Challenge Based Learning

Take action and make a difference

Introduction

Traditional teaching and learning strategies are becoming increasingly ineffective with a generation of secondary students that have instant access to information, are accustomed to managing their own acquisition of knowledge, and embrace the roles of content producer and publisher.

Today's high school curriculum presents students with assignments that lack a real-world context and activities that lead to uninspired projects and end in a letter grade. Many students either learn to do just enough to get by or they lose interest and drop out. In this interconnected world, with ubiquitous access to powerful technology and access to a worldwide community, new models of teaching and learning are possible.

Students embrace media that presents participants with a challenge and requires them to draw on prior learning, acquire new knowledge, and tap their creativity to fashion solutions. The entertainment networks have capitalized on this formula with shows like *The Amazing Race, Top Chef, Trading Spaces,* and *Project Runway* in which participants creatively draw on their knowledge and resources to create appropriate solutions to challenges.

To address the need to create new ways of engaging students to achieve, Apple worked with educators across the country to develop the concept of Challenge Based Learning. Challenge Based Learning applies what is known about the emerging learning styles of high school students and leverages the powerful new technologies that provide new opportunities to learn to provide an authentic learning process that challenges students to make a difference.

The Challenge Based Learning effort is part of a larger collaborative project initiated in 2008 called Apple Classrooms of Tomorrow—Today (ACOT^2) to identify the essential design principles of the 21st century learning environment with a focus on high school. ACOT^2 follows in the tradition of Apple Classrooms of Tomorrow (ACOT), a research and development collaboration among public schools, universities, and research agencies that Apple initiated in 1985 and sustained through 1995 with outstanding results.

Challenge Based Learning is an engaging multidisciplinary approach to teaching and learning that encourages students to leverage the technology they use in their daily lives to solve real-world problems. Challenge Based Learning is collaborative and hands-on, asking students to work with other students, their teachers, and experts in their communities and around the world to develop deeper knowledge of the subjects students are studying, accept and solve challenges, take action, share their experience, and enter into a global discussion about important issues.

Challenge Based Learning includes these attributes:

- Multiple points of entry and varied and multiple possible solutions
- Authentic connection with multiple disciplines
- Focus on the development of 21st century skills
- Leveraging of 24/7 access to up-to-date technology tools and resources
- Use of Web 2.0 tools for organizing, collaborating, and sharing
- Focus on universal challenges with local solutions
- Requirement that students do something rather than just learn about something
- Documentation of the learning experience from challenge to solution

These attributes ensure that Challenge Based Learning engages learners, provides them with valuable skills, spans the divide between formal and informal learning, and embraces a student's digital life.

To support Challenge Based Learning, Apple is creating an online environment that provides teachers with access to challenges along with guiding questions, activities and resources, and solutions to the challenges designed and published by other students.

Key Components

The Challenge Based Learning process begins with a big idea and cascades to the following: an essential question, a challenge, guiding questions, activities, resources, determining and articulating the solution, taking action by implementing the solution, reflection, assessment, and publishing.

The Big Idea: The big idea is a broad concept that can be explored in multiple ways, is engaging, and has importance to high school students and the larger society. Examples of big ideas are Identity, Sustainability, Creativity, Violence, Peace, and Power.

Essential Question: By design, the big idea allows for the generation of a wide variety of essential questions that should reflect the interests of the students and the needs of their community. Essential questions identify what is important to know about the big idea and refine and contextualize that idea.

The Challenge: From each essential question a challenge is articulated that asks students to create a specific answer or solution that can result in concrete, meaningful action.

Guiding Questions: Generated by the students, these questions represent the knowledge students need to discover to successfully meet the challenge.

Guiding Activities: These lessons, simulations, games, and other types of activities help students answer the guiding questions and set the foundation for them to develop innovative, insightful, and realistic solutions.

Guiding Resources: This focused set of resources can include podcasts, websites, videos, databases, experts, and so on that support the activities and assist students with developing a solution.

Solutions: Each challenge is stated broadly enough to allow for a variety of solutions. Each solution should be thoughtful, concrete, actionable, clearly articulated, and presented in a publishable multimedia format such as an enhanced podcast or short video.

Assessment: The solution can be assessed for its connection to the challenge, accuracy of the content, clarity of communication, applicability for implementation, and efficacy of the idea, among other things. In addition to the solution, the process that the individuals as well as teams went through in getting to a solution can also be assessed, capturing the development of key 21st century skills.

Publishing: The challenge process allows for multiple opportunities to document the experience and publish to a larger audience. Students are encouraged to publish their results online, soliciting feedback. The idea is to broaden the learning community and foster discussion about solutions to the challenges important to students.

The Process

Challenge Based Learning follows a workflow that mirrors the 21st century workplace. Students are given enough space to be creative and self-directed and at the same time are provided with support, boundaries, and checkpoints to avoid frustration. The workflow can be structured and modified in a variety of ways. The following process is provided as a starting point but is not meant to be prescriptive.

Setting Up a Collaborative Environment

A shared working space is helpful for a successful challenge. The workspace should be available to students 24/7, include needed resources, access to activities, a calendar, and serve as a communication channel with the teacher and between team members.

A variety of resources can be used to create a collaborative environment, including:

Apple Tools: iWeb and the resources included with MobileMe provide a set of tools for building a collaborative environment to support a challenge.

Google Tools: Google Sites, Calendars, Gmail, and Docs also can be used to create a collaborative space. A Google Site can be used for distributing information and content as well as serving as a collaborative space for each of the student groups.

Introduction

Once the big idea is selected, the first step is to develop with the class an overview of the big idea and the related essential question. This sets the broader context and foundation for the work that will follow. The class then identifies a suitable challenge or is introduced to one of the existing challenges.

Team Formation

In today's workforce, individuals with various skill sets typically work together in teams on specific projects or challenges. During this team formation stage, it is important to consider roles and responsibilities and discuss the developmental nature of teams.

Assessment

The teacher and the teams discuss what they will use as a measure of their success and adopt, adapt, or develop a project rubric to gauge the success of their solution.

Guiding Questions

After the teams are formed and briefed, the students begin the process of identifying the questions that will guide their analysis of the challenge topic. These questions outline what the students think they need to know to formulate a viable solution. Questions will be answered, reframed, or new questions will be formulated along the way as information is gathered and concepts explored.

Guiding Activities and Guiding Resources

During this stage, the teams seek to find answers to the guiding questions by participating in a variety of learning activities, conducting research, experimentation, interviewing, and exploring various venues to assist in crafting the best solution. The activities can be teacher directed or student directed, whole group, small group, or individual, depending on the topic and the need. The goal of this stage is for students to gain a solid foundation on which to develop their solution.

Prototype/Testing

Once the students have identified possible solutions, they can build them out, try them with small user groups, or present them to a focus group. This process allows the teams to polish their solution.

Implement

The next step is to develop the implementation plan for the solution and put it into action. The scope of implementation will vary greatly depending on time and resources, but even the smallest effort to put the plan into action in a real-life setting is important.

Assess

The teams can use the project rubric developed at the beginning of the process to gauge the success of their implementation.

Reflection/Documentation

Throughout the process, the students should document their work and reflect on the process. Much of the deepest learning takes place by considering the process, thinking about one's own learning, analyzing ongoing relationships with the content and between concepts, interacting with other people, and developing a solution. Blogs, video, podcasts, digital storytelling, and photographs are all great ways to document and reflect on the process.

Publish

Students should be encouraged to publish their work in a variety of locations. One way for students to publish is to create a two-to-three minute video about their solution and share it locally or post it online for broader visibility.

Ongoing Informative Assessment

Informal assessment that helps students move toward a viable solution should take place throughout the project. Formal assessment can take place at specific points within the project. Three obvious points of assessment involve the development of an articulation of what makes a compelling solution, assessment of their documentation of the process, and the results of the action taken. This type of practical evaluation is much closer to how work done in the world outside of school is evaluated.

Example Challenges

To illustrate the Challenge Based Learning process, Apple has engaged with educators across the country to develop a series of challenges that can be used or modified by other teachers. These initial example challenges (more to come in January) fall under the big idea of Sustainability. A summary of these initial challenges is included here. See the Appendix for details of each.

Sustainability is a defining issue for this generation. In this instance, the term is defined broadly as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (www.epa.gov/Sustainability).

A wide variety of challenges can be presented under the Sustainability umbrella such as the four challenges presented here on the issues of water, food, energy, and air.

These are meant to be examples and to serve as discussion points. Teachers and students can work with these challenges or determine new themes and challenges that are important and meaningful to their specific context.

Big Idea—Sustainability: Water, Food, Energy, Air

Water

Essential Question: How does my water consumption impact my world?

It is a simple fact of life: we need water. Water is essential to life on earth. We need it to drink, keep clean, generate power, and grow the food we eat. We are using up our planet's fresh water faster than it can be replenished naturally. You can make a difference by improving the use of water in your home, school, and community.

Challenge: Improve your home, school, or community use of water.

Food

Essential Question: How does my food consumption impact my world?

You are what you eat. So what are you? Maybe it's time to consider food and how it affects our bodies and the world around us. The decisions we make when deciding what to eat have a significant impact on our personal health and wellbeing, our ability to perform the activities we engage in, and our environment.

Challenge: Improve what and how you eat.

Energy

Essential Question: What is the impact of my fossil fuel consumption?

Eighty five percent of U.S. energy consumption is of fossil fuels. They also play a part in a wide variety of other products we use daily. Any way you look at it, dependence on fossil fuels is problematic. They are a finite resource, the source of considerable pollution, and supply cannot meet worldwide demand. So what can you do to reduce your family's consumption? You first need to discover all of the ways that you use fossil fuels in your everyday life—not just the car trip to the mall or school but all of their more hidden uses. Then you need to act.

Challenge: Reduce your family's use of fossil fuels.

Air

Essential Question: How do my actions impact the air we breathe?

The air we breathe has no boundaries. What we put in the air ends up in someone else's lungs. According to the American Lung Association, in 2001, over 6 million American children and close to 14 million American adults suffered from asthma. We also know that the quality of the air has a negative impact on the ozone layers and that many cities issue ozone warnings. Not only is the quality of our outside air a concern, but we also are learning that the air we breathe in schools and our homes may be hazardous.

Challenge: Improve the air you breathe.

Opportunities to Participate

Challenge Based Learning is built with participation in mind, and there are multiple opportunities for participants to share. By promoting participation and sharing, Challenge Based Learning can develop organically and leverage the interests of students and teachers across the globe. As the world changes, new big ideas, essential questions, and challenges can be posed. The level of participation will vary based on time constraints, interest, and so on. Within the Challenge Based Learning process, teachers and students can participate at many different levels.

Engage in conversation. The overall Challenge Based Learning process and each challenge will have a group discussion component. You will be able to join the group—enter into the discussion, ask questions, make recommendations, and suggest new big ideas.

Engage your students in a challenge. Implement one of the challenges with your students.

Publish. Once you have taken on a challenge, have your students document their solutions through video and publish them alongside other solutions in the challenge gallery (coming in January) or within other online repositories.

Expand on the sample challenges. As you identify new guiding questions, activities, and resources, you will be able to recommend them for addition to the challenges by posting them in the appropriate strand within the discussions.

Create new challenges. Students and teachers will be invited to create a new challenge using the standard template. Perhaps you have a different sustainability issue that impacts your community or an entirely new big idea, essential questions, and challenge. As you publish new challenges, others can engage with you.

Moving Forward

Today's challenges call for bold action. No longer can school be a time where the curriculum is devoid of reality and opportunities for immediate application. Students are looking to be challenged in an authentic manner. They need to learn how to confidently ask questions and identify, research, analyze, and solve problems. Challenge Based Learning is designed to equip a new generation of students to solve real problems, develop 21st century skills, and make a difference in their community and the world. When provided with guidance, students can approach today's critical challenges and make a difference.

The Challenge Based Learning Community will provide a space for teachers, students, and experts to address local challenges that are impacting neighborhoods, communities, and the world. It will encourage participation at many different levels, allowing for the organic development of a rich and engaging body of knowledge and community freely available to all educators. Learning communities can share different perspectives on issues and consider the variety of challenges faced around the globe and the solutions to these challenges designed by students. Powerful ideas combined with youthful creativity and cutting edge technology will address the myriad challenges facing our world, country, and communities.

Appendix

Sustainability: Water

The Essential Question

How does my water consumption impact my world?

Overview

It is a simple fact of life: we need water. Water is essential to life on earth. We need it to drink, keep clean, generate power, and grow the food we eat. We are using up our planet's fresh water faster than it can be replenished naturally. You can make a difference by improving the use of water in your home, school, and community.

The Challenge

Improve your home, school, or community use of water.

Guiding Questions

Guiding questions direct the research of the challenge topic.

Examples

- How do we use water?
- How much do we use?
- How is water wasted?
- How much water is wasted?
- How can water be conserved?

Guiding Activities

These activities assist students with answering the guiding questions and set the foundation for them to develop insightful and realistic solutions. They can be student or teacher directed. The student teams may begin with these activities but will need to seek out new ones to answer their questions. The goal is not to create a prescribed path to a solution but to provide guidance when needed.

Examples

- **Setting the Foundation**

  Student groups brainstorm everything they know about water, then search the Internet for basic water information and the top water issues. See "Guiding Resources" for websites to start this research.

- **Calculate Your Individual Water Footprint**

  Students determine how much water they and their families use with the H_20 Calculator available from the National Wildlife Federation.

- **Water Source Scavenger Hunt**

  Students use the Surf Your Watershed site provided by the U.S. Environmental Protection Agency to locate the community's watershed. If available, they use the data in the site to identify local groups or experts to interview about the watershed.

- **Where Does Your Water Go?**

  Students research how much water is used to brush their teeth, flush the toilet, and water the yard. The U.S. Geological Survey provides a web-based water calculator that gives a general overview of water use. They can also use a spreadsheet to track the use of water in their household.

Guiding Resources

This is focused content that supports the activities and assists students with developing a solution. The ingredients include websites, videos, podcasts, experts, and other resources.

Examples

- **Indoor Water Use in the United States**

  This site from the Environmental Protection Agency provides statistical information about indoor water use.

  www.epa.gov/watersense/pubs/indoor.htm

- **Water Science for Schools**

  This U.S. Geological Survey site includes a wide range of resources about many aspects of water and includes pictures, data, maps, and an interactive water knowledge test.

  http://ga.water.usgs.gov/edu/mwater.html

- **Conserve and Protect Water**

  This site from the National Wildlife Foundation provides a personal water calculator and other water-awareness activities.

  www.nwf.org/water

- **WaterSense Quiz**

  This activity from the Environmental Protection Agency is designed to help raise students' water awareness. The site includes many other resources.

  www.epa.gov/watersense/water/text.htm

- **Surf Your Watershed**

  This Environmental Protection Agency site identifies your local watershed and any citizen-based groups that are active in your area.

  http://cfpub.epa.gov/surf/locate/index.cfm

- **Water Drops: All About H_20**

  This series of 90-second podcasts from renowned hydrologist Peter Black provides comprehensive information about water.

  http://deimos3.apple.com/WebObjects/Core.woa/Browse/esf.edu.1520520292

- **Water for Tea**

  In this 12-minute video from NASA, Star Trek star Patrick Stewart hosts a voyage to better understand the "bigger picture" of water on earth.

  http://deimos3.apple.com/WebObjects/Core.woa/Browse/lifeonterra.com.1525139207

Solution/Action

The challenges are stated broadly enough to allow for a variety of solutions. Each group of students will base its solution on what students have learned as they moved through the guiding activities. Any solution must be concrete and actionable.

Example

Students researched and recorded all of the ways that water was being used in their school. They checked all fixtures for leaks, looked at student and teacher use, and explored how water was used for landscaping. They determined that one of the largest sources of water use was the school landscaping. The students went about determining the amount of water necessary to sustain the current landscaping, the source of that water, and alternative landscaping options. They designed a plan for changing the school landscaping that included a plant palette, a forecast for the amount of water saved, and a budget and prediction of the district's return on their investment. To explain their plan, students created public service announcements as well as brochures. All of this information was then presented to the school board.

Sustainability: Food

The Essential Question

How does my food consumption impact my world?

Overview

You are what you eat. So what are you? Maybe it's time to consider food and how it affects our bodies and the world around us. The decisions we make when deciding what to eat have a significant impact on our personal health and wellbeing, our ability to perform the activities we engage in, and the environment.

The Challenge

Improve what and how you eat.

Guiding Questions

Guiding questions direct the research of the challenge topic.

Examples

- What do I eat?
- Where does my food come from?
- What is the cost of getting food to my table?
- How does food impact me?
- How does the food I eat affect the world?
- What is in my food?
- What are some local sources of food?

- Why do I eat?
- Why do I eat what I eat?
- What does food mean to me?

Guiding Activities

These activities assist students with answering the guiding questions and set the foundation for them to develop insightful and realistic solutions. They can be student or teacher directed. The student teams may begin with these activities but will need to seek out new ones to answer their questions. The goal is not to create a prescribed path to a solution but to provide guidance when needed.

Examples

- **What Are the Issues?**

  Students complete a review of Internet resources with their guiding questions. Websites that can be used to get started are listed in "Guiding Resources." Students brainstorm issues surrounding food, thinking both micro (their eating habits) and macro (community and global impacts).

- **Analyze Your Menu**

  Students create a photo journal of what they eat for lunch or dinner during a normal week. They take pictures, create a spreadsheet, and identify the ingredients, number of calories, and how much of it they consumed.

- **Food Map**

  Students take one of the items they eat for lunch, identify its contents, and attempt to track the source of the contents. They see if they can determine the number of miles the food travels to get to them.

- **What Should I Eat?**

  Students review dietary recommendations from a variety or sources. They determine how many calories are recommended on a daily basis. They then review their diet inventory to see how many calories they are consuming. They break down where the calories come from in terms of fat, protein, and carbohydrates. They also consider the sources and science behind the dietary recommendations.

- **What's in the Package?**

  Students analyze food packaging at their school, what gets recycled, what gets thrown away. Research includes the amount of waste along with recycling strategies and alternative products. Are the current packaging strategies sustainable environmentally?

- **Label Scavenger Hunt**

  Students learn about the purpose of and how to read nutritional labels. They collect a label from one item of food that they consume and analyze its content.

Guided Resources

This is focused content that supports the activities and assists students with developing a solution. The ingredients include websites, videos, podcasts, experts, and other resources.

Examples

- **U.S. Department of Agriculture Food and Nutrition Information Center**

  This USDA site provides comprehensive food and human nutrition information, including the current Dietary Guidelines and materials for educators.

  http://fnic.nal.usda.gov

- **Foodroutes.org**

  This website provides information about the importance of buying local and how to do it in your neighborhood.

  http://foodroutes.org

- **Local Harvest**

  This website allows you to locate farmer markets, family farms, and other sources for purchasing sustainably grown foods in your area.

  www.localharvest.org

- **The Oil in Your Oatmeal**

  This movie presents an analysis of the overall cost of a breakfast when all factors are considered.

  www.youtube.com/watch?v=KsOsipWacG0

- **Cooking Up A Story Podcast**

  This podcast from the Local Food Sustainable Network provides information about issues involving food and sustainability. Two episodes relate to the documentary *King Corn* (2007), which concerns the use and production of corn in the United States, including the role of high fructose corn syrup in our daily diet.

  http://phobos.apple.com/WebObjects/MZStore.woa/wa/viewPodcast?id=251805518

- **Chef Ann's Podcast**

  This podcast from school chef Ann Cooper explores issues related to school food and nutrition for students.

  http://phobos.apple.com/WebObjects/MZStore.woa/wa/viewPodcast?id=121140232

- **Where Does Your Food Come From?**

  In this episode of The Ethics of Eating podcast from American Public Media, Michael Pollan, author of *The Omnivore's Dilemma* and *In Defense of Food: An Eater's Manifesto,* argues for a more sustainable food production system.

  http://deimos3.apple.com/WebObjects/Core.woa/Browse/americanpublicmedia.org.1353684204.01353684211.1351757528?i=1620428009

Solution/Action

The challenge is stated broadly enough to allow for a variety of solutions. Each group of students should base its solution on what students learned as they moved through the guiding activities. The solution must be concrete and actionable.

Example

Students researched one regular lunch item at school and discovered the ingredients, the nutritional value, the manufacturer, and the cost per serving. They then researched possible substitutes for the item that contained locally grown ingredients, was more nutritional, and was cost effective. They conducted a comparison between the two food items and a tasting for the students. The analysis and recipe were presented to the head of food services, parents, and the school board. A letter writing campaign along with testimony from local nutritional experts was used to convince the food service department to try the new recipe.

Sustainability: Energy

The Essential Question

What is the impact of my fossil fuel consumption?

Overview

Eighty five percent of U.S. energy consumption is of fossil fuels. They also play a part in a wide variety of other products we use daily. Any way you look at it, dependence on fossil fuels is problematic. They are a finite resource, the source of considerable pollution, and supply cannot meet worldwide demand. So what can you do to reduce your family's consumption? You first need to discover all of the ways that you use fossil fuels in your everyday life—not just the car trip to the mall or school but all of their more hidden uses. Then you need to act.

The Challenge

Reduce your family's use of fossil fuels.

Guiding Questions

Guiding questions direct the research of the challenge topic.

Examples

- What is a fossil fuel?
- Where does my family use fossil fuels?
- How much fossil fuel does it take to heat or cool my house?
- What is made from fossil fuels?
- How much gas does my family use in one week?
- How much oil does it take to make a gallon of gas?
- What are the alternatives to fossil fuels?

Guiding Activities

These activities assist students with answering the guiding questions and set the foundation for them to develop insightful and realistic solutions. They can be student or teacher directed. The student teams may begin with these activities but will need to seek out new ones to answer their questions. The goal is not to create a prescribed path to a solution but to provide guidance when needed.

Examples

- **Learn About Fossil Fuels**

  Students research and develop a clear definition of fossil fuels.

- **Oil Scavenger Hunt**

  Students examine all of the things they use in a normal day and do research to learn if they contain or use oil. They try to quantify the amount of oil each item represents.

- **How Much Fossil Fuel Do You Own?**

  Students create a list of products that have fossil fuels in them. They do an inventory of all the items in their homes that contain fossil fuel and investigate alternatives to these items.

- **Transportation**

  Students calculate the amount of gas used during the week to transport members of their family. They then identify alternatives.

- **How Much Fossil Fuel Is in a Plastic Bag?**

  Students calculate the amount of fossil fuels needed to create plastic bags. They record how many plastic bags their family uses in a week. They then determine how much energy they can save by not using plastic bags.

- **Finding Alternatives**

  Students research providers of alternative energy sources in their community. They interview the providers and identify pros and cons of the options.

Guiding Resources

This is focused content that supports the activities and assists students with developing a solution. The ingredients include websites, videos, podcasts, experts, and other resources.

Examples

- **Energy Story: Fossil Fuels—Coal, Oil and Natural Gas**

  The California Energy Commission provides an overview of fossil fuels.

  www.energyquest.ca.gov/story/chapter08.html

- **Fossil Fuels**

  This site from the Institute for Energy Research includes an overview of fossil fuels.

  www.instituteforenergyresearch.org/energy-overview/fossil-fuels

- **Energy Efficiency**

  The Energy Information Administration provides information for students about energy consumption and efficiency.

  www.eia.doe.gov/kids/energyfacts/saving/efficiency/savingenergy_secondary.html

- **Official Energy Statistics from the U.S. Government**

  This site includes a large collection of raw data to use for analysis from the Energy Information Administration.

  www.eia.doe.gov

- **Personal Impact Calculator**

  This global warming calculator, from the AOL Research and Learn site, can be used to measure a household's greenhouse gas emissions and learn how to reduce them. This calculator was updated in December 2006 with data from the EPA.

  http://reference.aol.com/planet-earth/global-warming/calculator

- **AAA Fuel Cost Calculator**

  This site provides a tool for estimating the fuel cost of trips using the starting location and destination and vehicle manufacturer, year, and model.

  www.fuelcostcalculator.com

- **Smart Energy**

  This podcast from Stanford professor Margo Gerritson explores technologies and ideas to power the world safely and efficiently.

  http://deimos3.apple.com/WebObjects/Core.woa/Browse/itunes.stanford.edu.1380022380

- **Stanford University Woods Energy Seminar**

  This interdisciplinary series of talks primarily by Stanford experts covers a broad range of energy issues.

  http://deimos3.apple.com/WebObjects/Core.woa/Browse/itunes.stanford.edu.1635890187

- **Inside Renewable Energy**

  This overview of the renewable energy industry includes interviews, news, events, product information, and more.

  http://phobos.apple.com/WebObjects/MZStore.woa/wa/viewPodcast?id=135363982

Solution/Action

The challenges are stated broadly enough to allow for a variety of solutions. Each group of students will base its solution on what students learned as they moved through the guiding activities. Any solution must be concrete and actionable.

Example

Students researched different ways that their families utilized fossil fuels. They determined that the use of plastic grocery bags was one area where they could reduce the amount of fossil fuels used. Students first did an inventory of how many bags each team member's family used during a normal month. They calculated the amount of fossil fuels that these bags represented. They then designed and implemented a green bag campaign that acted both as a fundraiser for the school and measurably reduced the number of plastic bags their families used monthly. The green bag campaign included designing creative bags that would be attractive to consumers, determining the cost of production, developing a marketing plan, and selling the bags. A final comparison showed that the footprint of the bags was less than the plastic bag consumption.

Sustainability: Air

The Essential Question

How do my actions impact the air we breathe?

Overview

The air we breathe has no boundaries. What we put in the air ends up in someone else's lungs. According to the American Lung Association, in 2001, over 6 million American children and close to 14 million American adults suffered from asthma. We also know that the quality of the air has a negative impact on the ozone layers and that many cities issue ozone warnings. Not only is the quality of our outside air a concern, but we also are learning that the air we breathe in schools and our homes may be hazardous.

The Challenge

Improve the air you breathe.

Guiding Questions

Guiding questions direct the research of the challenge topic.

Examples

- What is the composition of air?
- How is air quality defined?
- What is the quality of the air in my home and community?
- What impacts air quality?
- How does air quality impact plants and animals?
- How can air quality be improved?

Guiding Activities

These activities assist students with answering the guiding questions and set the foundation for them to develop insightful and realistic solutions. They can be student or teacher directed. The student teams may begin with these activities but will need to seek out new ones to answer their questions. The goal is not to create a prescribed path to a solution but to provide guidance when needed.

Examples

- **Learn About Air**

  Students explore the guiding resources to gain background knowledge on the atmosphere and air quality.

- **Create a Virtual Environment**

  To learn about the impact of airborne pollutants, students create two terrariums, introduce different pollutants to one, and compare their impact on the plants.

- **How Is the Air Quality in My Community?**

  Students visit the airnow.gov website (see "Guiding Resources") and determine the quality of the air in their location. They identify the major types of pollution and determine their sources.

- **How Is the Air Quality in My School?**

  Students use the Indoor Air Quality Tools for Schools Action Kit to investigate indoor air problems. The kit is provided by the U.S. Environmental Protection Agency (see "Guiding Resources").

- **Cost Benefit Analysis**

  What is the cost of clean air? Students research what it costs companies to modify their process to meet air quality regulations. They explore how that impacts the cost of products. They also interview local companies to see how they protect air quality and what it costs them.

Guiding Resources

This is focused content that supports the activities and assists students with developing a solution. The ingredients include websites, videos, podcasts, experts, and other resources.

Examples

- **AIRNow Air Quality Index (AQI)**

  This cross-agency U.S. government site has an index for reporting daily air quality. It tells you how clean or polluted your outdoor air is and what associated health effects might be a concern.

  http://airnow.gov

- **Indoor Air Quality**

  This Environmental Protection Agency site provides information about indoor air quality.

  www.epa.gov/iaq

- **Indoor Air Quality Tools for Schools Program**

  The IAQ TfS Action Kit, most elements of which can be downloaded from this Environmental Protection Agency site, shows schools how to carry out a practical plan to improve indoor air problems.

  www.epa.gov/iaq/schools/toolkit.html

- **Ground-level Ozone**

  This Environmental Protection Agency site includes general information on ozone and ground-level ozone.

  www.epa.gov/air/ozonepollution

- **Major Air Pollutants**

  This PDF document provides a list of major air pollutants, their sources, and their effects.

  www.ciese.org/curriculum/airproj/docs/major_air_pollutants.pdf

- **Pollution in Your Community**

  At this site, you can get an in-depth pollution report for your county, covering air, water, chemicals, and more.

  www.scorecard.org

- **Air Pollution and Respiratory Health**

  This site presents information about air pollution from the Centers for Disease Control and Prevention.

  www.cdc.gov/nceh/airpollution

- **Air Quality**

  This video podcast from University of California Davis covers topics related to air quality.

  http://deimos3.apple.com/WebObjects/Core.woa/Browse/ucdavis-public.1454546375

Solution/Action

The challenges are stated broadly enough to allow for a variety of solutions. Each group of students will base its solution on what students learned as they moved through the guiding activities. Any solution must be concrete and actionable.

Example

Students investigated the air quality issues in their school using the Indoor Air Quality Tools for Schools (IAQ TfS) Action Kit provided by the Environmental Protection Agency. This in-depth program contained all of the content they needed to analyze, correct, and prevent indoor air quality issues in schools across the district. Using the information they learned, they created a series of video public service announcements that were distributed to all schools. They made presentations to the district executive team and board resulting in the adoption of district-wide policies and educational programs concerning school air quality.