share**. Debrief, having each group share the summary points of their energy source with their peers. By the conclusion of this exercise, each student should have the "Energy Exploration" worksheet completed, including a clear understanding of which energy sources are renewable and nonrenewable, and the environmental impacts of each.

Adaptation versus Mitigation. The challenge of confronting the impacts of climate change is often framed in terms of two potential paths: *adaptation* and *mitigation*. **Mitigation** refers to any strategy or action taken to remove or reduce the amount of greenhouse gases released into the atmosphere. **Adaptation** involves efforts to limit vulnerability to climate change impacts through various measures, while not necessarily dealing with the underlying cause of those impacts. Adaptation and mitigation are complementary to each other. If mitigation measures are undertaken effectively, there will be less need to adapt to changes. Similarly, if adaptation measures are strong, the impacts associated with any given degree of climate change will also be less.

- ***Can you think of an example wherein your community adapted to climate change? What was the vulnerability and the adaptation?***
- ***What efforts do you think your community should take to help mitigate climate change impacts in the future?***

[12] TEXT BOXES: "Adaptation vs. Mitigation," *Penn State College of Earth and Mineral Sciences,* 2014, https://www.e-education.psu.edu/meteo469/node/175 and "Adaptation and Mitigation," *KNOW Climate Change,* 2014, http://know.climateofconcern.org/index.php?option=com_content&task=article&id=143

[13] Adapted from: "Renewables are Ready," *Union of Concerned Scientists,* 2003, http://www.ucsusa.org/assets/documents/clean_energy/renewablesready_fullreport.pdf

5. **Energy in Use**. In groups, students take an inventory of energy-sourced items found in their classroom (for example: lights, computers, projectors, phones). For each item, students identify whether it is powered by a renewable or nonrenewable energy source.
   - Total the number of items powered by renewable and nonrenewable energy sources.
   - For those powered by nonrenewable energy, students identify at least one way in which renewable energy could power the same item.

6. **Local Connections**.[14] Students research and identify an example (in addition to any identified in their classroom) of a renewable energy source being used in their community and share this on the Online Platform.
   - What renewable energy source is being used?
   - What type of nonrenewable energy is it replacing?
   - What are the environmental impacts, both benefits and consequences?

Renewable Energy in Jordan – Solar Power. One of the most promising potential investments in renewable energy worldwide will be installing more than 250 MW of concentrated solar power (CSP) in Jordan's Ma'an development zone through different projects developed by the private sector. The upcoming CSP solar power plants in Ma'an would highlight Jordan's strategy of sustainable energy diversification. The Ma'an Development Area enjoys about 320 days of sunshine a year, with a high level of irradiance that allows over 2500 million kWh of primary energy to be harvested annually from each square kilometre. At full capacity, the planned flagship CSP plant could meet some 4% of the Kingdom's electricity needs, reducing the reliance on electricity imports from neighboring countries.

Renewable Energy in the United States – Hydropower. Water is the most common renewable source of energy in the United States today. Many hydroelectric power plants use a dam on a river to store water. Water released from behind the dam flows through a turbine, spinning it, which then turns a generator to produce electricity. Electricity generated this way is known as hydroelectricity, and it accounts for about 7% of the electricity used by the nation. The Hoover Dam, for example, generates on average about 4 billion kilowatt-hours of hydroelectric power each year, which is enough to serve 1.3 million people. Hydroelectric power doesn't necessarily require a large dam. A small or micro-hydroelectric power system can produce enough electricity for a home, farm, or ranch.

CONNECT on GOOGLE+: Share details on the renewable energy source in action you researched on Google+. View and comment on the posts of your peers!

[14] TEXT BOXES: "Solar Power Projects in Jordan," *CleanTech Solutions,* 1 Nov 2013, http://www.cleantechloops.com/solar-projects-in-jordan/ and "Hydropower at the Hoover Dam," *US Department of the Interior,* 2009, http://www.usbr.gov/lc/hooverdam/faqs/powerfaq.html

"The Climate Change and Energy Connection" Reading

What is the climate change and energy connection?[15]

It takes many kinds of energy to fuel our lives. We use energy from the food we eat to power our daily activities. We also use different sources of energy to transport us, to heat and cool our homes, and to power our computers and televisions. In many cases, using energy emits greenhouse gases that contribute to climate change.

Some energy is produced through the burning of **fossil fuels**. When we produce energy this way, it adds to the amount of carbon in the atmosphere. We are adding more CO_2 in the atmosphere than the carbon cycle is able to keep up with. This means we are increasing CO_2 concentrations in the atmosphere to a level that impacts climate change.

Fossil Fuels are a source of energy produced by the decomposition of prehistoric plants and animals.

Greenhouse Gases are certain gases in the atmosphere (water vapor, carbon dioxide, nitrous oxide, and methane) that trap energy from the sun.

Transportation is a major use of energy and a large source of **greenhouse gas emissions**. Fossil fuels, which account for almost all the energy used in transportation, produces greenhouse gases such as carbon dioxide ($C0_2$), nitrous oxide (N_2O) and other air pollutants.

Another major use of energy is for heating and cooling buildings where we live, work, and go to school. Most heating and cooling of buildings and cars, as well as the energy required to cook food, is done through the use of electricity, or the burning of oil, natural gas, firewood or other biomass (plant or animal matter). All of these methods produce greenhouse gas emissions, including CO_2.

We use electricity to power appliances and electronics and to light buildings and streets. Burning coal in large power plants often produces electricity. Energy from burning coal travels long distances through wires to homes, schools, and business. Coal-burning power plants are a major source of CO_2 emissions.

The good news is that there are many technologies available to reduce climate impacts from transportation, heating, cooling, and providing electricity. According to Princeton University scientists, by using things we already know about, we can maintain CO_2 emissions at our current level (7 billion tons of CO_2 per year.) Electricity can come from renewable energy sources (usable power that can be replaced as it is consumed) like the sun, wind, and water and don't contribute greatly to greenhouse gas emissions.

Of all approaches to reducing greenhouse gas emissions, **energy conservation** is the easiest and least expensive. Increasing insulation (which keeps inside air warmer in the winter and cooler in the summer) and using energy-efficient appliances (which do the same amount of work using less energy) can help reduce our emissions.

[15] Adapted From: "Facing the Future, Save Your Energy!," 2013, http://www.facingthefuture.org/

"Energy Exploration" Worksheet

	Description	Notes
Solar Power	**What is solar energy?** Solar energy is energy from the sun that can be converted into electrical energy. **How is it used?** Photovoltaic (PV) cells, which are made from metals and silicon, are often used to convert solar energy into electricity. **Environmental Impact?** Although a PV cell itself doesn't release greenhouse gases, the process of creating the PV cell is energy intensive and releases greenhouse gases. **Human Impact?** Initially PV cells can be costly for consumers. However, because the sun's energy is free and people who get energy from PV cells don't have to pay an electric company for solar energy, solar power can be cost-effective in the long term.	☐ Renewable ☐ Non-renewable Benefits: Consequences: Does using solar energy for electricity contribute to climate change? Should solar energy be a major source for future electricity production?
Hydropower	**What is hydropower?** Hydropower is the energy generated by moving water. **How is it used?** A dam is built to harness flowing water and create electricity as needed. **Environmental Impacts?** Hydropower does not result in carbon dioxide emissions, air or water pollution. Dams do have major impacts on the environment. Sediment (soil, sand, leaves) can build up in the bodies of water held by dams, reducing water quality. This affects the organisms that live in and around the water. It may also cause erosion along riverbanks. **Human Impacts?** People must be relocated from their homes if they live in an area where a dam and reservoir are to be constructed. Some people may benefit from reservoirs, which can serve as resources for recreational activities such as swimming and fishing. Water is a relatively cheap energy source. The cost of hydropower lies in building and maintaining dams and channels.	☐ Renewable ☐ Non-renewable Benefits: Consequences: Does using hydropower for electricity contribute to climate change? Should hydropower be a major source for future electricity production?

Wind	**What is it?** Wind is produced when the sun unevenly heats Earth's surface, causing air to circulate. This moving air is a form of energy that can be converted into electricity. **How is it used?** Generating electricity from wind power is most efficient when wind is blown consistently. Converting wind energy into electricity requires wind turbines (windmills). **Environmental Impacts?** The mining and processing of the metals used to make the turbines require energy and produces greenhouse gases. The operation of wind turbines does not produce any pollution. Wind turbines can be installed on land or offshore. **Human Consequences?** Some people don't like the way wind turbines look or the noise that large wind farms can create. Cost of wind power varies from year to year and high demand for wind turbines has pushed up prices.	☐ Renewable ☐ Non-renewable Benefits: Consequences: Does using wind power for electricity contribute to climate change? Should wind energy be a major source for future electricity production?
Nuclear Energy	**What is it?** Nuclear energy is obtained by splitting apart atoms in a process called fission. Uranium, a nonrenewable metal found in rocks, is used as a fuel for nuclear fission. In a nuclear reactor, where nuclear energy is used to generate electricity, heat is released from this process. This heat is used to generate electricity. **How is it used?** Nuclear power plants are built near large bodies of water because the plants require a lot of water. Water is used to produce steam from the heat of fission; the steam spins a turbine to generate electricity. Water is also used to absorb wasted heat. Once used, the water is put back into the nearby body of water. **Environmental Impacts?** Fission doesn't result in any greenhouse gas emissions. However, greenhouse gases are produced during construction of a nuclear power plant and from mining and transporting uranium. **Human Impacts?** Uranium is radioactive and can harm living organisms if it is released into the environment. Uranium used for nuclear fuel can be used to create nuclear weapons.	☐ Renewable ☐ Non-renewable Benefits: Consequences: Does using nuclear power for electricity contribute to climate change? Should nuclear energy be a major source for future electricity production?

Geothermal	**What is it?** Geothermal energy (GE) is heat that originates within the earth. Extremely high temperatures are produced inside the earth by the slow decay of radioactive particles, a process that happens naturally in rocks. Reservoirs of hot water, steam, and hot dry rocks can be used to generate electricity. **How is it used?** GE can be felt near Earth's surface (hot springs). The shallow ground of the earth provides GE that can be accessed almost anywhere to heat or cool buildings. GE heat pumps transfer heat from the ground into buildings in the winter and reverses the process in the summer, transferring heat from the air into the cooler ground. **Environmental Impacts?** Pipes can be drilled 1-2 miles (1.6 – 3.2 km) below Earth's surface to reach reservoirs of thermal energy. Construction of geothermal power plants that drill pipes deep into the ground can affect land stability in the surrounding region. However, after a power plant has been constructed, geothermal energy has lower environmental impacts than fossil fuels. Geothermal energy is constantly available and is unaffected by weather.	☐ Renewable ☐ Non-renewable Benefits: Consequences: Does using geothermal energy for electricity contribute to climate change? Should geothermal energy be a major source for future electricity production?
Oil	**What is it?** Oil is formed from the remains of animals and plants that lived millions of years ago. Over time, layers of sand covered the remains of these animals and plants. Heat and pressure from these layers helped the remains turn into what we call crude oil. **How is it used?** To find oil and natural gas, companies drill through the earth to the deposits deep below the surface. The oil and natural gas are then pumped from below the ground by oilrigs. They then usually travel through pipelines or by ship. **Environmental Impacts?** Petroleum harms the environment through air and water pollution. Oil emits dangerous greenhouse gases and oil spills cause ecological disasters. **Human Impacts?** Products from oil help us fuel airplanes, cars, and trucks, heat our homes, and make products like medicines and plastics. Oil sources are very limited and will not last forever.	☐ Renewable ☐ Non-renewable Benefits: Consequences: Does using oil for electricity contribute to climate change? Should oil be a major source for future electricity production?

Coal	**What is it?** Coal is a black rock formed by organic material over millions of years. It is a fossil fuel because of the long time required to create it. **How is it used?** Initially, coal is extracted from the surface of underground mines. The coal is often washed at the coal mine to remove impurities before it is transported to the power plant. At the power pant, coal is commonly burned in a boiler to produce steam. The steam is run through a turbine to generate electricity. **Environmental Impacts?** Burning coal releases air pollutants and creates solid waste called ash. Transporting coal from mines to power plants relies heavily on fossil fuels to power trains, and trucks. **Human Impacts?** Safety concerns related to shaft mining include lung damage to workers and collapse of mine shafts. Mountaintop removal can damage ecosystems and drinking water supplies. Although transporting coal is expensive, coal is affordable for consumers.	☐ Renewable ☐ Non-renewable Benefits: Consequences: Does using coal for electricity contribute to climate change? Should coal be a major source for future electricity production?
Natural Gas	**What is it?** The main ingredient in natural gas is methane, a greenhouse gas that warms the earth's surface. It is considered a fossil fuel because it is composed of ancient organic material. **How is it used?** Natural gas can be drilled from below the Earth's surface either on land or in the ocean. Pipelines are used to bring up to the Earth's surface, where it is stored or transported elsewhere to create electricity. **Environmental Impacts?** Burning natural gas to create electricity produces carbon dioxide and nitrous oxide emissions. Natural gas burns "cleaner" than coal and oil because it produces fewer greenhouse gas emissions and other air pollutants. Drilling below the Earth's surface for natural gas can cause erosion and landslides. **Human Impacts?** Natural gas is very flammable and can cause explosions if it leaks from pipes or storage containers.	☐ Renewable ☐ Non-renewable Benefits: Consequences: Does using natural gas for electricity contribute to climate change? Should natural gas be a major source for future electricity production?

World Energy Debate	
TIME: 60 minutes	**MATERIALS**: Debate Graphic Organizer (EH p. 31, SW p. 32)

OVERVIEW

Students will engage in a debate and use research, persuasion and public speaking skills to deepen understanding of sustainable energy alternatives as a means to combat the effects of climate change.

INSTRUCTIONS

1. **Select a topic:** Students identify an example of nonrenewable energy use in their school or community. Refer to your classroom inventory list ("What is Renewable Energy" Activity) for ideas.

2. **Create a Debate Prompt**: Students write a debate prompt on replacing their chosen energy source with a type of renewable energy. This should be an opinion statement, meaning that it can be argued and there is no right answer. The prompt should have more than two potential perspectives or answers.

   Sample Debate Prompt: Solar energy is a solution to our school's growing electricity bill.

3. **Define Debate Positions**: As a class, brainstorm 2-4 positions on the debate prompt. Each will serve as the main argument of one group or side in the debate, like a thesis statement would lead an essay. The position should directly respond to the prompt and be argued with the support of concrete evidence. **Students should consider perspectives from all sides of the debate.*

4. **Research and Prepare Your Positions:** Divide the class into groups, one for each debate position (ideally 2-3 students per group). Students take on perspectives different than their own and work in groups to research their topic, define arguments for their position, and find evidence and supporting arguments.

   Students use the *Debate Graphic Organizer* to prepare three arguments supporting each position. Each argument should include 2-3 pieces of evidence, quotes, or perspective from academic or media resources.

   Students spend 5-10 minutes after researching to clarify the group's position on the debate prompt, and prepare three arguments and evidence. Students will prepare as a team, but should designate one student as a "lead speaker" to present opening and closing arguments. Other students in the group should be prepared to present specific arguments and evidence, and rebut other group's positions.

5. **Debate!** Provide 20-30 minutes for students to debate on their topic, using their research notes and well-crafted arguments. Use the format on the next page to guide the debate.

   Note: *An educator or student should moderate the debate, to ensure that groups follow time limits and ask questions respectfully.*[16]

6. **Post-Debate Reflection.** As a class, reflect upon the debate in a group discussion.
   - What did you learn from other groups in the debate?
   - What was it like to argue a position that wasn't the same as your own view?
   - Did your opinions about this issue change? If so, how? If not, why?

[16] Rebuttal argument definition based off of Pearson resources at *http://wps.ablongman.com/long_faigley_grca_3/43/11074/2835168.cw/index.html*.

Debate Components

Opening Statement: An opening statement presents your position and gives a brief overview of the main argument. This is your first chance to engage your audience; be assertive and confident.

Rebuttal: Rebuttal statements use critical thinking to challenge other debaters' claims. Rebuttals may ***refute*** an argument, or prove that it is incorrect, by identifying flaws in the evidence or assumptions. Rebuttals can also acknowledge the valid elements of the other side's perspective, but then provide a ***counter argument*** that is stronger and more important than the original statement.

Challenging: When a debater is presenting, other groups may challenge, or present a question or statement aimed to provide information to the audience or contest the speaker's point with a counter argument.

Debate Format (20-30 minutes)

OPENING STATEMENTS: 1 minute per team Each team (up to 4) presents their opening statement, which includes their position on the debate prompt and an overview of their main arguments.
ARGUMENT and EVIDENCE ROUNDS: 5-7 minutes per team Each team (up to 4) has the opportunity to present their three main arguments and supporting evidence, followed by an opportunity for other teams to challenge, and concludes with a rebuttal. There will be as many rounds as there are teams.
1. The team **presents its 3 main arguments** and supporting evidence (2-3 minutes).
2. **Opportunity to challenge***: Other groups ask any clarifying questions or challenge the presented arguments (1 minute). **Students may challenge only once per round, to encourage as many students to participate in the activity as possible.*
3. **Rebuttal**: The presenting team has the opportunity to defend its position and clarify arguments (2-3 minutes).
CONCLUDING STATEMENTS: 2 minutes per team Each team (up to 4) has a final opportunity to argue for their position. The closing statement should recap the team's position and argument, while answering any lingering questions that were not answered during the rebuttal. As the last statement of their position, speakers should be persuasive and confident.

Debate Graphic Organizer

Debate Prompt:

Group Position:

Arguments Supporting Position	**Evidence from Media and Academic Resources** *(Sources could include websites, newspaper, articles, video, etc.)*
Argument 1:	1. 2. 3.
Argument 2:	1. 2. 3.
Argument 3:	1. 2. 3.

ACT

IVC #2 Presentation Preparation and Outline	
TIME IVC Preparation – 45 minutes (before IVC) IVC – 90 minutes (including dial-in)	**MATERIALS** IVC #2 Outline (SW p. 33 – 34)
OVERVIEW The outline below will be used as a guide for discussion during the second IVC.	
INSTRUCTIONS 1. **Presentation Preparation: Renewable Energy in Action.** In this IVC, students **share examples of how a renewable energy source is being used in their community** (from "What is Renewable Energy?" activity). ○ Students compile pictures of this renewable energy source in action and prepare to describe: ○ What type of nonrenewable energy is it replacing? ○ What are the environmental impacts, both benefits and consequences? 2. **IVC Outline.** Have students use the outline below to prepare roles, responsibilities and presentation notes for **IVC #2: Sustainable Energy Sources**.	

	Day	Date	Tech Dial-in Time	Conference Start Time	Backup Day / Date
IVC 2: Sustainable Energy Sources					

IVC Outline

I. Introduction and Greetings (5 minutes) GNG facilitator welcomes all participating students to the second IVC meeting. One representative from each school shares:

- Number of students participating in IVC #2:
- Something interesting that has happened in your community since the last IVC:
- A national/international event that has impacted you/your community since the last IVC:
- Local weather and temperature (in degrees Celsius and Fahrenheit):

II. Climate Change in the News (8 minutes) One representative from each school shares a LOCAL newspaper headline or story about climate change, weather, science and/or technology innovation.

- Name of class representative:
- News Topic and Title:
- Summary:

III. Presentation: Renewable Energy in Action (16 minutes) Students share examples of renewable energy sources in use in their community.

Name of Class Representative:

- Renewable Energy Source
- How has this energy source impacted your community?
- What type of nonrenewable energy is it replacing?
- What are the environmental impacts, both benefits and consequences?

Use this space to record questions:

IV. Debrief: Debate Recap (20 minutes) Students share reflections from their in-class energy debate.

- Name of class representative(s):
  - Statement, arguments and counterarguments debated
  - Did your opinions about this issue change? If so, how? If not, why?

Use this space to record questions:

V. 60-Second Showcase! (8 minutes)

Select three student representatives to share a personal interest or talent for their peers. *Try to maintain Show and Tell as predominately visual or require little technical explanation, especially for IVCs using consecutive translation.*

a. Name of Representative:

b. Name of Representative:

c. Name of Representative:

VI. Conclusion (3 minutes)

GNG facilitator thanks all students and teachers for participating and reminds participants to prepare the next module and for the upcoming IVC.

REFLECT

IVC #2 Debriefing Conversation	
TIME: 15 minutes *(Either immediately following or shortly after IVC meeting)*	**MATERIALS** Pen, paper, internet access to online platform
OVERVIEW Following each IVC, educators are encouraged to engage their students in a short reflective conversation on the module topic, the module activities, and their IVC experience.	
INSTRUCTIONS ***Use the suggested reflection questions below to guide a conversation with your class.*** 1. **REFLECT on your Conversation:** • What is the difference between renewable and nonrenewable energy sources? • How can we start transitioning to using only renewable energy sources? • How are adaptation and mitigation related to one another? Do you know of any ways your own community is addressing impacts of climate change through either adaptation or mitigation? • Of the topics covered in the IVC, which would you like to discuss further? • What questions do you have for the next IVC? 2. **CONNECT on Google+:** • Using sustainable energy sources will be important for the future of our planet. Where are some areas nonrenewable energy is used in your community, and what are some ways you think you can address these challenges through a collaborative project with your international peers?	

EDUCATOR FEEDBACK SURVEY: Following each IVC, educators are encouraged to complete the "Educator Feedback Survey." The survey should not take more than 10 minutes to complete, and will be e-mailed directly to educators immediately following the IVC.

Module 3: Citizen Science

Overview

In **Learn**, students will participate in the worldwide Citizen Science Project, "World Water Monitoring Challenge," through collecting data on bodies of water in/near their community and contributing their results to a worldwide database. Students will be introduced to the **Collaborative Innovation Project** and consider ways in which citizen science can be harnessed as a data collection tool in their own work.

In **Act**, students will share their Citizen Science data collection and conduct a needs assessment to brainstorm ideas for the Collaborative Innovation Project.

Background

Technology innovations are occurring daily. **Citizen science**, the practice of using technology to include public participation within scientific research, is one example of technology-enabled engagement of everyday individuals in scientific exploration.

In citizen science, people are given the opportunity to collaborate with one another, scientists and researchers by collecting, sharing and contributing to data monitoring and collection programs.

Modern advances in technology make citizen science more accessible today than ever before. Historically, when professional scientists wanted to gather information, they would use pre-existing citizen science networks of birders, weatherbugs, and other amateur groups. With the widespread availability of the Internet in the late 1990s, it became easier for people outside of these networks to share and contribute information to data collection projects. Through easily accessible technology, new networks and communities of interested citizen scientists are created each day, able to contribute to ongoing projects and create new projects, all the while increasing access points for everyday individuals and expert scientists to learn more about the world and how we can contribute to understanding it.[17]

Module Objectives

- To practice data collection tools through testing water quality in local communities
- To engage with individuals worldwide in a large-scale citizen science project

	Activity	Estimated Time
LEARN	Citizen Science: World Water Monitoring Citizen Science and Our Community Collaborative Innovation Project: Introduction and Needs Assessment	60 Minutes + Overnight 30 Minutes 30 Minutes + Overnight
ACT	Interactive Videoconference #3	45 Minutes Prep 60 Min. IVC + 30 Min. Dial-in
REFLECT	Connect on Google +	15 Minutes

[17] Adapted from: "Citizen Science," *National Geographic Education*, 2013, http://education.nationalgeographic.com/education/encyclopedia/citizen-science/?ar_a=1

LEARN

Citizen Science: World Water Monitoring Challenge[18]	
TIME: 60 minutes + overnight	**MATERIALS:** Computer, Internet Access, Water Quality Test Kit, "Citizen Science: Water Quality Data Collection" Worksheet (EH p. 37 – 38, SW p. 38 – 39), Appendix A: World Water Monitoring Challenge: Instructions

KEY VOCABULARY

Citizen Science, Turbidity, Temperature, Dissolved Oxygen, pH

OVERVIEW

In this activity, students will participate in the citizen science project, "World Water Monitoring Challenge." They will be tasked to measure the water quality from at least one body of water in their own community, and then share their data with a network of over 250,000 volunteers collecting water quality data from around the world.

INSTRUCTIONS

1. **Introduction**. Water access and quality was identified as one of the five global challenges affected by change in the earth's climate. Have students identify of a body of water in or near their own community. Develop a word web around the phrase **CLEAN WATER** identifying:
   - What does it mean for that body of water to be clean?
     - Who uses that body of water?
     - Does clean water mean that humans are able to drink the water?
     - Does clean water mean that the water is safe for animals?
     - Why should water be clean? What may prevent water from being clean?

> *Note: **Clean Water** is being defined as water that maintains a healthy ecosystem safe for humans, plants and/or animals, depending on water source.*

2. **Measuring Water Quality.** Distribute "Citizen Science: Water Quality Data Collection" Worksheet, reviewing:
   - **Part 1: Water Quality Indicators**, ensuring the purpose for testing each indicator is understood.
   - **Part 2: Data Collection Safety and Procedures**
   - **Part 3: Water Quality Test Kit Components**

3. **Collecting Water Quality Data.** In groups or individually, have students identify a body of water in their community, complete the four water quality tests, and record their data in **Part 4: Water Quality Data and Observations**. Water types must include: bay, canal, ditch, drain, estuary, lake, ocean, pond, reservoir, river, spring/seep, straight, stream/creek, or wetlands.

4. **Become a Citizen Scientist**. As part of World Water Monitoring Day, individuals worldwide are collecting data on the quality of water in their community. Students will join this global data collection campaign by contributing water quality data to the World Water Monitoring Day international database.
   - **Set-up Account:** Visit http://www.monitorwater.org/default.aspx to setup your group's account for the entire class.
   - **Register Your Site:** Click "Add a site" to enter the location information of your water sample.
   - **Enter Data:** Enter the data collected for each water quality indicator. Your data will contribute to the **World Water Monitoring Report 2014!**

   If time and availability permits, collect data from more than one water type and/or on more than one date in order to be able to contribute multiple data entries for your city and country.

[18] "World Water Monitoring Challenge," 2013, http://www.worldwatermonitoringday.org/

"Citizen Science: Water Quality Data Collection" Worksheet

Part 1: Water Quality Indicators

Water Quality Indicators		Appropriate Levels
Turbidity	Turbidity is the measure of how clear and free of matter water is. Suspended matters including clay, silt, organic and inorganic cause water to be turbid, or cloudy.	8 JTU – 10 JTU: May be harmful to animal life 5 JTU – 7 JTU: Healthy, well functioning ecosystem 0 JTU – 4 JTU: Safe for drinking
Temperature	Temperature is the measure of how hot or cold water is.	Warmer water holds less dissolved oxygen
Dissolved Oxygen	Dissolved oxygen is the percentage of oxygen that is saturated in water.	Total dissolved gas concentrations in water should not exceed 110 percent. Concentrations above this level can be harmful to aquatic life.[19]
pH	pH is the measure of how acidic or basic water is.	Standard pH levels are 6 to 8

Part 2: Data Collection Safety and Procedures

Read carefully and review pages 4 – 7 of **Appendix A: Water World Monitoring Challenge: Instructions**. Record notes on the following sections:

For Your Safety	
Test Kit Safety	
After Testing	
Testing Hints	
Collecting a Water Sample	

Part 3: Water Quality Test Kit Components

Read carefully and review pages 8 – 17 of **Appendix A: Water World Monitoring Challenge: Instructions.** Record notes on the following sections:

Turbidity Collection Procedure	
Thermometer Collection Procedure	
Dissolved O_2 Collection Procedure and % Saturation	
pH Collection Procedure	

[19] "Why dissolved oxygen is important," http://www.state.ky.us/nrepc/water/wcpdo.htm

Part 4: Water Quality Data and Observations[20]

Collect water from up to three sites and record measurements for temperature, dissolved oxygen, pH and turbidity in the chart below. *(Note: Chart also appears in Appendix A, page 19).*

- Water types must include: bay, canal, ditch, drain, estuary, lake, ocean, pond, reservoir, river, spring/seep, straight, stream/creek or wetlands.

Parameter	Site 1	Site 2	Site 3
Date			
Location			
Air Temperature			
Water Temperature			
Dissolved Oxygen			
pH			
Turbidity			

For each water sample collection site, record responses to the following questions:

1. How is the land around your site being used?

2. What is the source of your water body—where has it come from and where is it going?

3. Is there plant life growing alongside the water body (e.g., trees, shrubs, grasses)?

4. What is the weather like? What was it like the day before?

5. How does the water look? Is there trash in it? Is it oily or foamy?

6. Do you see insects in or near the water body (hint: try turning over a few rocks)? If so, does it look like there are several different types?

7. Is the stream deep or shallow, wide or narrow?

8. Is the stream bank eroding (does it look like it's crumbling)?

9. Are there lots of rocks and logs in the stream?

[20] "Observation Guide," *World Water Monitoring Challenge*, 2012, http://dev.wwmd.org/Observation_Guide.aspx

Citizen Science and Our Community [21]

TIME: 30 minutes	**MATERIALS:** Paper, Pencils, Internet Access

OVERVIEW

Students will reflect on their participation in a citizen science project, and consider how they may use citizen science and global online data collection as a tool in an environmental project of their own.

INSTRUCTIONS

1. **Analysis of Citizen Science Data**: Login to your World Water Monitoring Day account. Compare the data collected for your location to the world, national and state averages provided.
   - How does your data compare to each average? Attempt to explain any similarities, differences and/or abnormalities in water quality as compared to the given averages for your region.

2. **Comparison of Citizen Science Data:** After logging into your account, access the previous year's data and reports: http://www.monitorwater.org/ReviewReports.aspx.
   - Using the 2013 Map (http://monitorwater.org/outpost/map.aspx), **compare the data that you collected** this year to:
     - Data collected by a citizen scientist in the **same region in 2013** (same city, state and/or closest city/state).
     - Data collected by a citizen scientist on a **different continent from your own**.

   How does your data compare to the two samples collected in 2013? Attempt to explain any similarities, differences and/or abnormalities in water quality as compared to the given averages for each region.

3. **Reflection**: Lead class in discussion:
   - How did you feel engaging in this experience? Did you enjoy participating in this data collection process? Was there anything that you did not enjoy?
   - What benefits do you think scientists gain as a result of having water quality data collected across so many regions?
   - What challenges do you think exist with citizen science projects?
   - What did you learn about other places as a result of having access to data on their water quality? Were you able to hypothesize any reasons to explain similarities, differences and/or abnormalities in water quality as compared to the given average.

4. **Using Citizen Science:** In the next activity, students will be introduced to the Collaborative Innovation Project, which they will develop with peers internationally to address climate change in local and global communities. Based on experiences participating in a citizen science project, have students **list at least three ways in which they can foresee citizen science and global online data collection being helpful in their own endeavors to address climate change challenges.**

Climate Change and Water Quality. Heavy downpours can increase the amount of runoff into rivers and lakes, washing sediment, nutrients, pollutants, trash, animal waste, and other materials into water supplies, making them unusable, unsafe, or in need of water treatment. Freshwater resources along the coasts face risks from sea level rise. As the sea rises, saltwater moves into freshwater areas. This may force water managers to seek other sources of fresh water, or increase the need for desalination (or removal of salt from the water) for some coastal freshwater aquifers used as drinking water supply.

- ***How is climate change and water quality related?***
- ***Is water quality in your community affected by climate change? Why might this be problematic and what solutions, if any, are being taken to address water quality concerns?***

[21] TEXT BOX: "Water Resources," *US EPA*, 2013, http://www.epa.gov/climatechange/impacts-adaptation/water.html#waterquality

Collaborative Innovation Project: Introduction & Needs Assessment	
TIME: 30 minutes	**MATERIALS:** Collaborative Innovation Project Guidebook

OVERVIEW

Students will be introduced to the Collaborative Innovation Project and conduct a needs assessment in their communities in order to begin identifying potential topics to address in projects. **Upload activity on Google+ and share during the IVC!**

INSTRUCTIONS

1. **Introduce the Project:** Distribute the **Collaborative Innovation Project Guidebook** and have students read/review the introductory section (Guidebook, pgs. 1 – 9).

   Have a student or group of students read the Challenge Letter aloud (Guidebook, p. 7) to his/her peers. Lead a brief class discussion:
   - *What are your thoughts and feelings around taking on the Science Innovator challenge?*
   - *What obstacles do you think you will face during this challenge?*
   - *What is one thing you hope to achieve as a result of this challenge?*

   Record student responses, to be revisited at the conclusion of the project for reflection.

2. **Community Interview**: Background research into the community that students aim to impact with their project is extremely important so they can learn about the environmental issues that are most important and relevant to their target audience. In groups, have students interview members of the community to better understand the impact and scope of climate change within the community.
   - **Who**: Identify who in your community could give you insight into both issues and solutions around climate change. Who in your community has a stake in addressing climate change challenges? Use the people below as a guide to help you determine whom to interview:
     - Two teachers (Outside of your GNG program)
     - Two students (Outside of your GNG program)
     - Community members (Outside of school)
   - **What:** Use your knowledge of your community to create your own questions. Use the sample questions below to get you started.
     - Do you know what contributes to climate change, and what some effects of climate change are?
     - What challenges do you think our community faces as a result of changes in climate?
     - Of all of the challenges we discussed so far, do any challenges impact you personally?
     - Whom else does this issue effect?
     - What do you think can be done to address this issue?
     - What has already been done to address this issue?

3. **Compile Interview Data**: Debrief on all interviews conducted and make a list of issues mentioned by interviewees. Tally issues that were mentioned by more than one interviewee and be prepared to share the most common issues mentioned (at minimum five) by the next IVC with peers. Continue interviews with community members until students are able to identify at least five different environmental and climate change related issues affecting members of their community.

CONNECT on GOOGLE+: Share at least five issues identified from your needs assessment interviews to Google+. View and comment on the posts of your peers!

ACT

IVC #3 Presentation Preparation and Outline	
TIME IVC Preparation – 45 minutes (before IVC) IVC – 90 minutes (including dial-in)	**MATERIALS** IVC #3 Outline (SW p. 42 – 43)
OVERVIEW The outline below will be used as a guide for discussion during the third IVC.	

INSTRUCTIONS

1. **Presentation Preparation: Collaborative Project Needs Assessment**.
   In this IVC, students **share outcomes of their needs assessment,** which they gathered through community interviews of the previous activity. Students prepare to share issues collected through the needs assessment, including:
   - Who reported each issue?
   - How do these issues impact your community? Your partner country?
   - Why do you think these topics are important to address?
   - Are you and your classmates personally interested in pursuing any of these topics?

2. **IVC Outline.** Have students use the outline below to prepare roles, responsibilities and presentation notes for **IVC #3: Citizen Science**.

	Day	Date	Tech Dial-in Time	Conference Start Time	Backup Day / Date
IVC 3: Citizen Science					

IVC Outline

I. Introduction and Greetings (5 minutes) GNG facilitator welcomes all participating students to the third IVC meeting. One representative from each school shares:

- Number of students participating in IVC #3:
- Something interesting that has happened in your community since the last IVC:
- A national/international event that has impacted you/your community since the last IVC:
- Local weather and temperature (in degrees Celsius and Farenheit):

II. Climate Change in the News (8 minutes) One representative from each school shares a REGIONAL newspaper headline or story about climate change, weather, science and/or technology innovation.

- Name of class representative:
- News Topic and Title:
- Summary:

III. **Debrief: Citizen Science (16 minutes)** Students share their water quality data and compare this to the data of their partner country, as well as other international sites. Students discuss the merits and challenges of citizen science.

- Data Collection for Our Site (including water temperature, dissolved oxygen, pH and turbidity):

- Comparison to Partner Country and/or International Sites:

- Perceived merits and challenges of citizen science and global online data collection for own endeavors to address climate change challenges:

Use this space to record questions:

IV. **Presentation: Collaborative Project Needs Assessment**. Students share outcomes of their needs assessment, which they gathered through community interviews. **(20 minutes)**

- Issues to share with peers:

- Of the issues shared, are any relevant to both you local community and your partner country?
  - Share initial thoughts on where and how you think you may be able to address some of these challenges through a collaborative project.
  - What additional information might you need to gather before making further decisions?

Use this space to record questions:

V. **60-Second Showcase! (8 minutes)**

Select three student representatives to share a personal interest or talent for their peers. *Try to maintain Show and Tell as predominately visual or require little technical explanation, especially for IVCs using consecutive translation.*

- Name of Representative:
- Name of Representative:
- Name of Representative:

VI. **Conclusion (3 minutes)**

GNG facilitator thanks all students and teachers for participating and reminds participants to prepare the next module and collaborative project work for the upcoming IVC.

REFLECT

IVC #3 Debriefing Conversation	
TIME: 15 minutes *(Either immediately following or shortly after IVC meeting)*	**MATERIALS** Pen, paper, internet access to online platform
OVERVIEW Following each IVC, educators are encouraged to engage their students in a short reflective conversation on the module topic, the module activities, and their IVC experience.	
INSTRUCTIONS ***Use the suggested reflection questions below to guide a conversation with your class.*** 1. **REFLECT on your Conversation:** • What topics are of particular interest? Why? What additional research should you complete before deciding upon a topic? • Of the topics covered in the IVC, which would you like to discuss further? • What questions do you have for the next IVC? 2. **CONNECT on Google+:** • How do you think you might be able to incorporate citizen science into some of the ideas proposed for the Collaborative Innovation Project?	

EDUCATOR FEEDBACK SURVEY: Following each IVC, educators are encouraged to complete the "Educator Feedback Survey." The survey should not take more than 10 minutes to complete, and will be e-mailed directly to educators immediately following the IVC.

Module 4: Sustainable Design

Overview

In **Learn**, students define sustainability through learning about four creative and environmentally friendly designs. Students will use a "Design Abacus" to estimate the sustainability of a product's design.

In **Act**, students videoconference for the final time before meeting in-person for TechCamp in June 2014, identifying and sharing any current solutions and actions addressing the issues of their needs assessment, and brainstorming where and how they will be able to contribute further in innovative and sustainable ways.

Background

Sustainable design focuses on solutions to climate change challenges that are socially, economically and ecologically sustainable. Common principles of sustainable design include:

- Materials have a low environmental impact (for example: recyclables and non-toxic materials)
- Efficiency in manufacturing
- Longer lasting and better functioning products
- Products are easy to reuse and recycle

Sustainable design is an example of climate change **mitigation**, or a strategy or action taken to remove or reduce the amount of greenhouse gases released into the atmosphere.[22]

The "Design Abacus" is a tool students can use to evaluate the sustainability of a product. This tool is employed based on students' estimates and perceptions, not on actual data. The purpose of using a "Design Abacus" is not to conduct exact measurements and collect exact data, but rather to help students understand different social, economic or ecological impacts that products have, and how and where to focus improvement efforts to increase sustainability.[23]

Module Objectives

- To identify what makes a product sustainable in design
- To analyze current products for sustainability, and be able to problem-solve solutions towards more sustainable ends

	Activity	Estimated Time
LEARN	What does it mean to be sustainable? Measuring Sustainability: Design Abacus Collaborative Innovation Project Preparation: Initial Research	30 Minutes 45 Minutes 30 Minutes
ACT	Interactive Videoconference #4	45 Minutes Prep 60 Min. IVC + 30 Min. Dial-in
REFLECT	Connect on Google +	15 Minutes

[22] "Adaptation and Mitigation," *KNOW Climate Change,* 2014, http://know.climateofconcern.org/index.php?option=com_content&task=article&id=167

[23] "Sustainable Manufacturing Portal," *Loughborough University,* 2009, http://www.centreforsmart.co.uk/smp/tools_designabacus.php

LEARN

What does it mean to be sustainable?	
TIME: 30 minutes	**MATERIALS:** Paper, Pencils, Internet Access; "Creative Inventions" Worksheet (EH p. 46, SW p. 47)

OVERVIEW

Students will define sustainability and gain inspiration for creations that are sustainably designed.

INSTRUCTIONS

1. **Warm-up**. Distribute "Creative Inventions" Worksheet. Lead discussion:
   - What do all of the products have in common?
   - What types of energy are typically used to accomplish the purpose of each product?
   - What types of energy are being used to power each of these creative inventions?
   - What are the environmental impacts of each product? How does this compare to the traditional ways in which energy is used for each product purpose?

> ***Sustainable Design – Jordan.*** Feynan Ecolodge, located 215 km south of Amman, is a guesthouse that is entirely solar-powered, with natural ventilation and all water coming from a local spring. Plastic bottles are banned, as is meat! To save having to power a fridge to chill meat, the lodge serves vegetarian meals only!

2. **What is sustainability?** Define what it means for a product design to be **sustainable**. Standard definition should include:
   - **Sustainable Design**: designing of physical objects, the built environment, and services to comply with the principles of social, economic and ecological sustainability[24]

3. **Local Connections.**[25] In groups or individually, have students identify at least one product they use daily but which is not environmentally sustainable in design. That is, the product uses energy sources that are nonrenewable and emit waste that is harmful to the atmosphere. Using the "Creative Inventions" worksheet as a reference, lead group in a whole class discussion on how they can creatively re-design the product to be more environmentally sustainable. Examples can range from simple to complex and may include:
   - Students who access drinking water through a water purification system that is electronically powered may develop an idea to generate the purification system using solar power.
   - Students living in urban city areas with limited outdoor space may develop an idea to use unusual places to grow fresh fruits and vegetables, including rooftop terraces and indoor hydroponic gardens.

> ***Sustainable Design – United States.*** The Wayne L. Morse U.S. Courthouse in Eugene, Oregon was awarded the U.S. LEED Gold certification for its use of environmental enhancements and energy efficiency. Reduced irrigation through native, drought-tolerant plants combined with waterless urinals and low-flow toilets, and showerheads reduce water use by more than 40 percent, compared with a conventional facility. The building materials have a high-recycled content, are regionally available, need minimal maintenance, and have low chemical emissions.

[24] "Principles of Sustainable Design," *Queensborough Community College*, *http://www.qcc.cuny.edu/susproj/PrinciplesofSustainableDesign.html*

[25] TEXT BOXES: "Feynan Lodge Community Project, Jordan," *The Guardian*, 19 Feb 2010, http://www.theguardian.com/travel/2010/feb/20/guardian-green-list-2010-jordan-feynan-lodge and "Current Projects," *Royal Society for the Conservation of Nature*, 2008, http://www.rscn.org.jo/orgsite/rscn/aboutrscn/ourprojects/currentprojects/tabid/66/default.aspx#423 and "Ten Great Examples of Green Buildings Worldwide," *Open Knowledge,* 2014, http://knowledge.allianz.com/environment/energy/?657/ten-great-examples-of-green-building-worldwide-gallery

"Creative Inventions" Worksheet[26]

Paper Generator Harvests Static Electricity

Innovators Ivan Poupyrev and Emre Karagozler answer, "How can we create a new form of power generation devices?" using Teflon paper placed between two conductive layers, which accumulates a charge as high as 1,000 volts when paper is rubbed against it. That's enough to power a row of LEDs, e-paper displays, infrared devices, or even to communicate with a computer.

Pedal Power Phone Charger

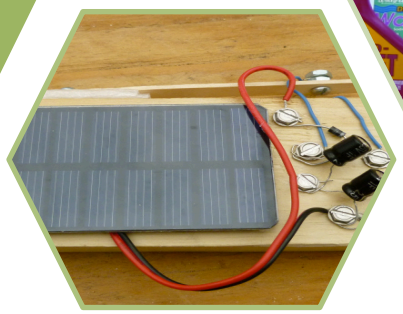
Alastair Bland's circuit takes higher-voltage alternating current (AC) from a retro-style bike headlight generator, converts it to direct current (DC), and steps it down to a safe voltage for charging a cell phone or other mobile device. After quick installation, this circuit will set you up to start charging your phone while riding your bike!

Backyard Biodiesel

With an old juice bottle to serve as the "reactor" vessel, vegetable oil (either new or used) can be processed into a fuel that's thin enough to spray from a regular diesel engine's fuel-injection system. This is done chemically, by converting the oil into two types of compounds: biodiesel, which shares the original oil's combustibility, and glycerin, which retains the oil's thick, viscous properties. Drain away the glycerin, and you're left with a fuel that you can pour into any diesel vehicle!

Battery-free Solar-powered Flashlight

Unlike commercial solar powered flashlights, which store chemical energy in batteries that then convert this chemical energy to electrical energy, this flashlight stores electrical energy directly in two one-farad super capacitors. Today we use two one-farad capacitors to store electrical energy to light an LED; tomorrow we will be using a bank of 10K farad capacitors to store electrical energy to power an automobile!



[26] All of these creative inventions are showcased in Maker Media's Make Magazine: "Make: Projects," *Make*, 2013, http://makezine.com/

Measuring Sustainability: Design Abacus[27]	
TIME: 45 minutes	**MATERIALS:** Paper, Pencils, Internet Access; "Design Abacus" Worksheet (EH p. 48, SW p. 49)

OVERVIEW

In this activity, students will measure the environmental impact of classroom items using a Design Abacus.

INSTRUCTIONS

1. **Identify a product.** Have students return to Module 2 and their inventory list of items that use energy in their classroom ("What is Renewable Energy" Activity). Have students identify one item and place its name in the focal area box on the "Design Abacus" Worksheet. The focal area of the analysis will be on the daily **use** of this product.

2. **Identify characteristics for evaluation.** Students will evaluate this item based on how good or bad they think its performance is across seven characteristics. Have students choose seven characteristics by which to evaluate the performance of the product. They may use the seven characteristics of the list below, or create their own characteristics, and write down the good and bad equivalent for these characteristics on the worksheet.

Bad Characteristics	Good Characteristics
Uses a lot of energy in manufacture	Minimizes energy use in manufacture
Uses a lot of energy when used	Minimizes energy use when used
A lot of waste of raw materials in manufacture	Minimizes use of raw materials in manufacture
Very expensive	Affordable for most people
Likely to break	Durable
High number of recyclable or reusable materials	No recyclable or reusable materials
Many levels of packaging	No packaging

3. **Assess.** Begin the product assessment by rating the current product on each characteristic on the worksheet, very good on top and very bad at the bottom (+2 to -2). Students estimate how good or bad the current product is within each characteristic and record how confident[28] they are about their estimates by plotting this on the top half of the worksheet.

4. **Analyze.** Connect the dots marked on the confidence chart and the characteristics chart. Students now have an overall profile of the product and the environmental impact of its design. The closer to the "good characteristics" and the higher your confidence level, the better. If students have a low confidence level, consider additional research before moving forward.
   - In what characteristics do you see the most need for improvement in design?
   - In what characteristics does this current product have low environmental impact, and thus a good sustainable design?

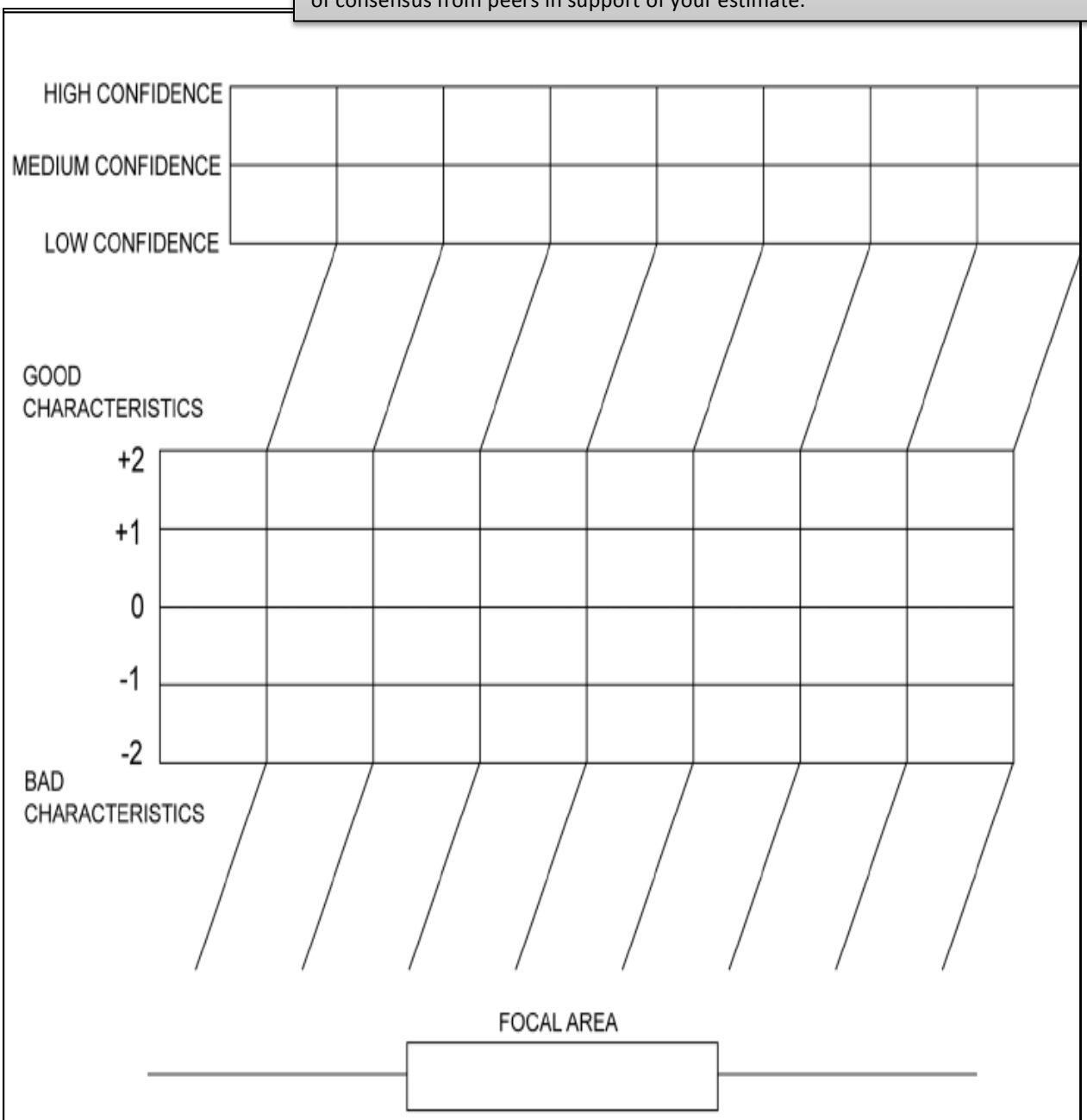
5. **Hypothesize**. If given the opportunity to re-design this product to be more sustainable, which elements of the product would you address and improve upon? Have students select one characteristic which was rated low. Identify why it would be important to address this topic, and how they would do so. Remap the improved design onto the original worksheet in a different color.

[27] "Sustainable Manufacturing Portal," *Loughborough University*, 2009, http://www.centreforsmart.co.uk/smp/tools_designabacus.php

[28] *Intergovernmental Panel on Climate Change*, 2014, http://www.grida.no/climate/ipcc_tar/wg2/images/fig1-box1.gif

"Design Abacus" Worksheet

High Confidence = High amount of evidence to support your estimate and **High** amount of consensus from peers in support of your estimate.
Medium Confidence = Low amount of evidence but high consensus from peers **OR** high amount of evidence but low consensus from peers.
Low Confidence = Low amount of evidence to support your estimate and **Low** amount of consensus from peers in support of your estimate.



Adaptation of Integrated Design abacus, Shot In the Dark, 2000

Collaborative Innovation Project: Initial Research

TIME: 30 minutes | **MATERIALS:** Collaborative Innovation Project Guidebook

OVERVIEW

Students will research and identify any current solutions and actions addressing the climate change issues of their needs assessment, and brainstorm where and how they may be able to contribute further in innovative and sustainable ways. **Upload activity on Google+ and share during the IVC!**

INSTRUCTIONS

1. **Initial Research.** Have students list all collaborative project issues discussed in IVC #3 in the chart below. Divide into groups to conduct initial research on current solutions or actions taking place to address each issue. Have each group collect as much information as possible in each category: local, regional, global, and within my partner country.

Issue	Current Solutions and Actions Being Taken			
	Local	Regional	Global	Partner Country

2. Have students review the table and begin to brainstorm where and how they may be able to make an impact.
   - Are any of the current solutions/actions sustainable? If no, are there ways in which you and your peers can contribute to better sustainability?
   - Can any of the current solutions or actions be improved upon?
   - Are there any issues which are not being addressed currently? Why do you think this may be?

   To help decide on which issues to pursue further, students should make sure the proposed issues and project ideas answer the following questions with "yes."
   - Will a project on this topic positively benefit my community?
   - Will a project on this topic positively benefit my partner country?
   - Will a project on this topic be something we will be able to address within the allotted time?

CONNECT on GOOGLE+: Share at least one issue you identified, a current solution or action, and where or how you and your peers think you could contribute further. View and comment on the posts of your peers!

ACT

IVC #4 Presentation Preparation and Outline	
TIME IVC Preparation – 45 minutes (before IVC) IVC – 90 minutes (including dial-in)	**MATERIALS** IVC #4 Outline (SW p. 51 – 52)
OVERVIEW The outline below will be used as a guide for discussion during the fourth IVC.	
INSTRUCTIONS 1. **Presentation Preparation: Collaborative Project Initial Research** Students share outcomes of their initial research on the issues identified of the community needs assessment (Module 3), including: ○ Current solutions and/or actions addressing each issue at the local, regional or global level ○ Are any of the current solutions/actions sustainable? If no, are there ways in which you and your peers can contribute to better sustainability? ○ Reflecting on your research, where and how do you identify your role? 2. **IVC Outline.** Have students use the outline below to prepare roles, responsibilities and presentation notes for **IVC #4: Sustainable Design**	

	Day	Date	Tech Dial-in Time	Conference Start Time	Backup Day / Date
IVC 4: Sustainable Design					

IVC Outline

I. **Introduction and Greetings (3 minutes)** GNG facilitator welcomes all participating students to the fourth IVC meeting. One representative from each school shares:

- Number of students participating in IVC #2:
- Something interesting that has happened in your community since the last IVC:
- A national/international event that has impacted you/your community since the last IVC:
- Local weather and temperature (in degrees Celsius and Fahrenheit):

II. **Climate Change in the News (8 minutes)** One representative from each school shares a GLOBAL newspaper headline or story about climate change, weather, science and/or technology innovation.

- Name of class representative:
- News Topic and Title:
- Summary:

III. **Debrief: Sustainability (16 minutes)** Students share reflections in evaluating products for sustainability using the design abacus, and solutions for increased sustainability in their lives.

- Classroom item evaluated for sustainability
  - Changes recommended to make item more sustainable:
  - Explanation of design changes and anticipated long term impact:

Use this space to record your questions:

IV. **Presentation: Collaborative Innovative Project Initial Research (20 minutes)** Students share outcomes of their initial research, including any solutions currently addressing issues identified and where and how they view their role and contribution.

- Current solutions and/or actions addressing each issue at the local, regional or global level:
- Reflecting on your research, where and how do you identify your role?

Use this space to record your questions:

V. **60-Second Showcase! (10 minutes)** Select three student representatives to share a personal interest or talent for their peers. *Try to maintain Show and Tell as predominately visual or require little technical explanation, especially for IVCs using consecutive translation.*

- Name of Representative:
- Name of Representative:
- Name of Representative:

VI. **Conclusion (3 minutes)** GNG facilitator thanks all students and teachers for participating and reminds participants to prepare for the upcoming TechCamp!

REFLECT

IVC #4 Debriefing Conversation	
TIME: 15 minutes *(Either immediately following or shortly after IVC meeting)*	**MATERIALS** Pen, paper, internet access to online platform

OVERVIEW

Following each IVC, educators are encouraged to engage their students in a short reflective conversation on the module topic, the module activities, and their IVC experience.

INSTRUCTIONS

Use the suggested reflection questions below to guide a conversation with your class.

1. **REFLECT on your Conversation:**

- How do you feel about the topics proposed by your peers during the IVC? What topics are of particular interest?
- What additional research should you complete before deciding upon a topic?
- In a few short weeks we'll be meeting together at TechCamp! What are you looking forward to? Is there anything you are anxious about that you would like to share?

2. **CONNECT on Google+:**

- Reflecting on the issues proposed, what are some sustainable design elements you think can and should be included your project ideas?

EDUCATOR FEEDBACK SURVEY: Following each IVC, educators are encouraged to complete the "Educator Feedback Survey." The survey should not take more than 10 minutes to complete, and will be e-mailed directly to educators immediately following the IVC.

TechCamps!

Overview

In June 2014, TechCamps participants will turn knowledge into action! Camp activities will include workshops, field trips and guest speakers around the following topics:

- *Climate Change Issues*
- *Environmental Sustainability*
- *Relevant Technologies in Science and Innovation*
- *Data Collection*
- *Design Thinking*
- *Digital Storytelling*
- *Project Development and Prototyping*
- *Higher education and Professional careers in science and technology*

TechCamps will culminate in **Tech Torrent**, a showcase of students' **Collaborative Innovation Project** designs, to be developed with support from technology mentors through summer 2014. Final projects will be showcased in a **Virtual Project Fair** in September 2014.

Preparation

Prior to joining in-person for TechCamps, all students, parents, and educators will participate in an orientation session. The orientation session will occur virtually and engage both students and educators in preparation for regional and international travel. Students should be sure to come to TechCamps with the following:

- TechCamps Handbook
- Workshop and Videoconference Notes
- Collaborative Innovation Project Guidebook
- Collaborative Innovation Project Preparation: Introduction and Needs Assessment
- Collaborative Innovation Project Preparation: Initial Research
- Creative ideas for sustainable and innovative projects!

TechCamps Objectives

- Deepen understanding on climate change impacts and innovative solutions through guest speakers, site visits and workshops
- Gain hands-on skills applying scientific and technical skills
- Conceptualize, design and gain feedback on Collaborative Innovation Projects by completing:
  - **Milestone 1: Define**
  - **Milestones 2: Imagine**
  - **Milestone 3: Prototype**
  - **Milestone 4**: **Test**

Module 5: Environmental Action

Overview

In **Learn**, students will explore the stories of three science and technology entrepreneurs who are making positive changes in their own communities, and consider how their Collaborative Innovative Projects can be shared with others to achieve similar ends.

In **Act,** Students will complete **Milestone 5: Share** of the Collaborative Innovation Project Guidebook in preparation for sharing their projects with the world.

Background

Climate Change is a major problem, but positive change can be made at a small, local level. Individuals have power in the future of our environment. As a community, we can create change within our community and the world.

Module Objectives

- Understand that there is no one solution to climate change and one perfect energy source
- Conclude the Collaborative Innovation Project and share with communities

	Activity	Estimated Time
LEARN	Innovator Case Studies Sharing Our Story with the world	45 Minutes 45 Minutes
ACT	Interactive Videoconference #5	45 Minutes Prep 60 Min. IVC + 30 Min. Dial-in
REFLECT	Connect on Google +	15 Minutes

LEARN

Innovator Case Studies	
TIME 45 minutes	**MATERIALS** Case Study Overview (EH p. 56, SW p. 57) "Leadership Types" Worksheet (EH p. 57, SW p. 58)

OVERVIEW

In this activity, students will learn about young people who took on active roles in their communities to promote positive social change. Students will consider the skills and methods used by others to engage communities, and how they could likewise harness these skills when engaging their own communities.

INSTRUCTIONS

1. **Warm-Up:** Distribute the "Case Study Overview" worksheet. In small groups, have students read a case study provided, or do research on a case study of their own. Guide small group discussion:
   - What prompted the young leader in your case study to engage their community?
   - What goal was the young person trying to accomplish?
   - What obstacles or challenges do you think the young person faced in trying to reach this goal?
   - What skills, qualities, or tools did the young person use in order to achieve this goal?
   - What skills or qualities exhibited by the young person in your case study are relevant to your own role as a young person in your community?

2. **Recognizing Different Leadership Types:** Distribute the "Leadership Types" worksheet. Have students review the different types of leaders, add a sixth leadership type, and identify where both they and the young person of their case study fit within the spectrum of leadership types. Stress that all leadership types work together to promote positive change.

3. **Discussion**: Debrief as a class.
   - What characteristics, qualities and leadership types were similar or different among students?
   - Does being a leader refer to a single person or a group working together?
   - Must all leaders posses each of the characteristics you identified promote positive action, or do different character traits still yield influential leaders?

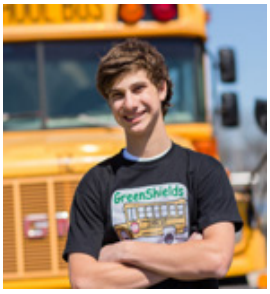
Optional: EXPAND YOUR UNDERSTANDING
Tomorrow's Leaders, Today

- Many of today's well-known leaders began as individuals leading everyday lives, who possessed determination and ambition. In your community and country today, what rising leaders do you see?
- Reflect on your leadership qualities and draft an action plan of a project you would like to implement in your local community.

Case Study Overview

Hayley Hoverter is an award-winning technology innovator, an entrepreneur, a CEO – and she's also a 16-year-old high school student. […]. Hayley Hoverter invented a new type of sugar packet, Sweet (dis)Solve, that dissolves in hot water. It's flavorless, it's colorless, and potentially could save up to 2 million pounds of trash each year -- and that's just at Starbucks.[29] Hoverter's idea started brewing when she was six-years old when and used to go into work with her mom at Starbucks while living in San Francisco, California. "I remember the piles and piles of trash from that one store," says Hayley. Her passion for the concept and the idea itself stood out in [a high school entrepreneurship] class and she has since gone on to develop her idea into her company: Sweet (dis)Solve.[30] For additional information, view: http://vimeo.com/30195859

Hayat Sindi, the first Saudi woman accepted into Cambridge University, developed a low-tech diagnostic tool to detect disease by analyzing bodily fluids. What is the tool? A piece of paper. Using a paper-based diagnostic test, diagnostic results show up in less than a minute and can be easily read using a color scale provided with the device. (The team even chose colors that someone who is colorblind can see.) […] For Sindi, the solution [to health challenges facing the developing world] is to bring the "lab" to them, and paper-based technology allows that to happen. "Paper is very inexpensive, universally available, lightweight, and easy to carry," she explains. "Health care workers will be able to visit as many as 200 homes each day, perform tests, and take action immediately. Only minimal training is required and no external power, electricity, equipment, clean water, or sterile environment is needed. After use, devices can be burned with a match, preventing contamination. It's a tool that allows even the poorest people in the most medically challenged places to get the tests they need."[31] For additional information, view: http://poptech.org/popcasts/hayat_sindi_accessible_health



Jonny Cohen used his curiosity in science to invent an aerodynamically shaped air shield (known as Greenshield) for the front of school buses that reduces bus fuel use by 10%. The GreenShield redirects the airflow, decreases drag and increases gas mileage, saving money for school districts and decreasing CO_2 emissions. Jonny was only in the seventh grade when he developed the GreenShield, and has since been recognized as the Forbes "30 Under 30" Energy List in 2012, and 2013. [32] For additional information, view: http://www.nbcnews.com/video/nbcnews.com/37277837

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[29] Doug Rand. "Young Entrepreneurs at the White House Science Fair," *The White House Office of Science and Technology,* 10 Feb. 2012, http://www.whitehouse.gov/blog/2012/02/10/young-entrepreneurs-white-house-science-fair

[30] "16-Year Old Social Entrepreneur Wins National Competition Vowing To Reduce World Waste," *Forbes,* 7 Oct 2011, http://www.forbes.com/sites/kymmcnicholas/2011/10/07/16-year-old-social-entrepreneur-wins-national-competition-vowing-to-reduce-world-waste/

[31] "Hayat Sindi: Science Entrepreneur," *National Geographic*, 2013, http://www.nationalgeographic.com/explorers/bios/hayat-sindi/

[32] "Young Innovators Appointed to Serve on Festival's Youth Advisory Board!," *Science Blogs,* 2013, http://scienceblogs.com/usasciencefestival/2013/11/15/young-innovators-appointed-to-serve-on-festivals-youth-advisory-board/

"Leadership Types" Worksheet[33]

"What it means to be a leader is not in a single form. We need to embrace and encourage and support different approaches to leadership. [Solving] the complex challenges that exist in the world today is about convergence of those approaches to leadership." – Jennifer Corriero, TedxTeen, 27 March 2010

Individuals who engage their communities to promote positive change come in all shapes and sizes, with different skills, qualities and methods that aide in their success. Below are five types of leaders. Each leadership type is individually influential, and collectively powerful.

1. Reflecting on the young person of your case study discussion, develop a sixth leadership type in the final row and indicate why this role is significant in positively engaging communities.

2. What leadership type(s) are you? What is one way in which you will showcase this type in your own community engagement through the collaborative project?

Different Types of Leaders

Role Model	• Leads by example in own behaviors and values • Guides, mentors, and/or tutors others towards an end goal
Visionary	• Excited by the possibilities of the unknown • Takes value in learning from mistakes • Drives self and others towards new opportunities
Public Voice	• Engages wide audiences • Spreads important messages to the masses
Collaborator	• Brings people of different backgrounds to common space for dialogue • Uses networks to engage people of different resources, skills and abilities
Storyteller	• Tells the stories of those creating change • Brings attention to the role and value of all contributors to a cause
_____	

[33] "Different Types of Leaders" chart compiled from:
Jennifer Corriero. "Next Generation Youth Leadership," *TedxTeen, 27* March 2010, http://www.youtube.com/watch?v=hI6Czn7GeSw
"Five Practices," *The Student Leadership Challenge,* 2011, http://www.studentleadershipchallenge.com/About/Five-practices.aspx

Sharing Our Story with the World	
TIME 45 minutes	**MATERIALS** Computer, Internet Access

OVERVIEW

In this activity students will plan and develop a short media piece capturing the concept and impact of their project to share in the **Virtual Project Fair.**

INSTRUCTIONS

1. **View**: "Inspired into Action: William Kamkwamba"
   http://www.youtube.com/watch?v=wGe65xwd-0c&feature=youtu.be

   - What parts of William's story caught your attention? What was compelling about his story?
   - What was his invention?
   - What challenge did his invention address?
   - What impact did his invention have on his community?
   - Why do you think it is important for William to tell his story to the world?

2. **How will you tell your story?** When you create something to share with the world, it is crucial to communicate your ideas in a way that is engaging and thought provoking to a variety of audiences. Reflect on William's story, and consider how you can emulate some of his story-telling techniques in your own virtual presentation.

   Develop your narrative:
   - What do you want to share about your project?
   - What are the personal and educational stories that you will include in your narrative?
   - Why is it important for you to share your story with the world?

   Choose your medium:
   - What medium do you think would capture the story of your product and its impact best?
   - What medium are you most comfortable working with?

   Create a visual representation of your product and share on the Project Fair Virtual Platform!

SHARE on the VIRTUAL PROJECT PLATFORM: Upload your final project presentation to the Virtual Project Fair platform! Share the link with peers, friends and family!

ACT

IVC #5 Presentation Preparation and Outline	
TIME IVC Preparation – 45 minutes (before IVC) IVC – 90 minutes (including dial-in)	**MATERIALS** IVC #5 Outline (SW p. 60 – 61)
OVERVIEW The outline below will be used as a guide for discussion during the final IVC.	

INSTRUCTIONS

1. **Presentation Preparation. Milestone 5: Share**
   Students conclude the Collaborative Innovation Project by completing **Milestone 5: Share** (Project Guidebook, pgs. 20 – 21), including:
   - Finalize your product
   - Craft a distribution plan
   - Share your product with the world in the Virtual Project Fair!

   CONNECT on GOOGLE+: Share your Distribution Plan on Google+. View and comment on the videos of your peers!

2. **IVC Outline.** Have students use the outline below to prepare roles, responsibilities and presentation notes for **IVC #5: Environmental Action**

	Day	Date	Tech Dial-in Time	Conference Start Time	Backup Day / Date
IVC 5: Environmental Action					

IVC Outline

I. **Introduction and Greetings (5 minutes)** GNG facilitator welcomes all participating students to the final IVC meeting. One representative from each school shares:

- Number of students participating in IVC #5:
- Something interesting that has happened in your community since the last IVC:
- A national/international event that has impacted you/your community since the last IVC:
- Local weather and temperature (in degrees Celsius and Farenheit):

II. **Climate Change in the News (10 minutes)** One representative from each school shares a newspaper headline or story about climate change, weather, science and/or technology innovation from their PARTNER COUNTRY.

- Name of class representative:
- News Topic and Title:
- Summary:

III. **Debrief: Innovator Case Studies (20 minutes)** Students share reflections on the Innovator case studies and discuss their own leadership skills and qualities, including how students can use these skills in engagement of their own community.

Case Study Observations and Comments Use this space to record questions:

IV. **Presentation: Milestone 5: Share (30 minutes)** Students share the visual representation of their project to be showcased on the Virtual Project Fair and discuss how they will share their project and TechCamps experience with their home community.

Reflecting back to your needs assessment interviews, what is the anticipated community impact of your project: ➢ Who is your target audience to share your project with? ➢ Why is this audience important to engage? ➢ How will you engage this audience? Use this space to record notes and questions:

V. **60-Second Showcase! (10 minutes)**
Select three student representatives to share a personal interest or talent for their peers. *Try to maintain Show and Tell as predominately visual or require little technical explanation, especially for IVCs using consecutive translation.*

➢ Name of Representative: ➢ Name of Representative: ➢ Name of Representative:

VI. **Culminating Discussion (20 minutes)** This is the final IVC meeting. Reflecting on the module topics and your experiences to date, record any final questions for your peers.

VII. **Conclusion (7 minutes)** GNG facilitator thanks all students and teachers for participating, reminds students to remain connected through the online platform, and invites all to join the alumni network!

Name of Representative; Final Remarks:

REFLECT

IVC #5 Debriefing Conversation	
TIME: 15 minutes *(Either immediately following or shortly after IVC meeting)*	**MATERIALS** Pen, paper, internet access to online platform

OVERVIEW

Following each IVC, educators are encouraged to engage their students in a short reflective conversation on the module topic, the module activities, and their IVC experience.

INSTRUCTIONS

Use the suggested reflection questions below to guide a conversation with your class.

1. **REFLECT on your Conversation:**
   - Did you realize anything new about yourself and your own ability to engage others?
   - How was the process of completing your collaborative project? Did you face any unanticipated challenges? If so, are you content with how you and your peers overcame them?
   - How do you feel about engaging a wider audience around the issue addressed in your project?

2. **CONNECT on Google+:**
   - What was your favorite memory from participating in TechCamps?
   - Share pictures and feedback from your community event!

EDUCATOR FEEDBACK SURVEY: Following each IVC, educators are encouraged to complete the "Educator Feedback Survey." The survey should not take more than 10 minutes to complete, and will be e-mailed directly to educators immediately following the IVC.

Appendix A

World Water Monitoring Challenge: Instructions

Source: "World Water Monitoring Challenge: Instructions," *World Water Monitoring Challenge,* 2013, http://www.worldwatermonitoringday.org/uploadedFiles/Content/Resources/English-Spanish_Instructions.pdf

World Water Monitoring Challenge

Test. Share. Protect.

Instructions/Instrucciones

English/Español

Contents

For your safety 4
Test kit safety/After testing 6
Testing hints/Collecting a water sample 7
Turbidity 8
Temperature 11
Dissolved oxygen 13
pH 17
Data sheet 18

Contenido

Para su seguridad 20
Seguridad de equipo de vigilancia/después del análisis 22
Consejos para realizar los análisis/recolección de muestra de agua 23
Turbidez 24
Temperatura 27
Oxígeno disuelto 29
pH 33
Hoja de información 34

WARNING! This set contains chemicals that may be harmful if misused. Read cautions on individual containers carefully. Not to be used by children except under adult supervision.

¡CUIDADO! Esta colección contiene químicos que pueden ser dañinos si no se utilizan corectamente. Lea cuidadosamente las precauciones de cada recipiente. No debe ser utilizado por los niños sin la supervisión de un adulto.

For your safety

Before you take to the water, read these safety instructions!

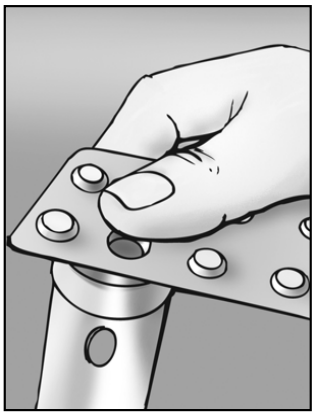
- Always monitor with one or more partners. Let someone else know where you are, when you intend to return, and what to do if you don't come back at the appointed time.
- If possible, have a cell phone and a first aid kit handy. Know any important medical conditions of team members (e.g., heart conditions, diabetes, allergies) and bring any needed medications.
- Listen to weather report. Do not go sampling in heavy rain or if a storm is predicted.
- Keep your pets at home. Dogs can damage stream banks and hurt or destroy aquatic life and wildlife.
- Never cross private property without the permission of the landowner. Better yet, sample only at public access points such as bridge or road crossings or public parks.
- Watch for dogs, farm animals, snakes, and insects such as ticks and bees. If possible, wear boots, a hat, light colored long pants and long-sleeved shirts. Tuck in your pant legs and spray pants and sleeves with insect repellant.
- Know how to identify poisonous or other problem plants or vegetation to ensure the safety of those monitoring.
- Never drink the water in a stream or lake. Assume it is unsafe and bring your own water.
- Do not monitor if the water appears to be badly polluted or is posted against swimming.
- Do not walk on unstable stream banks that might be in danger of eroding or collapse.
- Never wade in swift or high water.

- Stay out of the stream as much as possible.
- Stream bottoms are slippery, can contain deep pools or sink holes, and can also have sensitive habitats that should not be disturbed.
- If you take a boat out, follow safe boating practices. Wear a life jacket at all times!
- Keep equipment and chemicals away from children. The Dissolved Oxygen TesTabs® in the World Water Monitoring Challenge test kit are hazardous if swallowed or if they come in contact with skin or eyes. To dispose of unused tablets, dilute them in a bucket of water and flush them down the drain. Refer to the Material Safety Data Sheet under the 'Test Kits' menu at www.MonitorWater.org for more safety and disposal information.
- Wear latex or rubber gloves when you take the sample and conduct the tests. Wash your hands with soap when you're finished and dispose of all of your trash properly when you're done.
- If at any time you feel uncomfortable about conditions at the site, stop monitoring and leave at once.

Your safety is more important than the data!

Note: The Material Safety Data Sheet (MSDS) that details handling of the 3976A/Dissolved Oxygen TesTabs® was not written for the small quantity of tablets included in the WWMC test kit. In such cases where tablets are dispensed one at a time, eye protection and lab coats may not be necessary and should be required at the discretion of the instructor. If tablets are dispensed directly into the tube without contact with the skin as directed, gloves may also be unnecessary and should be required at the discretion of the instructor.

Test kit safety

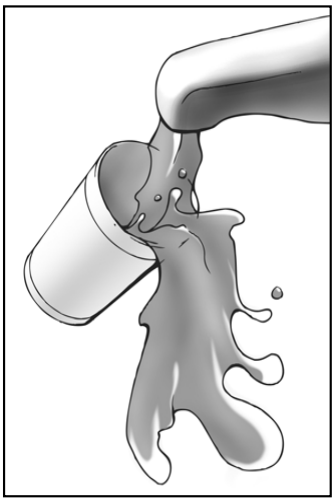


The TesTab® reagents used in this kit are designed with safety in mind. The single-unit, foil packaged TesTabs® are easy to dispense. Store TesTabs® in a cool, dry place and only open the foil when ready to use the tablet.

A single tablet, either alone or reacted with a sample, is not a health hazard. However, TesTabs® should not be ingested. Additional information for all LaMotte reagents is available in the United States, Canada, Puerto Rico, and the US Virgin Islands from Chem-Tel by calling 1-800-255-3924. For other areas, call 813-248-0585 collect to contact Chem-Tel's International access number. Each reagent can be identified by the four digit number listed on the upper left corner of the reagent label, in the contents list and in the test procedures.

The numbers printed on the foil are insignificant. Look for the name of the test on the foil package to determine which TesTab® to use for each test. For example: "DO" is printed on the foil of the TesTab® used for the dissolved oxygen test.

Note: Wash hands after performing experiments. Follow all safety rules and guidelines provided by your school or organization regarding laboratory and outdoor activities.



After testing...

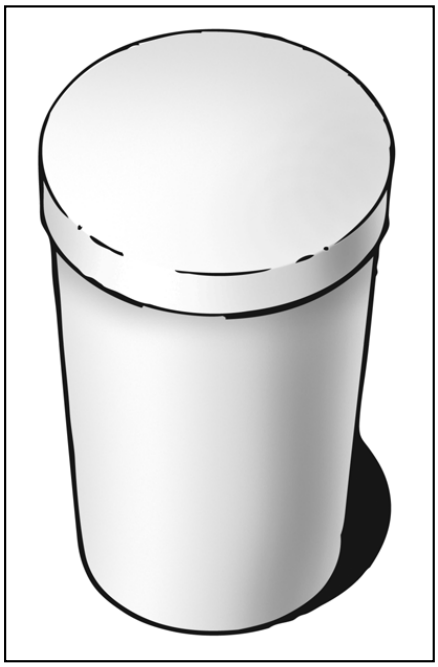
All reacted test samples can be disposed of by flushing down the drain with excess water. While in the field, reacted samples can be poured together into a waste container for later disposal.

Testing hints

- Follow all instruction steps in the proper order.
- A watch or timer is recommended for timing the five-minute wait in the dissolved oxygen test.
- Data can be recorded on page 18 of this booklet.

Collecting a water sample

Collect the water sample in a sterile, wide mouthed jar or container (approximately 1 liter) that has a cap. If possible, boil the sample container and cap for several minutes to sterilize and avoid touching the inside of the container or the cap with your hands. The container should be filled completely with your water sample and capped to prevent the loss of dissolved gases.



Test each sample as soon as possible or within one hour of collection. When possible, perform dissolved oxygen procedure at the monitoring site immediately after collecting the water sample.

Turbidity

Turbidity is the measure of the relative clarity of water. Turbid water is caused by suspended and colloidal matter such as clay, silt, organic and inorganic matter, and microscopic organisms. Turbidity should not be confused with color, since darkly colored water can still be clear and not turbid.

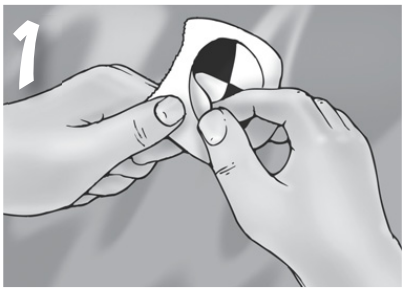
Turbid water may be the result of soil erosion, urban runoff, algal blooms, and bottom sediment disturbances which can be caused by boat traffic and abundant bottom feeding fish.

Note: This test has limited utility in pristine, clear waters. For more precision in measuring turbidity in standing waters such as lakes, reservoirs and estuaries you could obtain and use a Secchi disk.

For information on how to make your own Secchi disk and how to take the measurement, go to http://www.secchidipin.org/makedisk.htm. In addition, transparency tubes can be used for more precision in measuring the turbidity of flowing waters such as streams and rivers.

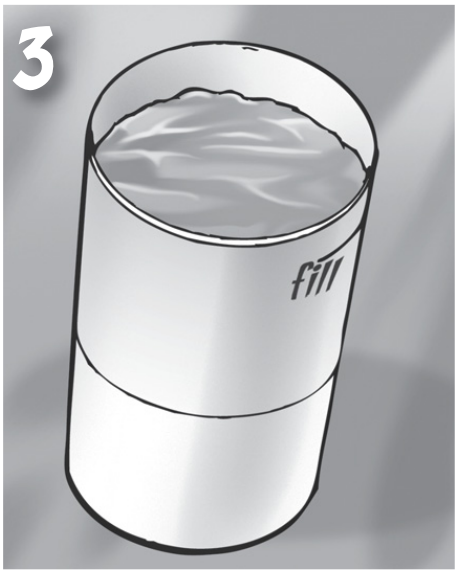
Turbidity procedure

The white jar is used to perform the turbidity test. If possible, adhere the Secchi disk icon sticker to the jar 8-24 hours before use to allow the adhesive to cure.

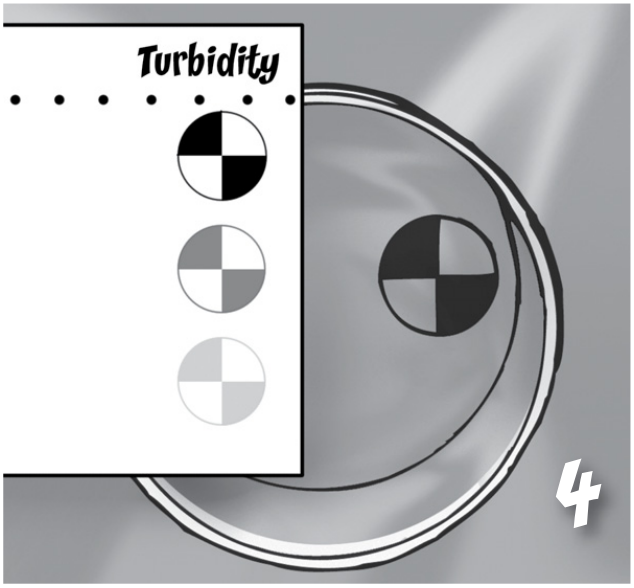


1. Remove the backing from the Secchi disk icon sticker.

2. Adhere sticker on the inside bottom of the white jar. Position the sticker slightly off center.

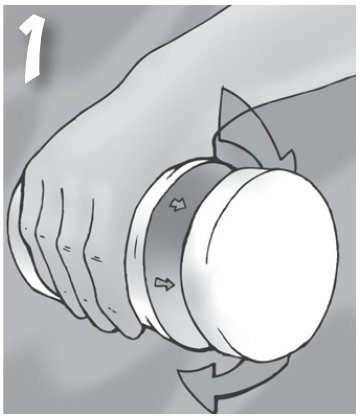


3. Fill the jar to the turbidity line located on the label.



4. Hold the turbidity chart on the top edge of the jar. Looking down into the jar, compare the appearance of the Secchi disk icon in the jar to the chart. Record the result as turbidity in JTU.

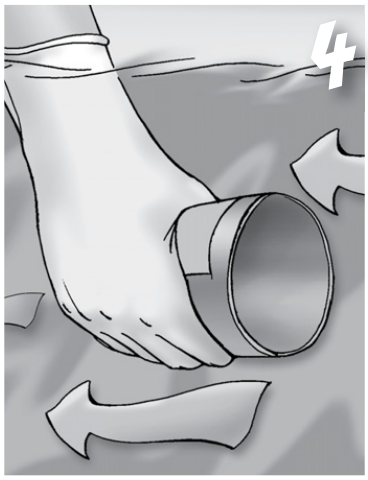
Collection procedure



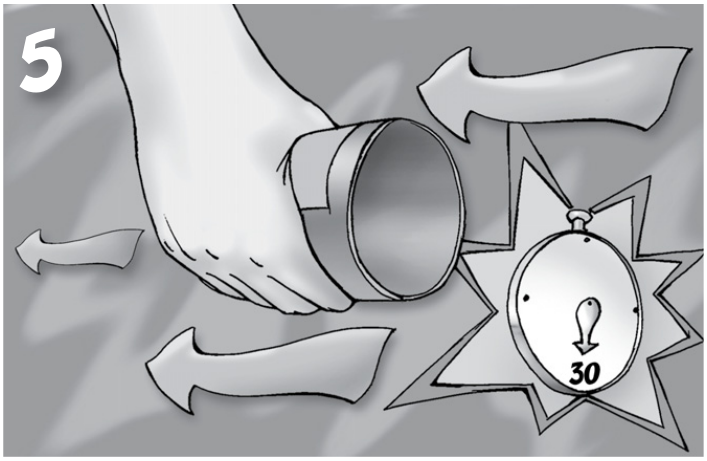
1. Remove the cap of the sampling jar.

2. Wear protective gloves. Rinse the jar 2-3 times with the stream water.

3. Hold the jar near the bottom and plunge it (opening downward) below the water surface.



4. Turn the submerged jar into the current and away from you.



5. Allow the water to flow into the jar for 30 seconds.

6. Cap the full jar while it is still submerged. Remove it from the water body immediately.

Use of thermometers

The two thermometers have an adhesive back. Adhere them to the sampling jar or another object to make grasping them easier. The temperature is indicated by a liquid crystal number on the low-range thermometer and a green display on the high-range thermometer.

Temperature

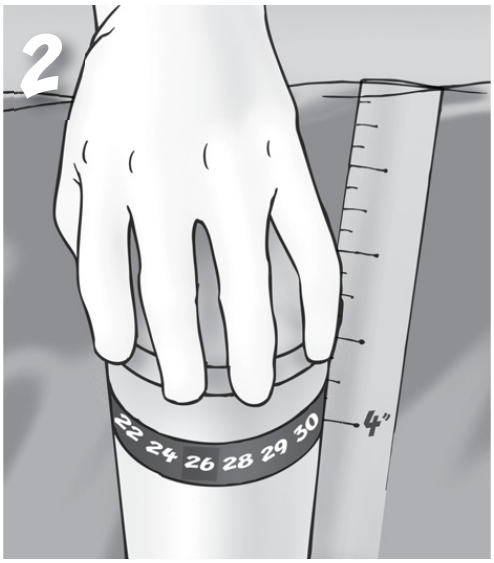
Aquatic animals (e.g. stream insects, trout and salmon) are sensitive to changes in water temperature and require a certain temperature range to survive and thrive. If water temperature is outside that range for a long time, organisms can be stressed and die.

Temperature affects the amount of oxygen water can hold. Cold water holds more oxygen than warm water, and all aquatic animals need oxygen to survive.

Temperature also affects the rate of photosynthesis by aquatic plants, and the sensitivity of organisms to toxic wastes, parasites and disease. Warm water discharged from factories, the removal of trees and vegetation that shade streams, and water that runs off city streets can cause temperature changes that threaten the balance of aquatic systems.

Temperature procedure

1. Wear protective gloves.



2. Place the thermometer four inches below the water surface for one minute.

3. Remove the thermometer from the water and read the temperature (the number with the green background on the high-range thermometer). Record the number in degrees Celsius.

Dissolved oxygen

Dissolved oxygen (DO) is important to the health of aquatic ecosystems. All aquatic animals need oxygen to survive. Natural waters with consistently high dissolved oxygen levels are most likely healthy and stable environments and are capable of supporting a diversity of aquatic organisms. Natural and human-induced changes to the aquatic environment can affect the availability of dissolved oxygen.

The saturation percentage of dissolved oxygen (% saturation) is an important measurement of water quality. Cold water can hold more dissolved oxygen than warm water. For example, water at 28°C will be 100% saturated with 8 ppm dissolved oxygen. However, water at 8°C can hold up to 12 ppm of oxygen before it is 100% saturated.

High levels of bacteria or large amounts of rotting plants can cause the % saturation to decrease. This can cause large fluctuations in dissolved oxygen levels throughout the day, which can affect the ability of plants and animals to thrive.

Note: This test is a screening test and will only give ballpark indications of poor, fair and good water quality. If you want more accurate measurements or need a higher range, you could use a Winkler titration kit that would be more expensive and require more careful handling.

PPM
(parts per million)

PPT
(parts per thousand)

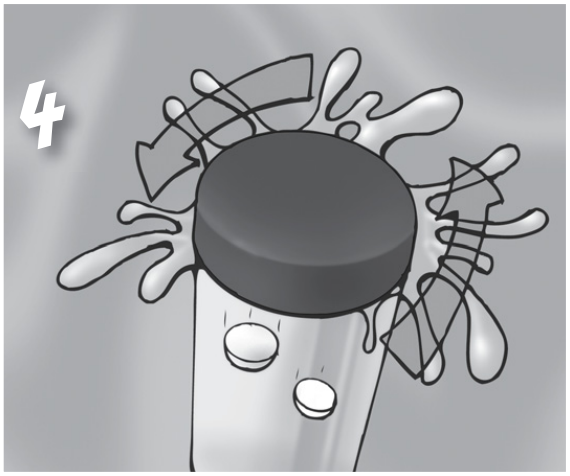
Units of measure for very dilute solutions. These units are very similar to percent. 1% is one part per hundred. 1 ppt is one part per thousand. 1 ppm is one part per million. In water testing, ppm is also called milligrams per liter (mg/L).

Dissolved oxygen procedure

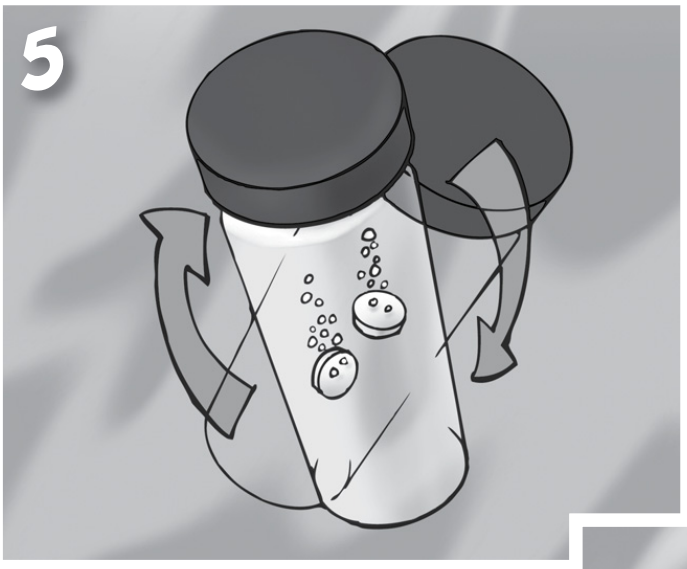
1. Record the temperature of the water sample.

2. Submerge the small vial (0125) into the water sample. Carefully remove the vial from the water sample, keeping the vial full to the top.

3. Drop two Dissolved Oxygen TesTabs® (3976) into the vial. Water will overflow when the tablets are added.

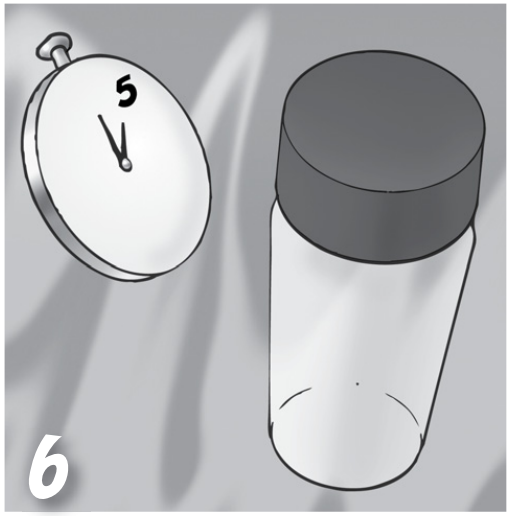


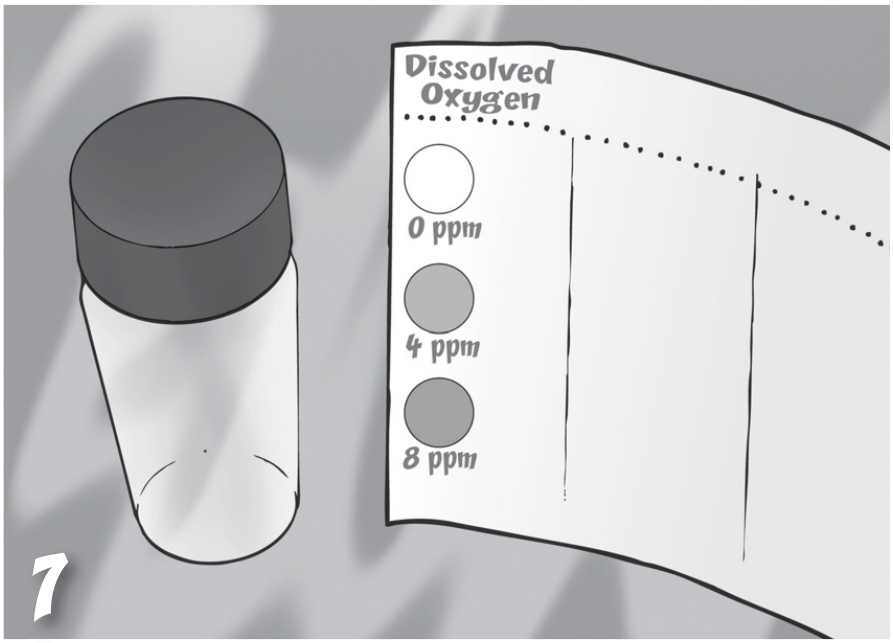
4. Screw the cap on the vial. More water will overflow as the cap is tightened. Make sure no bubbles are present in the sample.



5. Mix by inverting the vial over and over until the tablets have disintegrated. This will take about 4 minutes.

6. Wait 5 more minutes for the color to develop.





7. Compare the color of the sample to the dissolved oxygen color chart. Record the result as ppm dissolved oxygen.

% saturation

Locate the temperature of the water sample on the % saturation chart. Locate the dissolved oxygen result of the water sample at the top of the chart. The % saturation of the water sample is where the temperature row and the dissolved oxygen column intersect.

For Example: If the water sample temperature is 16°C and the dissolved oxygen result is 4 ppm, then the % saturation is 41.

Dissolved Oxygen, ppm

Temperature, °C	0 ppm	4 ppm	8 ppm
2	0	29	58
4	0	31	61
6	0	32	64
8	0	34	68
10	0	35	71
12	0	37	74
14	0	39	78
16	0	41	81
18	0	42	84
20	0	44	88
22	0	46	92
24	0	48	95
26	0	49	99
28	0	51	102
30	0	53	106

** Calculations based on solubility of oxygen in water at sea level, from* Standard Methods for the Examination of Water & Wastewater, *18th edition.*

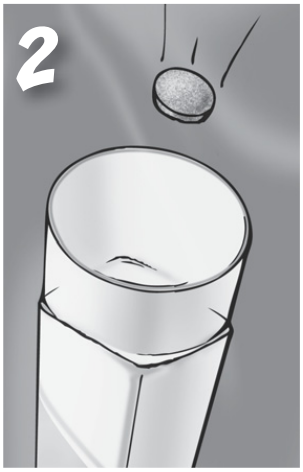
pH

pH is a measurement of the acidic or basic quality of water. The pH scale ranges from a value of 0 (very acidic) to 14 (very basic), with 7 being neutral. Most aquatic animals prefer a range of 6.5 to 8.0 They are adapted to a specific pH level and may die, stop reproducing, or move away if the pH of the water varies beyond this range.

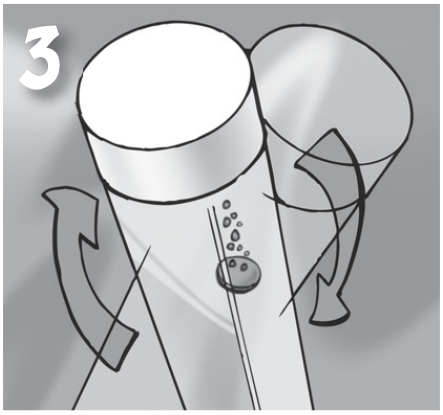
Low pH can also allow toxic compounds to become more available to aquatic plants and animals. This can produce conditions that hurt aquatic life. pH can be affected by atmospheric deposition (or acid rain), wastewater discharges, drainage from mines, and the type of rock naturally found in the area.

pH procedure

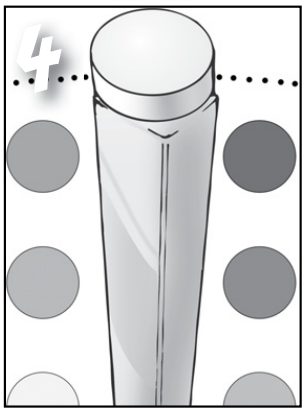
1. Fill the test tube (0106) to the 10 ml line with the water sample.



2. Add one pH Wide Range TesTab (6459).



3. Cap and mix by inverting until the tablet has disintegrated. Bits of material may remain in the sample.



4. Compare the color of the sample to the pH color chart. Record the result as pH.

Data sheet

Parameter	Example	Site 1	Site 2	Site 3
Date	September 18			
Location	Potomac Park			
Air Temperature	70°F			
Water Temperature	23°C			
Dissolved Oxygen	4 ppm			
pH	7			
Turbidity	40 JTU			

You're not finished yet! Make sure to enter your data at the WWMC database online. Your data proves you monitored and allows for a global snapshot of the world's water quality.

Parameter	Site 4	Site 5	Site 6	Site 7
Date				
Location				
Air Temperature				
Water Temperature				
Dissolved Oxygen				
pH				
Turbidity				