HOOPA VALLEY HIGH SCHOOL STEM PROJECT

Designing a Sustainable House

Humboldt Interdisciplinary Stem Initiative

Project Overview

This curriculum was adapted from curriculum developed by Jeff Hartman from City High School in Tucson, Arizona. It was originally designed for a 9th grade Integrated Science and Math. Hoopa High School teachers have adapted the curriculum for 10th grade biology and 11th grade natural resources classes. We have also tried to make it to be more relevant to our local area in northern California. We encourage teachers to adapt and use any of the materials.

This is a 4-6 six-week unit that is taught in the spring of 11th/12th grade Natural Resources class at Hoopa Valley High School. With a culminating project of student designed models of their own sustainability house. In addition portions of the unit are taught in 10th grade Biology and 11th grade Chemistry and some units are also reinforced in our Math courses. Chemistry is also using the Biodiesel curriculum located in the appendix to supplement the module. In addition this unit has been adapted to be used in a 3rd grade class with students making a "Tiny Town" that incorporates may ideas from this module. We have hopes to extend this lesson into an actual house that students will someday have access to and be able to work and learn at.

To emphasize common core and Next Generation Science standards this is a place-based, project-centered learning activity. Throughout the unit, students work on individual lessons focused on the local environment. Whenever possible, we use local resources and local examples to teach key concepts to help students develop a sense of place. Students demonstrate what they have learned by completing a final project, in this case by designing a model of a sustainable house.

- The overarching goals of this unit include: Students will be able to persevere and problem solve using an engineering design process to better understand alternative energy sources and sustainable development by designing their own sustainable house.

- To introduce students to the concept of sustainability and sustainable development;

- To develop a vocabulary to discuss sustainability issues;

- To teach students how energy is conserved, stored and transferred;

- To teach students about their local environment (Humboldt County/ Hoopa);

- To teach students about another biome (the Costa Rican rainforest);

- To compare and contrast sustainability issues in two different environments;

- To teach mathematical concepts (scaling, graphing, proportionality).

Quick Glance: Daily Curriculum Overview

Week 1 – Introduction to Sustainability (pg6)

Day 1 – Movie: The Lorax. Discuss movie; complete assignment. Homework: Passionate reading on the need and the urgency for sustainability.

Day 2 –-Discussion of the reading. Lecture – (Pre-Test) What is sustainability? Complete definition worksheet. Emphasize importance of conservation.

Day 3 -- Brainstorming re: what they would need to build a sustainable house. Complete Worksheet. Introduce sustainable house project. Hand out general project guidelines.

Day 4 –Students select locale, receive climate data and project presentation guidelines. Organize research groups.

Week 2 – Energy Issues (pg 26)

Day 1 – Local speaker to address alternative energy options (CCAT or SHATZ).

Day 2 – Lecture: Energy 101. Math worksheet re: how to calculate KWH. Homework: Reading from Global Science textbook re: alternative energy technologies. Using I-pad: http://www.altenergy.org/ or 11 bizarre sources of alternative energy

Day 3 – Complete energy worksheet. Wants/needs/energy usage/possible sources. Day 4 -- Visit to Blue Lake Rancheria (local energy efficient community).

Week 3 – Sustainable Building Materials and Design (pg34)

Day 1 – Debrief visit. Lecture; Introduction to building materials and design. KWL to brainstorm a list of criteria for sustainable building materials. Compare their list to handout. Introduce worksheet re: sustainable materials.

Day 2 – Research sustainable materials. Divide into groups and research possible materials and criteria questions. Complete worksheet.

Day 3 – Finish research.

Day 4 -- Tragedy of the Commons fishing exercise. Emphasize social aspect of sustainable design.

Week Four – Garden/Food/Scale Drawings (pg44)

Day 1 – Introduction to gardening issues. Tour of Hoopa community garden.

Possible tour of local farmer.

Day 2 – Introduce requirements for garden plan. Guest lecture re: planting schedules (Hoopa Ca).

Day 3 – Begin scale drawings – acre plot, house and garden. Day 4 -- Complete scale drawings

Week Five – Water/wastewater (pg 48)

Day 1 – Hoopa water resource plant and Arcata marsh wastewater treatment Introduce rainwater harvesting and math worksheet.

Day 2 – Lecture: wastewater, water conservation. Research composting toilets, greywater recycling, rainwater harvesting, septic tanks. Complete water plan worksheet.

Day 3 – Work on final project Day 4 – Work on final project

Week Six -- Final presentations (pg 51)

Days 1,2,3,4 – Student presentations.

CHAPTER 1

Week 1: Introduction to Sustainability

"What is the use of a house if you don't have a decent planet to put it on?

– Henry David Thoreau

Introduction to Sustainibility

Vocabulary

Sustainability

Environmental Conservation

Organic

Fair Trade

Emissions

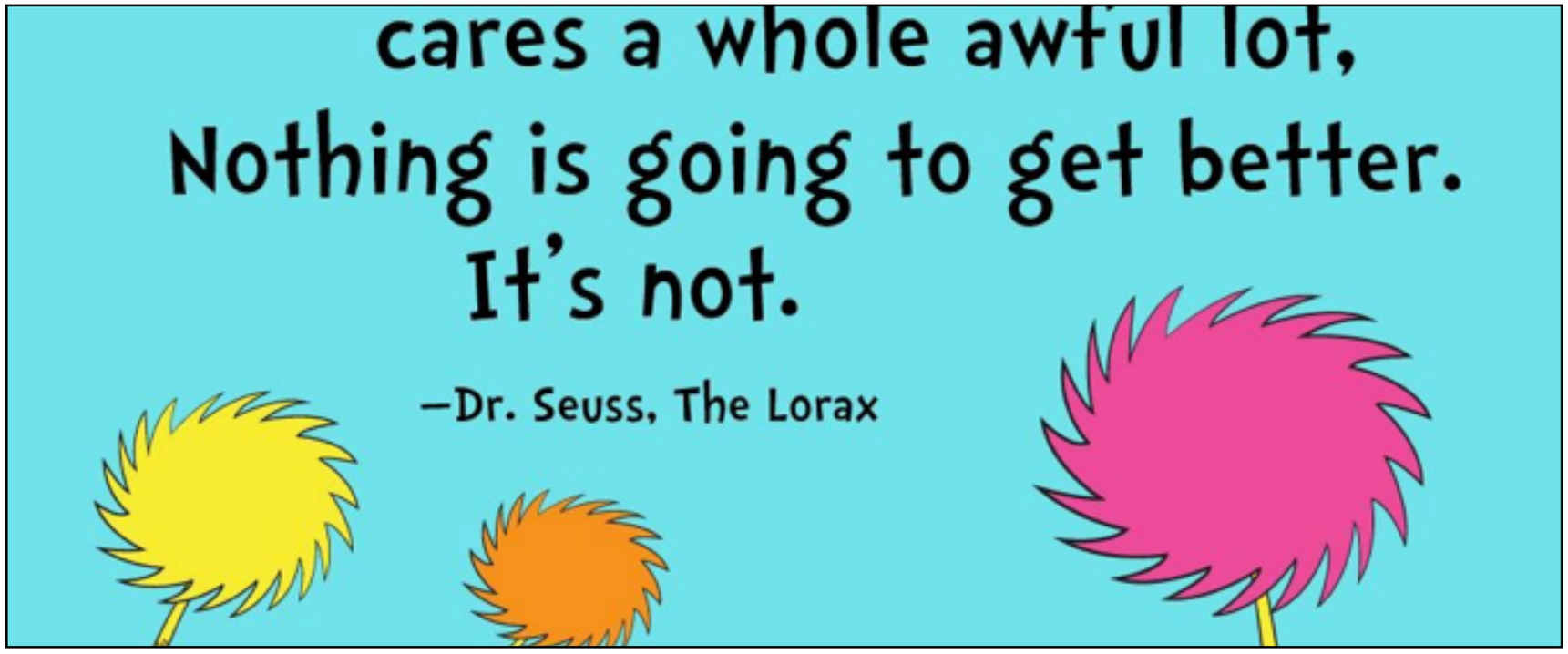
Permaculture

Ecological

Ecologically sound

Eco-system

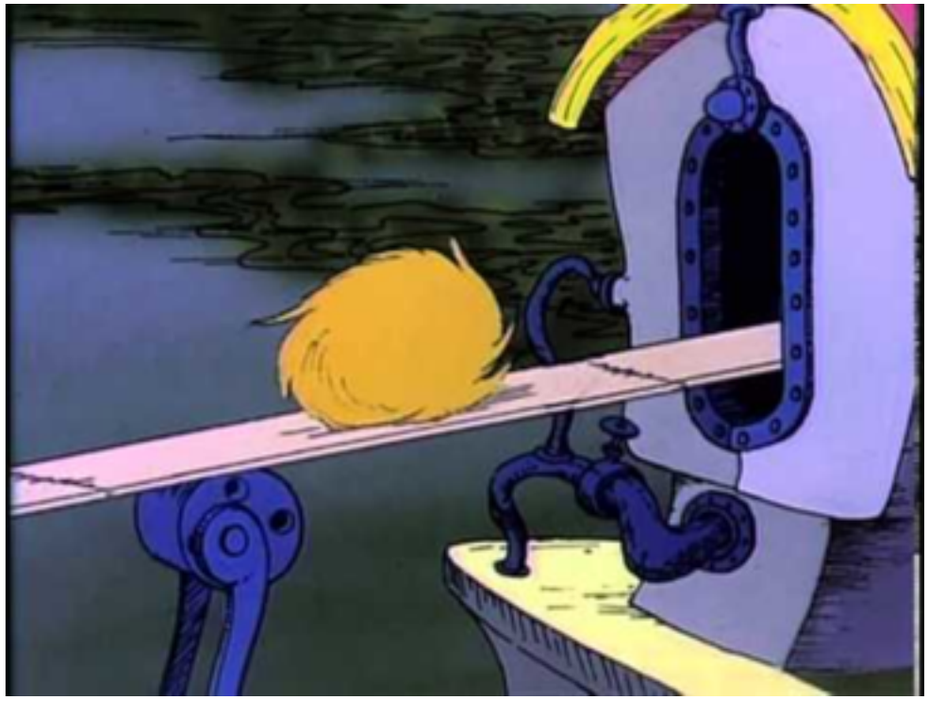
Figure 1.1



The LORAX is a fictional story about a man whose activities abused the environment and about what he learned from the experience. The story was written in 1971 and yet it contains many common components found in the environmental problems and issues facing humans around the world today. The LORAX also contains many of the components associated with sustainable development.

Sustainable development is a tricky idea. It suggests that humans "sustain" the environment by preserving, protecting, and conserving. Yet, economic development is still necessary in all countries, regardless of their current economic status. Many experts believe that this apparent conflict between outcomes is the key to the quality of future human life on the planet and that economic development using environmentally-friendly technology can help promote economic development that sustains the environment. The central focus of sustainable development is to balance quality of life with quality of the environment.

Interactive 1.1 The Lorax



Lorax Review Questions

1. The Once-ler used the land's natural resource to start a business which made and sold a product. What was the product? How was it used by buyers?

2. The product was made out of what natural resource?

3. The use of technology often requires the use of natural resources. This utilization of natural resources can have an effect on the environment. How did the production of thneeds affect important natural resource(s) in the story?

4. Often, technological production creates "byproducts". For example, a byproduct of sawing wood is sawdust. Sometimes the byproducts of technology are unwanted or dangerous (ex: poisonous chemicals). Name two byproducts that resulted from making thneeds.

5. Were these two byproducts helpful or harmful to the environment?

6. The Once-ler's business failed. Why did it fail? What could he have done to prevent this?

7. Now, think about the building materials used in your own home. List two of these building materials. Then list the byproducts of production and the by products of use.

8. At the end of the movie, the Lorax hints that we are doomed unless…. Unless what?

9. Name two things you can do to improve or offset the impact of your house on the local environment.

Selected (Angry) Readings on Sustainibility

What is an Angry Reading

1. Note: The goal here is to force students to confront the hard choices associated with the need to become a more sustainable society. To do that, we believe one must move beyond the nice and easy parts of the issue to make it personal and to challenge people to change behavior. That's why we refer to this as an "angry" reading.

Figure 1.2 Selected Readings

October 21, 2007

OP-ED COLUMNIST

Save the Planet: Vote Smart

By THOMAS L. FRIEDMAN

People often ask: I want to get greener, what should I do? New light bulbs? A hybrid? A solar roof? Well, all of those things are helpful. But actually, the greenest thing

you can do is this: Choose the right leaders. It is so much more important to change your leaders than change your light bulbs.

Why? Because leaders write the rules, set the standards and offer the tax incentives that drive market behavior across a whole city, state or country. Whatever any of us does individually matters a tiny bit. But when leaders change the rules, you get scale change across the whole marketplace. And the energy- climate challenge we face today is a huge scale problem. Without scale, all you have is a green hobby.

Have no illusions, everything George Bush wouldn't do on energy after 9/11 — his resisting improved mileage for cars and actually trying to weaken air-conditioner standards — swamped any good works you did. Fortunately, the vacuum in the White House is being filled by leaders from below.

Take the New York City taxi story. Two years ago, David Yassky, a City Council member, sat down with one of his backers, Jack Hidary, a technology entrepreneur, to brainstorm about how to make New York City greener — at scale. For starters, they checked with the Taxi and Limousine Commission to see what it would take to replace the old gas-guzzling Crown Victoria yellow cabs, which get around 10 miles a gallon, with better-mileage, low-emission hybrids. Great idea, only it turned out to be illegal, thanks to some old size regulations designed to favor Crown Vics.

Recalled Mr. Hidary: "When they first told me, I said, 'Are you serious? Illegal?'" So he formed a nonprofit called SmartTransportation.org to help Mr. Yassky lobby the City Council to change the laws to permit hybrid taxis. They also reframed it as a health issue, with the help of Louise Vetter, president of the American Lung Association of the City of New York.

"New York City has among the dirtiest air in the U.S.," Ms. Vetter said. "When it comes to ozone and particulate mat-

ter, New Yorkers are breathing very unhealthy air. Most of it is tailpipe emissions. And in New York City, where asthma rates are among the highest in the nation, the high ozone levels create very serious threats, especially for kids who spend a lot of time outdoors. Converting cabs from yellow to green would be a great gift to the city's children."

Matt Daus, who heads the taxi commission, which is independent of the mayor, was initially reluctant, but once he learned of the health and other benefits, he joined forces with Messrs. Yassky and Hidary, and the measure passed the City Council by 50 to 0 on June 30, 2005. Since then, more than 500 taxi drivers have converted to hybrids — mostly Ford Escapes, but also Toyota Highlanders and Priuses, and others.

On May 22, Mayor Michael Bloomberg, one of the greenest mayors in America, decided to push even further, insisting on a new rule, which the taxi commission has to approve, that will not just permit but require all cabs — 13,000 in all — to be hybrids or other low-emission vehicles that get at least 30 miles a gallon, within five years.

"When it comes to health and safety and environmental issues, government should be setting standards,"

the mayor said. "What you need are leaders who are willing to push for standards that are in society's long-term interest." When the citizens see the progress, Mr. Bloomberg added, "then they start to lead." And this encourages leaders to seek even higher standards.

I asked Evgeny Freidman, a top New York City fleet operator, how he liked the hybrids: "Absolutely fabulous! We started out with 18, and now we have over 200, mostly Ford Escapes. Now we only put hybrids out there. The drivers are demanding them and the public is demanding them. It has been great economically. With gas prices as they are, the drivers are saving $30 dollars a shift." He said drivers who were getting 7 to 10 miles a gallon from their Crown Vics were getting 25 to 30 from their hybrids. The

cost of shifting to these hybrids, he added, has not been onerous.

Now Mr. Hidary is trying to get law firms and investment banks, which use gas-guzzling Town Cars — 12,000 in the city — to demand hybrid sedans only.

This is how scale change happens. When the Big Apple becomes the Green Apple, and 40 million tourists come through every year and take at least one hybrid cab ride, they'll go back home and ask their leaders, "Why don't we have hybrid cabs?"

So if you want to be a green college kid or a green adult, don't fool yourself: You can change lights. You can change cars. But if you don't change leaders, your actions are nothing more than an expression of, as Dick Cheney would say, "personal virtue."

Nov. 2nd 2016

BBC

What is Standing Rock and why are 1.4m 'checking in' there?

More than 1.4 million people have "checked in" on Facebook to support protesters fighting against a new oil pipeline in Standing Rock, a Sioux Native American reservation in North Dakota.

Activists say the Sioux Indians are under threat as the pipeline could contaminate the tribe's water source.

Protesters are worried police might be tracking them on social media, igniting concerns over digital privacy.

Why are so many people checking in on Facebook?

Their aim is to confuse the police.

They believe the local police department is using Facebook's location feature to compile a list of activists who are protesting about the pipeline.

The location feature allows users to tag themselves at a specific location or "check-in" and add related photos and videos.

Over the weekend, activists asked people to falsely "check in" on Facebook to confuse police about the number and identity of those actually protesting.

Critics have accused the police of using unnecessary force against protesters

Supporters put out a call for help on Facebook.

"The Morton County Sheriff's Department has been using Facebook check-ins to find out who is at SR [Standing Rock] in order to target them in attempts to disrupt the prayer camps," said the earliest publicly traceable version of the post, shared by a Facebook user from North Carolina on Sunday.

"SO Water Protectors are calling on EVERYONE to check-in at SR to overwhelm and confuse them."

What do the sheriffs say?

They deny they are using social media to track protesters' movements.

Snopes, a website that investigates internet rumours, said they had contacted police who denied using social media to track protesters.

"An officer explained that the metric [Facebook data] presented no intelligence value," one article on the website said.

"If police were using geolocation tools based on mobile devices, remote check-ins would not confuse or overwhelm them," it added.

Snopes did not confirm who started the viral Facebook post initially.

Are there issues with the police possibly using Facebook to monitor protesters?

Earlier this month, the American Civil Liberties Union (ACLU) reported that police had been using social media to track protesters during the Ferguson and Baltimore riots last year.

They said police had sourced information from Geofeedia, a data-providing company based in Chicago. The ACLU

said this type of monitoring can "disproportionately impact communities of colour".

They also called upon social media executives to restrict access to data mining companies who would provide information to the police.

Facebook, Instagram and Twitter have since shut off access to Geofeedia.

What are people protesting about?

The $3.7bn (£2.8bn) Dakota Access pipeline has drawn huge protests in North Dakota where thousands of people are trying to halt its construction, most notably the Sioux Native Americans.

The tribe says the pipeline will traverse over their sacred ancestral burial grounds, archaeological sites, and could pollute their main source of water.

Protesters say the pipeline could pollute the tribe's main water source

Environmental activists have shown solidarity with the Sioux tribe saying the pipeline, which can transport up to 570,000 barrels of crude oil a day, will greatly increase fossil fuel emissions.

The company behind the pipeline, Energy Transport Partners, has said the project will boost local economies and is much safer than transporting oil by rail or road.

Have the protesters been treated fairly?

Critics say the police have used unnecessary force on activists. The local police have arrested nearly 150 activists.

They have contrasted the police treatment of North Dakota protesters to the recent acquittal of seven members of an armed militia who led a 41-day standoff at a wildlife refuge in Oregon over federal land ownership.

Some Native American activists have criticised the acquittal saying the Oregon protesters were given special privilege because they were white.

Actress Shailene Woodley was one of the protesters arrested

Native Americans in Standing Rock say they are committed to being unarmed.

Xhopakelxhit, a Native American activist at Standing Rock, told the Guardian: "If native people were armed like the Bundy militia, we would be killed."

A private security firms hired used by the pipeline company has used attack dogs on activists. Police say the firm was unlicensed and may face charges.

How have Native Americans been treated in the past?

Historically, the treatment of Native Americans has been brutal.

Spanish, British, and French colonisers all fought vicious wars with native tribes. And as the American nation state moved west, settlers and landowners fought bitter battles with tribes across the continent.

During the formation of states across America, the federal government made land deals with individual tribes. The reservation lands were agreed to under treaties and tribes were given autonomy to govern themselves on these lands.

The Sioux Indians have claimed the land they are protesting on is rightfully theirs under a 1851 treaty which was subsequently dishonoured. The police say they are on private land.

In September the federal government temporarily blocked pipeline construction under the Missouri River, close to the Standing Rock Reservation. Although this ruling is binding until further notice, construction elsewhere along the pipeline's route is not prohibited and has continued.

Klamath River Fish Kill

The news started coming in on a late September Saturday in 2002. Hundreds of salmon, maybe thousands of salmon, were floating belly-up in the lower Klamath River. The first emails were tentative, as folks in northern California wrote "we think there's a fish kill going on." By Monday, no one was using the word "think."

The count of dead fish was in the thousands and rising; people said you could smell the river way before you could see it -- the stench of dead salmon hanging in the hot California air. In the end, the California Department of Fish and Game estimated the count at over 65, 000 dead fish.

Movie 1.1 Short video on the klamath fish kill

From Earthjustice.org

What Is Sustainability

Figure 1.3 Working together for a sustainable world

"Individually, we are on drop. Together, we are an Ocean" - Ryunosuke Satoro

Sustainability is a difficult term to define because it is a general concept and not a specific thing. There are many different definitions of sustainability, but common themes run through them all. Here are a couple definitions:

From Wikipedia: Sustainability is a characteristic of a process or state that can be maintained at a certain level indefinitely. For planet earth, it is thus the intent to provide the best outcomes for the human and natural environments both now and into the indefinite future. One of the most often-cited definitions of sustainability is the one created by the Brundtland Commission, led by the former Norwegian Prime Minister Gro Harlem Brundtland. The

Commission defined sustainable development as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs." Sustainability relates to the continuity of economic, social, institutional, and environmental aspects of human society, as well as the non-human environment. Sustainability is one of the four Core Concepts behind the 2007 Universal Forum of Cultures.

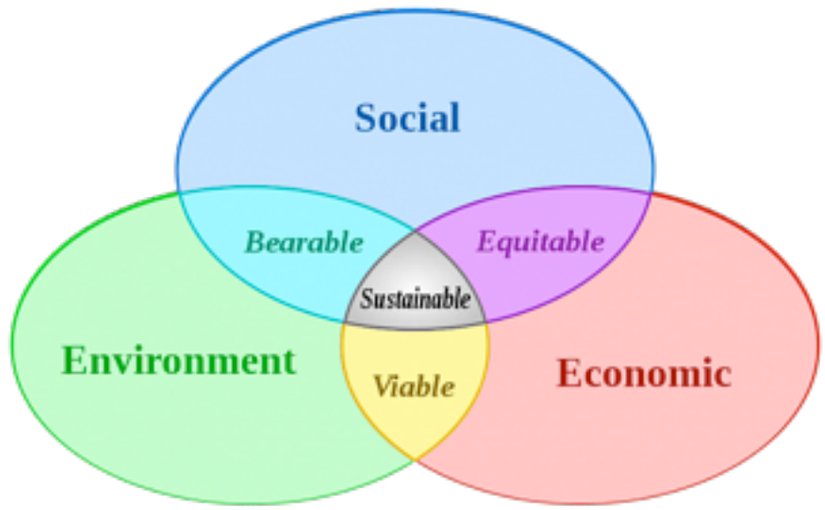
From the State of Oregon: Sustainability means using, developing, and protecting resources at a rate and in a manner that enables people to meet their current needs and also provides that future generations can meet their own needs. Sustainability requires simultaneously meeting environmental, economic and community needs.

From the IUCN, 1983: "Sustainable development is the maintenance of essential ecological processes and life support systems, the preservation of genetic diversity, and the sustainable use of species and ecosystems."

From the UNEP, 1987: Sustainability is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

From Robert Gilmann (author): Sustainability is equity over time … think of it as extending the Golden rule through time ... Do unto future generations as you would have them do unto you.

Many groups use a Venn diagram (or refer to a three-legged stool) to illustrate a definition of sustainability described by Oregon governor John Kitzhaber in 2000: “Imagine, if you will, three overlapping circles – one representing economic needs, one representing environmental needs, and one representing community social needs. The area where the circles overlap is the area of sustainability, the area of livability, the area where all the threads of quality of life come together.”



Student Worksheet
(Pre/Post Test)

What Is Sustainability?

Name:_____ Date: _____

As your final project for this unit, you will design and build a model of a "sustainable house." What is a sustainable house? Create your own definition and write it here.

A sustainable house is …

_____
_____
_____
_____
_____
_____
_____

List three features you would expect find in a sustainable house:

1. _____
   _____
2. _____
   _____
3. _____
   _____

List three features you would not expect to find in a sustainable house:

1. _____
   _____
2. _____
   _____
3. _____
   _____

Discussion/Assignment Guidelines

What Do We Need To Build A Sustainable House?

Working individually or in groups assigned by your teacher, discuss the following questions and write your answers in your science notebook under the heading:
Sustainable House Requirements.

1. What economic, environmental and social factors must be addressed in order for a house to be considered sustainable?
   Discuss this with your group and then make a full page, three column list in your science notebook of these factors. Columns should be labeled economy, environment and society and each column should contain at least three factors that you believe must be met for a house to be considered sustainable. *(For example, under economy your group might decide that in order for a house to be sustainable it must cost less than $150,000.)*

2. In terms of environmental sustainability, a household must find acceptable ways to get energy, build a shelter, and secure food and water. What factors must be addressed in order for a household to meet these requirements in a sustainable manner?
   Discuss this with your group and then make a full page, three column list in your science notebook of all these factors. Columns should be labeled energy, building materials, and food/water. Each column should contain at least three factors you believe must be met in order for a house to be considered sustainable. *(For example, your group might decide that in terms of food, the only way to be sustainable is to only eat food that comes from within 200 miles of your location.)*

3. Look back at the definition of "sustainability" that you developed earlier in this unit. Discuss your definition with your group. Do you think this is still a good definition? If so, why? If not, how would you change it?
   Write your answer to this question in your science notebook.

Sustainable House

Project Overview

For the remainder of the term we are going to explore the issue of sustainability. To facilitate this focus, each student (or in some cases teams of 2 students) will build a model of a "sustainable house" that they will present to the class as their final project. Your house will be located in one of two places: in Humboldt county CA. It can be inland in Hoopa CA. or on the coast in Arcata CA.

Basic requirements:

- Your house will be built on a one-acre plot and should house five people.
- Each house must have a kitchen, a bathroom, 1-3 bedrooms and contain be at least 1,000 and no more than 3,000 square feet of living space.
- The house must be "off the grid." This means the house cannot be dependent on any municipal electrical, gas, water, or sewage treatment systems.
- The property will contain a pesticide-free garden that will produce food on a year-round basis.

Cost:

Although economic affordability is clearly a sustainability issue, there is no price limit for construction of your house and you do not have to estimate the total cost. However, for your final presentation, you must calculate:

- How many kilowatt hours of electricity you will need to maintain your home (on an annual basis);
- How much it will cost to build the energy system to generate power (electricity) for your house

This is a big project. We will devote lots of class time to research; however you will have to do some investigation and construction outside of class. There is lots of information about sustainability available in our textbooks and on the web. I will help you by providing some of these resources, bringing in guest speakers and giving short lectures on key topics.

Most of your grade will be based on your final presentation, however there also will be several short assignments during the course of this project.

Issues To Consider As You Design Your Sustainable House

As you begin to develop a plan for your sustainable house, you may want to consider the following issues.

Location

- What is the climate where your house will be built? How will this affect design and construction?
- How does daily and seasonal movement of the sun affect where and how your house should be built? Consider the topography of your plot and which direction your house will face.

Energy

- What energy source will your house use and why?
- What energy conservation measures will your house use and why?
- Is this source renewable or non-renewable?

Water/wastewater

- How will your house get its water?
- How much water will you need for five people?
- What will you do with your wastewater?

Building materials

- What materials will you use to build your house?
- Are these materials available locally
- Are these materials "eco-friendly?"

Household systems

- What are your lighting requirements?
- What are your air conditioning and air circulation requirements?
- Consider entrances, ventilation, mechanical systems, etc.

Garden

- How big is your garden and how much water will it take?
- What plants will you have growing at what times of the year (a calendar)?
- How good is the local soil? Will it need improvement and, if so, how will you improve it?
- How will you protect your garden from pests?

Climate Data

During this project, you will have to research your given locale to determine what kinds of building practices make sense and are sustainable in that area. Here is some general climate information to get you started and to use in calculations throughout this project.

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Arcata CA

Arcata (zip 95521), California, gets 39 inches of rain per year. The US average is 37. Snowfall is 0 inches. The average US city gets 25 inches of snow per year. The number of days with any measurable precipitation is 120.

On average, there are 177 sunny days per year in Arcata (zip 95521), California. The July high is around 62 degrees. The January low is 42. Our comfort index, which is based on humidity during the hot months, is a 82 out of 100, where higher is more comfortable. The US average on the comfort index is 44.

Wikipedia- Arcata's climate is dominated by marine influences associated with Humboldt Bay and the Pacific Ocean. On average, Arcata experiences 40 to 50 inches (1,000 to 1,300 mm) of rain per year, though there is a short but pronounced dry season from June to September. Northerly winds keep the spring very cool and create a coastal upwelling of deep, cold ocean water. This upwelling in turn results in foggy conditions throughout the summer, with high temperatures commonly in the 50s and low 60s. Yet just a few miles inland the temperatures may be up to 25 degrees warmer in the summer and fall. Winter high temperatures average in the low 40s to mid-50s, with lows in the mid-30s to lower 40s. Temperatures infrequently dip below 30 °F (–1 °C) in the winter, and nearly as infrequently climb above 72 °F (22 °C) in the summer and fall.

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Hoopa CA

Hoopa (zip 95546), California, gets 58 inches of rain per year. The US average is 37. Snowfall is 2 inches. The average US city gets 25 inches of snow per year. The number of days with any measurable precipitation is 106.

On average, there are 177 sunny days per year in Hoopa (zip 95546), California. The July high is around 90 degrees. The January low is 36. Our comfort index, which is based on humidity during the hot months, is a 84 out of 100, where higher is more comfortable. The US average on the comfort index is 44.

Wikipedia- This region experiences warm (but not hot) and dry summers, with no average monthly temperatures above 71.6 °F. According to the Köppen Climate Classification system, Hoopa has a warm-summer Mediterranean climate, abbreviated "Csb" on climate maps.[7] Hoopa receives on average 1,357 millimetres (53.4 in) of precipitation every year.

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CHAPTER 2

Energy Issues

"When there is a huge solar energy spill, its just called a nice day"

– unknown

Energy Issues

Vocabulary

1. Passive Solar
2. Compact fluorescent
3. Solar Power
4. Solar Panel
5. Photovoltaic
6. Hydropower
7. Geothermal
8. Wind Power
9. Turbine
10. Renewable Resource
11. Non-renewable Resource
12. Coal Energy
13. Nuclear Energy
14. Wave Energy
15. Tidal Energy
16. Biodiesel
17. Fossil Fuel
18. Energy Efficient

Figure 2.1 Wind Turbines Generating Energy

Learning objectives:

- To teach students how energy is conserved, stored and transferred
- To introduce students to the concept of renewable and non-renewable resources
- To familiarize students with the advantages and disadvantages of the most common energy sources
- To teach students how to calculate an energy budget (in kilowatt hours) for their house

- To improve math skills and calculate the amount of sugar in soft drinks

Key concepts:

- Some amount of energy is always lost with each transfer
- Calculating an energy budget for your house is like a checkbook – to be sustainable, energy in has to equal energy out

Interactive 2.1 Interactive vocabulary flash-cards

Use this interactive flash cards to study the vocabulary terms

Household Energy Guidelines

Figure 2.2 Compact Fluorescent light bulb

Interactive 2.2 Calculating Energy worksheet Click on this worksheet to answer questions about calculating the amount of energy you use.

Balancing the energy usage of your house is much like balancing a checkbook. The amount of energy input must equal the amount of energy output – that is, you must figure out a way to generate enough energy to run all the appliances you will need and want in your house. This worksheet will help you calculate the amount of energy you need to run your house, calculate where you are going to get it, and how you are going to store it (if appropriate),

Energy Supply Issues

Knowing the total number of KWH of energy needed per day is only part of the energy supply equation. There are two other main factors to consider: peak energy demand and energy storage capacity.

Peak energy demand is the highest amount of energy you will need at any given moment in time. For example, most houses need the most energy in the evening, when everyone is home and all the lights and computers and the heat/AC is on. Most businesses need energy during the day when people are working. If you get your energy from a continual source such as hydroelectric power, you will need to build a hydroelectric generator with enough capacity to meet the peak energy demand (and not the total energy demand).

You can calculate the peak energy demand (in kilowatts) by adding up all the energy consuming sources that could be running at the same time.

If you get your energy from a source like photovoltaic cells, they can only generate electricity when the sun is shining. So, to ensure you have energy when you need it, you will have to store the energy from PV cells in batteries. Storing electricity is difficult and expensive. (We are not going to address this topic in this project.). For this assignment only, we have invented the SHP03 – a super small, super resilient battery that can store 80% of the energy used to charge it. For example, if you put 100 watts into the SHP03, you can withdraw 80 watts any time you want it.

To calculate the amount of energy (in KWH) you must produce if you have an intermittent energy source and need to store energy for later usage, take the KWH/day that you need and multiply it by 1.25.

Energy Generation

1. How (by what methods) do you plan to generate the energy (electricity) to meet your household needs? Do you need to calculate peak energy demand or factor in an energy conversion and storage factor? Or both?

Energy guidelines

2. Describe all the components of your energy generation system. Be sure to indicate how much energy they generate, and whether they are designed for peak demand or cumulative consumption with the miraculous SHP03 battery storage.
3. Approximately how much will it cost to build your energy system? Where did you get your figures?

4. What is the environmental impact of your energy plan?

Energy Conversions: Math Worksheet #1

The purpose of this worksheet is to gain some comfort with terms around energy, and remember how conversion factors work. Before you can answer the questions, you must fill in the table below.

To Get From this unit	To this unit	Multiply by this number	Type of Measurement or Calculation (Energy or Power)
calories	Joules	4.186	Energy
calories	Calories	0.001	
Calories (food)	kcal	1	
BTU	calories	252	
Joules	BTU		
Joules	kJ		
Horsepower	kW	0.746	
Therm	BTU	99,976	
Gallon of Gas	BTU	114,000	
Gallon of Gas	Joules		
Gallon of Diesel	BTU	129,000	
kW-hour	Joules	3,600,000	

Using the table above, answer the following questions.

1. How much potential energy is represented by 1000 kg of water falling 3 meters? Show this in both Joules and kW-hour.

2. If you converted the therms of gas your home uses (Use 9 as an average), to Joules, what do you get?

3. If you converted the joules from answer 2 above, to kW-hours what do you get? How much would this cost if you used electricity instead of gas?

4. If the sun provides 4.8kW-hour/m2 of energy of land surface (average) throughout the year. How many m2 of solar panels would you need to achieve your home's kW-hour usage in a month?

5. How much natural gas would you need to carry in your car to equal the same energy content as 12 gallons of gasoline?

Calculating the Power Output of a PV Cell: Math Worksheet #2

Power = Energy/time So … Power (KW) == E (KWH)/ Time(hr)

Example: An average house in the U.S. uses 15 kilowatt hours of energy/day (Global Science, 1996). To calculate the power needed to meet the energy needs of this house, using PV cells and the SHP03 super battery, you take the energy usage (15 KWH) and divide it by the number of hours of collecting time (let's say 9 hrs./day for the Sonoran Desert) then multiply that number by 1.25 to get the amount of power you would need to generate from PV cells. In this example, you would need to generate 2.08 kilowatts from your solar panel array to cover your energy needs.

Calculate how many kilowatts you would need to generate from a solar panel array to cover the energy needs of your sustainable house. If you live in the Sonoran Desert you can assume there is an average of 9 hours of light/day and if you live in the Costa Rican rainforest you can assume an average of 4 hours/day. Show your work.

1. If solar cell systems cost $7,000 per kilowatt, what is the cost of putting a solar cell system on your house?

2. How much energy can be obtained from a square meter of solar cells each day? Solar cells are approximately 10% efficient.

3. According to the textbook Global Science, the earth's surface receives approx. 4 KWH/square meter of sunlight each day. This is a 24-hour average figure for the U.S. This figure will obviously be higher in the Sonoran Desert (let's say 6.5 KWH/square meter/day) and lower in the Costa Rican rainforest (let's say 2.5 KWH/square meter/day).

4. Calculate the number of square meters of solar panels you would need to power an average house (15 KWH/day) and your proposed house (?? KWH/day) in both the Sonoran Desert and the Costa Rican rainforest (That's four different figures).

Gallery 2.1 Solar Panels

Solar Panels on a hill side

CHAPTER 3

Sustainable Materials and Building Design

"Building Green Is An Environmentally And Socially Responsible Thing To Do"

-Gary Saulson

-

Learning objectives:

- To introduce students to many different building materials and design options being used locally and in another part of the world
- To compare and contrast the utility, efficiency, and sustainability of different building materials

Sustainable Materials

Vocabulary

1. Concrete
2. Rammed Earth
3. Bamboo
4. Hemp
5. Earth Sheltered Design
6. Daylighting
7. Straw Bale Construction
8. Volatile Organic Compounds
9. LEED certification
10. Toxicity
11. Energy Star
12. Rastra
13. SmartWood Certification
14. Renewable
15. Recyclable
16. Recycled
17. Reprocessed

Figure 3.1 What Material is best

List of Possible Sustainable Building Materials*

*This list is by no means complete and is meant to be a starting point from which you may do your own research on different materials that you might want to incorporate into your building design.

Straw is well used for wall systems, insulation, and is locally available, annually renewable, and environmentally sustainable.

Bamboo for flooring and furniture Recycled denim as insulation for walls Rammed Earth walls

Recycled glass for windows

Recycled carpet is available

Low toxin or toxin free paint for walls

Concrete is readily available and a good thermal sink

Straw Bale Construction is a popular alternative to traditional insulation

Reprocessed Plastic can be used as an alternative to wood for framework

Wool is a naturally insulating material that comes from sheep and can be used for carpeting

Marmoleum is an alternative to linoleum and is made from natural ingredients such as linseed oil

Paperstone is made from recycled paper, cashew nut oils, and water-based resins and is a good substitution for wood used as countertops

Cork is natural and a good alternative to wood for flooring

Local "green" Builders –

Alchemy Construction

PHONE: 707.822.8013, EMAIL: amy@alchemyinc.com VISIT: (by appointment only, please)

330 South G Street, Arcata, CA .

Heartwood Design/Build

Heartwood Design / Build · 707.822.3225

Plan It Green/ Humboldt green building program

Office Address: Plan It Green, 1385 8th St., Suite G. Arcata, CA 95521

Telephone:(707) 497-8637

Scurfield Solar and Heating

Telephone: 707.825.0759

Some Web Resources…

www.greenbuilder.com/sourcebook - this site has many options of building materials

www.arch.hku.hk/research/BEER/sustain.htm - this is an excellent site full of information defining key concepts of sustainable building and design

http://edc.uoregon.edu/resources - good site for links to other sustainable building materials pages

www.energstar.gov – good source to find listings of energy efficient appliances and electronics

www.nwf.org -- National Wildlife Federation – take a virtual tour of the Reston headquarters – a totally green building

www.strawsticksandbricks.com – good site for finding actual building materials to include in your house

www.compostingtoilet.org – site with information about composting toilets

www.gipo-rpi.com/lineal_plastic_lumber.html - site containing information about reprocessed plastic as a building alternative

www.greenbuildingsupply.com – has highly innovative "green" building materials to explore

Selecting Sustainable Building Materials

By now you have realized there are many different options available for building materials, and that much of what is available in a sustainable manner depends on where your house is located. This is a planning document to help you evaluate the materials you plan to use to make sure they are truly sustainable. Hint: You may want to include some this information in your final presentation when you explain why you chose the materials you did.

Efficiency/utility

- Are these materials energy and structurally efficient?
- Do they have the necessary insulation, conservation, and design qualities you need?

Source and Availability

- Are these materials available locally? If not, how far do they have to be transported to get to your location?
- Is the material in question worth the economic and environmental cost of transportating it to your location?
- Does it matter to you if you support the local economy or the small entrepreneurial businessperson versus the multinational corporations?

Production costs

- What are the environmental (and economic and social) costs of producing this material (growing, harvesting, mining, manufacturing, etc.)?

Costs of usage and disposal

- What are the environmental (and economic and social) costs of using this material?
- How long does it last?
- What are the environmental (and economic and social) costs of disposal?

Offsets

- Are there ways to offset the impacts of using these materials (modifying usage patterns, planting trees for carbon offsets, etc.)?

Building Material Whiteboard

Make a list of your building materials you plan to use on your house

CHAPTER 4

Garden and Food Issues

Objectives:

To teach students to analyze the basic requirements for growing food in any area (water, sun, soil, climate, pests, native/non-native species, etc.)

To help students develop a specific garden plan for a particular climate (Arcata, CA or Hoopa CA)

Garden and Food Issues

Vocabulary

1. Pesticide Free
2. Locally Produced
3. Compost
4. Fertilizer
5. Herbicide
6. Growing Season
7. Land Management
8. Irrigation
9. Grow Plan
10. Drought Resistant
11. Native Species
12. Introduced Species
13. Invasive Species
14. Decomposition

The goal for your garden is to plant crops to supplement your diet (or your income). It will not be possible to grow enough food to be self-sufficient on one acre, but you should be able to supplement your diet with locally grown food. You can use as much of your one acre for the garden as you wish.

Along with your final report, you must submit an aerial view of your garden on 11" x 17" paper. This drawing must be to scale and include a key. All items should be clearly labeled.

In your final report (spoken or written), you must also include the following information:

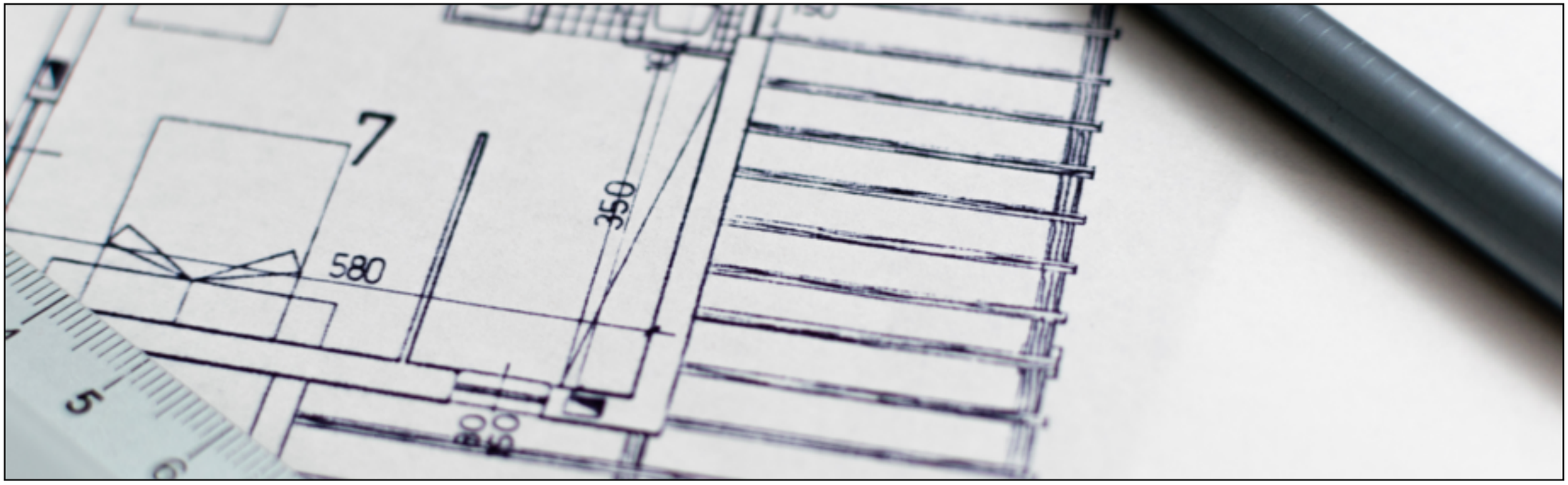
- Garden calendar: Please indicate what plants will be growing at various times of the year.
- Soil: Indicate how you will improve your local soil (if necessary) and where you will get these soil improvers.
- Water: Explain how you intend to get the water for your garden.
- Pests: Explain how you intend to protect your crops from pests without using pesticides.

Interactive 4.1 Scale Drawing of Garden

Use this interactive whiteboard to make a scale drawing of your garden

Scale Drawings

Figure 4.1 Scale drawing of house plans



Scale Drawing Guidelines

As part of your final grade, you will be required to submit three scaled drawings of your project. You will have to make, on 11" x 17" paper, scale drawings of:

- Your acre, including the footprint of your house and garden. You will also have to include any interesting or pertinent topographical features.
- Your house, including the size and location of all major interior features. If you have more than one floor, you will have to draw all of them on the same sheet of paper.
- Your garden, including where you plan to plant your crops and which seasons they

will grow.

Each of you will have a one acre plot. One acre = 43,560 square feet. The plots come in one of three shapes – a square, a rectangle, or a trapezoid. You can choose which shape you want.

ï Square = 208′ x 208′

- Rectangle = 240′ x 180′
- Trapezoid = Bases 300′ and 184′ and the height is 180′

Note: your drawings will be graded on neatness, level of detail, and accuracy of scale. Shape of my plot:

Interactive 4.2 How to do a scale drawing

Short video by Khan Academy on how to do a scale drawing

CHAPTER 5

Water and Wastewater:

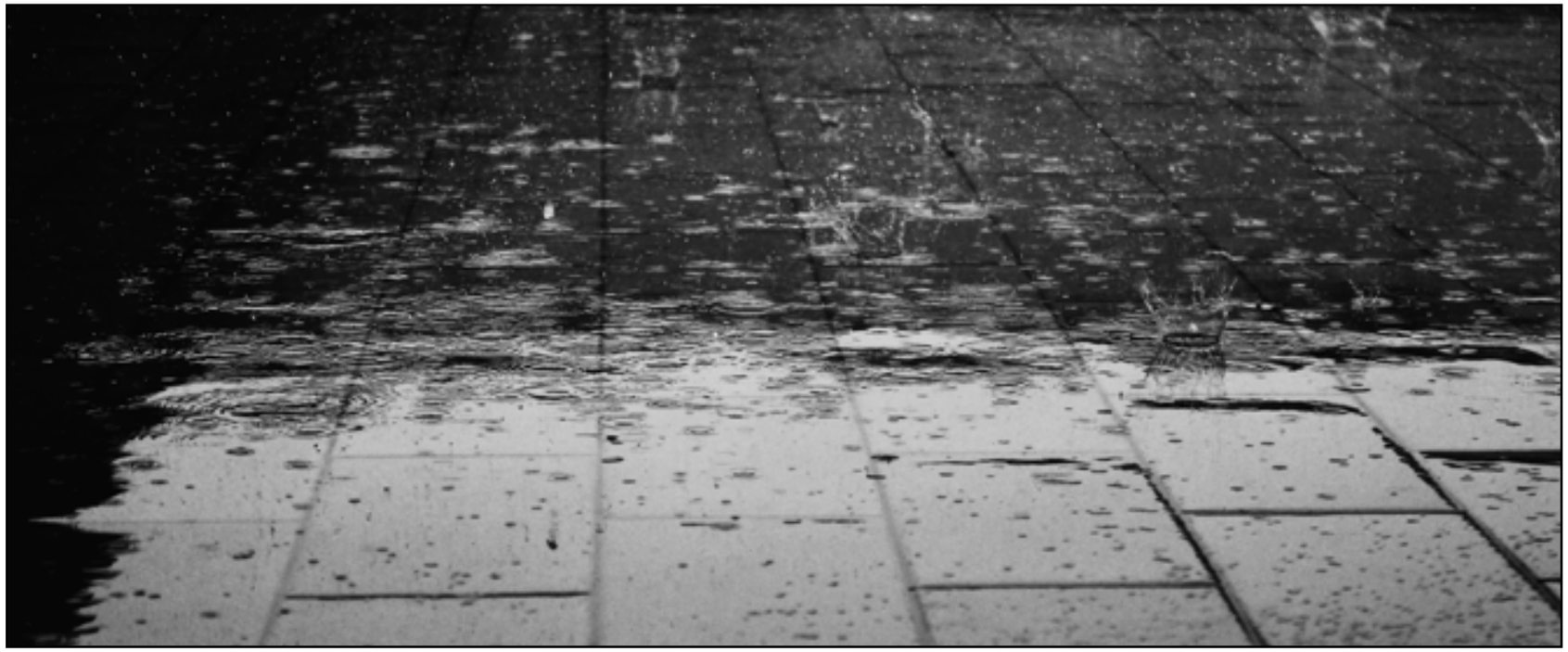
"Water, water, everywhere, Nor any drop to drink." – The Rime of the Ancient Mariner. Maybe this is exactly how men lost at sea feel. This is when the importance of water can never really be underlined more. However, can you even begin to imagine what life may be like if your life lacked water. What would you do then? Would it be easy for you to survive or would you just die out of thirst?

Water and Wastewater

Vocabulary

1. Cistern
2. Gray Water
3. Reclaimed Water
4. Potable Water
5. Water Table
6. Septic Tank
7. Aquifer
8. Water Catchments
9. Drought

Figure 5.1 Think about how you could use rainwater



Water presents very different challenges in rural Humboldt (i.e Hoopa) vs more populate areas with city services (i.e Arcata) To make your house sustainable, you must identify a realistic source of water that will meet the needs of your house and garden, as well as an environmentally responsible way to treat the wastewater. In addition, you must research and calculate an approximate cost for your water/wastewater treatment system.

In your final presentation, you must include the following information (either written or spoken):

- Where you will get water for your house
- Where you will get water for your garden
- How you will treat your wastewater
- The approximate cost of building your water/ wastewater system
- The water conservation measures you used in designing your house (consider exterior features such as rainwater harvesting and landscaping as well as interior features such as low flow toilets, faucet aerators, etc.)

Possible resources:

www.envirolet.com (products) www.compostingtoilet.org
www.biolet.com

www.clearstreamsystems.com www.greywater.com
www.rmi.org/sitepages/pid287.php
www.epa.gov/owm/spetic.index.html www.compostguide.com

Rainwater Harvesting

Rainwater harvesting is an excellent way to take full advantage of the natural rainfall in your area. One way to do this is to directly harvest the water that falls on the roof of your house and store it for later use. Another way is to landscape your property to store and direct the water to take full advantage of the rain. Or you could get creative …..

In this assignment you will calculate the amount of water you could harvest from the roof of your house. To do this you need to know:

1) the square footage of your roof:

2) the average rainfall (in inches/yr.) where your property is located: (Hoopa = 49.15 inches/yr.; Redding = 34.62 inches/yr.)

3) the conversion factor: 1 gallon = .134 cubic feet

#1) Calculate the amount of water, in gallons, you could harvest from the roof of your house.

CHAPTER 6

Student Presentations

This is the culmination of the project. Students present their final plans to the entire class and a panel of guests (some from within the school, others from the community). Students give a 4-6 minute verbal presentation that is supplemented by a powerpoint, a poster (storyboard), or a model. Students are also evaluated on how well they can answer questions after their presentation.

Evaluations

Figure 6.1 Make sure to take notes during presentation

Hoopa High School Sustainable House Research Project

Presentation Evaluation Sheet

Hoopa High School Sustainable House Research Project

Presentation Evaluation Sheet

Evaluator's name: _____

Student(s) presenting: _____

Location of house (circle one): Hoopa Arcata Other _____

Each student will make a verbal presentation of what they learned during their Sustainable House Research Project. The presentation should last approximately 5 minutes and must be supported by a model, a tri-fold poster, or a powerpoint presentation.

Supporting materials (check one): model____tri-fold (poster)_____powerpoint _____

Students will be evaluated on the clarity, organization, and creativity of their presentation, as well as how well they addressed the following issues:

House Design

____ Does it meet the basic design requirements? (1,500 to 3,000 square feet, "off the grid," plan for a family of 5)
___ Does it seem to fit with the local environment?
____ Does the design show creativity?

Energy

____ Did the presentation include a well-designed energy plan?
_____ Did the presentation include a rough estimate of the cost of building such an energy system?
____ Is the energy plan sustainable and does it make sense for the local environment?
_____ Did the presentation include at least three specific measures to conserve energy?

Water/wastewater

____ Did the presentation include a realistic way to get enough water for the house?
____ Did the presentation include an environmentally responsible way to deal with wastewater?
____ Did the presentation include any water conservation measures?

Building Materials

____ Did the house design incorporate sustainable building materials?
____ Did the building materials come from the local environment?

Garde

____ Does the plan include a year round garden to grow crops to supplement the inhabitants diet or income?
____ Do the chosen crops make sense for the local environment?

52

Peer Feedback – Sustainable House Project

Your Name:

_____

****

Student Presenter(s):

_____

What I liked best about this sustainable house/presentation:

_____
_____
_____
_____
_____
_____
_____
_____

One thing I learned:

_____
_____
_____

****

Student Presenter(s):

_____

What I liked best about this sustainable house/presentation:

_____
_____
_____
_____
_____
_____
_____

One thing I learned:

_____
_____

55