Title:	BACKGROUND RESEARCH
Grade and Subject:	8^{th}-12^{th} grades
Number of Days for Completion of the Project:	1
Overarching Project Goals/Outcomes:	Acquiring background knowledge for a scientific investigation! Students will be provided with an article discussing green space and its benefits. Select sections will be read as a class, while the rest of the article will be read individually. A corresponding worksheet will help guide students in reading the article and picking out the important facts and passages of the article.
Materials:	• Article • Article Worksheet • Pens/Pencils
Introduction:	Discussion on the importance of conducting background research for scientific research investigations.
Instruction/Direct Experience:	1. Students will gain experience reading scientific articles along with critical reading skills.
Independent Activities:	Students will work in pairs reading and completing the article's corresponding worksheet.
Assessment:	Student's class participation in article discussion and successful completion of article and worksheet.
Follow-up	This lesson provides a foundation for the multi-month carbon compensation project that will follow. The article will be referenced throughout the project and used in the introductory section of the students' poster.

Discussion notes in preparation for pre-excavation survey

Discussion will begin with PPT on what an archaeologist does!

- What can potentially be found?
    - -Newspapers – they have dates!!!
    - -Bottle Caps
    - -Food wrappers (with or without expiration dates)

IT'S NOT JUST "GARBAGE" REMAINS… WHAT ABOUT NATURAL REMAINS FROM HUMAN ACTIVITIES?!

- -Charcoal
- -Fire pit
- -A pile of leaves (children playing or someone cleaning up an area)
- -Animal bones (chicken bones) could indicate a meal that had been consumed

- What can different types of finds tell us about the people who left them?
    - -The dates of the event (or a general timeline).
    - -Over how long did the deposition take place (one season, one year, multiple seasons/years).
    - -What activities were the space being used?
    - -What was the diet of the users of the space?
    - -Did people cook?

- How do we record our findings? (maps, graphs, tables, etc.)
- What is important in designing a map?

Revision Date: **31 January 2009**
Susan Barton, Extension Specialist
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University of Delaware
Bulletin #137

Sustainable Landscapes Series

Human Benefits of Green Spaces

Adapted from the lecture "The Healing Garden: Social Research" by Dr. Susan Barton, PLSC100: Plants and Human Culture. November 18, 2008.

Interaction with gardens and natural spaces offers a variety of mental, physical and social benefits for humans, ranging from stress reduction, quicker healing, and mitigation of Attention Deficit Disorder in children to decreasing crime and air pollution. Sustainable sites consider human energy and creativity as a renewable resource, recognizing the potential for healthy living and employment conditions. City planners, governments, and ordinary citizens are only just beginning to appreciate the tangible benefits of green spaces and take advantage of opportunities for improving quality of life in urbanized areas.

Mental Health Benefits

Martine Petelot, a member of small community garden on a vacant lot in a congested area of Paris, France, argues that interactions with green spaces are essential for mental well-being: "Our garden allows us to work the earth, to watch things grow," he says. "People need to scratch about in the soil, breathe in the scent of plants and flowers, let off steam and meet other people. For many, it's almost like therapy."

- **Stress and violence reduction**. Parks, garden spaces, street trees, and landscaped traffic islands provide more than a pretty panorama, effectively reducing the stress of our daily lives by invoking a feeling of tranquility. Studies have shown that stressed individuals feel better after exposure to natural scenes. Accordingly, green spaces also reduce instances of aggression and violence.
- **Improved concentration.** Scientists assert that green spaces increase our ability to concentrate, both on the tasks at hand and on our subconsciously-viewed surroundings. Voluntary attention, the exhausting focus required to ignore distractions and remain intensely devoted to work or study must be employed

A Case for Green Space

Frances Kuo of the University of Illinois conducted a study of 28 identical high-rise public housing projects. She found that people living near green spaces:

- Boasted a stronger sense of community
- Coped better with everyday stress and hardship
- Were less aggressive and less violent
- Performed better on tests of concentration
- Managed problems more effectively

throughout the traditional workday. Involuntary attention is the effortless and enjoyable awareness of sensory stimuli in the environment—a benefit that has been selected for throughout the course of human evolution. In the past, those who found nature effortlessly engaging were more likely to know where the berries were, more likely to find the critters, and more likely to escape predators. Focusing on natural scenes gives voluntary attention a rest and allows involuntary attention to take over and recharge the human psyche.

Physical Benefits

- **Enhanced health.** Studies throughout the world have proven the power of green spaces to improve human health. Cities with high numbers of parks battle obesity and diabetes. Recent studies in the Netherlands and Japan show that people with easy access to green space boasted better health and lower mortality rates. Even relatively passive contact with nature—such as viewing it from a window—lowers blood pressure and anxiety levels.
- **More rapid healing.** Texas A&M's Roger Ulrich examined exactly how window views from a hospital room effected recovery time in surgical patients. He matched patients with similar demographics and surgical procedures but different window views—one facing a brown brick wall of an adjacent building, and the other looking at a small stand of deciduous trees. Those looking at the trees had fewer negative nurses' evaluations and post-surgical complications, used weaker pain killers, and remained in the hospital a shorter time—by 8.5%—compared to patients looking at a building wall.
- **Improved environmental conditions.** City greenery cleans and cools the air for improved quality of life. A study in Chicago determined that the city's trees filtered 234 tons of particulate pollution and cleansed the air of 98 tons of nitrogen dioxide, 93 tons of sulfur dioxide, and 17 tons of carbon monoxide. Vegetated areas also provide relief from the "heat island effect" caused by the heat-trapping quality of asphalt, concrete, and building materials. Air under a tree's canopy can be as much as 5 – 10° F cooler compared to full sun, with the underlying pavement up to 36° F cooler.

Social Benefits

- **Crime reduction.** Most people assume that increased vegetation translates to an increase of crime by offering hiding places for criminals and their criminal acts (see box on next page). Open mowed areas are generally considered safest, while densely vegetated areas are the most feared.

  Contrary to these common beliefs, maintained green spaces actually *reduce* crime. A study of 98 vegetated and un-vegetated apartment buildings in Chicago showed that vegetated spaces cut crime by half, in addition to inspiring pride for surroundings that translated into less litter and less graffiti. Besides mitigating psychological precursors to violence by reducing stress and anxiety, green spaces increase a neighborhood's

collective surveillance: Vegetated landscapes invite more people to use them, ensuring more eyes on the watch to prevent crime in outdoor spaces.

- **Increased workplace productivity.** In the business environment, green spaces improve productivity and morale among workers. Studies show that desk workers with a view of nature—either out a window, in a picture frame, or around them in the form of indoor plants—feel more relaxed overall, and those with no visibility of plants suffer the most stress and anxiety.
- **Safer driving.** Vegetated roadsides may also serve a social benefit by reducing fatigue, anger, aggression, fear and stress of automobile drivers. A study using videotapes to simulate differing levels of vegetation along roadside suggests that parkway design and roadside vegetation reduces frustration among drivers. (For information about Delaware's roadside vegetation program, consult the document "Enhancing Delaware Highways: Roadside Vegetation Concept and Planning Manual," available at http://www.deldot.gov/information/pubs_forms/manuals/edh/index.shtml.
- **Economic stimulation.** In multiple studies conducted by Kathleen Wolf at the University of Washington's College of Forest Resources, street trees and other streetscapes in downtown shopping districts were rated as highly preferable in surveys conducted among visitors. Not only do street trees foster a community's sense of place, but well-maintained streetscapes raise opinions about the quality of goods and services offered. In landscaped shopping districts, surveyed consumers were willing to spend 9-12% more than they would spend in an un-landscaped district.
- **Positive effects on children.** A national movement called "No Child Left Inside" popularized by Richard Louv in his book, *Last Child in the Woods* speaks to the countless benefits natural spaces have on child development. One national study of 450 children with Attention-Deficit/Hyperactivity Disorder determined that exposure to natural environments alleviated symptoms of the condition. Another study shows that views of trees from the home improves self-discipline among inner city girls, including enhanced concentration, inhibition of impulsive behavior, and delay of gratification. After creative play in verdant settings, children overall demonstrate increased ability to concentrate, complete tasks, and follow directions.

Why don't most people realize benefits of interactions with plants?

The wealth of benefits provided by plants is not ingrained knowledge in modern day American culture. Humans often have difficulty in even seeing plants in their own environment, much less connecting plants to tangible benefits. As James Wandersee explains in "Toward a Theory of Plant Blindness,"

> Only 0.0000016 of the data our eyes produce are considered consciously. It is assumed that the rest must somehow affect our thoughts feelings and actions and this means most of mental life must take place subconsciously. (2001)

For most people, plants are a part of the subconscious sector of mental life, perceived as the backdrop, not the actors in the playing out of our everyday lives.

Plant blindness aside, it remains difficult for humans to clearly track the cause and effect between presence of plants and resulting benefits due to the cumulative nature of these benefits. Decreases in crime over time, overall improved concentration and speedier hospital recovery times are not easily recognized or quantified, and even less easily linked to surrounding landscapes. Further research and widespread education—especially of city planners and local governments—may serve as the best tool for helping us recognize the advantages of green spaces.

Evidence of Plant Benefit Blindness?

In 2006, the Project EverGreen Survey conducted interviews to judge public agreement to the following statements, all which are true:

"Psychologists have found that access to plants and green spaces provides a sense of rest and allows workers to be more productive."

35% agree, 55% disagree

"When landscaping is developed in a neighborhood, there is a decrease in vandalism."

30% agree, 70% disagree

"Improving landscaping can reduce energy costs"

30% agree, 70% disagree

Minor investment, huge payoff

Due to widespread plant blindness, parks and other green spaces are usually considered luxuries, funded by leftover monies after buildings and hardscapes have been planned and built. However, as researcher Frances Kuo advocates, parks in cities represent a potential for a minor public investment with a huge payoff: "Parks help people take care of themselves," she asserts, "so cities don't have to spend as much on social, medical and safety services trying to fix their problems."

In other words, as Henry David Thoreau claims, a remedy we can never have enough of is a healthy dose of nature.

Additional Resources

Last Child in the Woods: Saving Our Children from Nature-Deficit Disorder by Richard Louv (Algonquin Books of Chapel Hill, 2005)

Human Dimensions of Urban Forestry and Urban Greening
www.cfr.washington.edu/research.envmind

"Paris Parks" by Jennifer Ackerman
http://www7.nationalgeographic.com/ngm/0610/feature3/index.html

"Toward a Theory of Plant Blindness" by James Wandersee
http://www.botany.org/bsa/psb/2001/psb47-1.html#Toward%20a%20Theory%20of%20Plant

"Trees are Worth Downtown's Investment" by Kathleen Wolf
http://www.cfr.washington.edu/research.envmind/CityBiz/DowntownExchange.pdf

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SO CALIFORNIA GOES

A Grand Experiment to Rein In Climate Change

By FELICITY BARRINGER
Published: October 13, 2012

LEGGETT, Calif. — Braced against a steep slope, Robert Hrubes cinched his measuring tape around the trunk of one tree after another, barking out diameters like an auctioneer announcing bids. “Twelve point two!” “Fourteen point one!”

Mr. Hrubes’s task, a far cry from forestry of the past, was to calculate how much carbon could be stored within the tanoak, madrone and redwood trees in that plot. Every year or so, other foresters will return to make sure the trees are still standing and doing their job.

Such audits will be crucial as California embarks on its grand experiment in reining in climate change. On Jan. 1, it will become the first state in the nation to charge industries across the economy for the greenhouse gases they emit. Under the system, known as “cap and trade,” the state will set an overall ceiling on those emissions and assign allowable emission amounts for individual polluters. A portion of these so-called allowances will be allocated to utilities, manufacturers and others; the remainder will be auctioned off.

Over time, the number of allowances issued by the state will be reduced, which should force a reduction in emissions.

To obtain the allowances needed to account for their emissions, companies can buy them at auction or on the carbon market. They can secure offset credits, as they are known, either by buying leftover allowances from emitters that have met their targets or by purchasing them from projects that remove carbon dioxide or other greenhouse gases from the atmosphere, like the woods where Mr. Hrubes was working.

Dozens of verifiers from different fields, from chemists to accountants to foresters, will be the first line of defense in

Enlarge This Image

Ramin Rahimian for The New York Times

Robert Hrubes measures the circumference of trees to determine how much carbon they can store, one approach to reducing greenhouse gases in the atmosphere.

So California Goes

Articles in this series will examine the state's new carbon trading law.

Green

A blog about energy and the environment.

Go to Blog »

Enlarge This Image

Ramin Rahimian for The New York Times

Mr. Hrubes, left, and Tom Tuchmann with a map of the Usal Redwood Forest. The foundation that owns the forest is considering selling credits under California’s new “cap and trade” law.

making sure the benefits are real.

Mr. Hrubes said his goal in any audit was to ensure that the forest's owner was "being conservative whenever a judgment call has to be made" in calculating greenhouse gas reductions.

The outsize goals of California's new law, known as A.B. 32, are to lower California's emissions to what they were in 1990 by 2020 — a reduction of roughly 30 percent — and, more broadly, to show that the system works and can be replicated.

The risks for California are enormous. Opponents and supporters alike worry that the program could hurt the state's fragile economy by driving out refineries, cement makers, glass factories and other businesses. Some are concerned that companies will find a way to outmaneuver the system, causing the state to fall short of its emission reduction targets.

"The worst possible thing to happen is if it fails," said Robert N. Stavins, a Harvard economist.

Just three years ago, California's plan was viewed as a trial run for a national carbon market that one day might tie into existing markets in Europe and elsewhere. President Obama's first budget proposal included a cap-and-trade program to cut national greenhouse gas emissions 14 percent by 2020; the House later passed an energy and climate bill that incorporated such a program.

But in 2010, political forces backed by the biggest emitters, oil and coal companies, blocked the plan in the Senate. In that year's midterm elections, conservative Republicans disavowed their party's role in creating similar programs; they continue to deride it as "cap and tax."

California air regulators are proud of their record in leading the nation to new auto emissions standards in the 1960s and efficiency standards for appliances in the 1970s. And so the pressure is on the state's Air Resources Board to get this right.

At first, only four means of carbon reduction will be approved for offset credits: timber management, the destruction of coolant gases, cuts in methane emissions from livestock waste and tree planting projects in urban areas. Already, developers of offset projects in more than 20 states are preparing to enter the new market, which for now accepts only credits generated in the United States. Some projects send coolant gases to be destroyed at an incinerator in Arkansas; others, tied to dairies in states like Ohio, Virginia and Wisconsin, will capture methane from livestock waste.

Most of these projects already sell offset credits in other markets like the Regional Greenhouse Gas Initiative, a cap-and-trade program covering utilities in the Northeast.

But offsets can be prone to misuse; some have generated significant private profits while producing questionable environmental benefits. The European Union's eight-year-old carbon trading market has been tarnished by fake credits and audits that failed to meet minimum standards. California's offsets have already been challenged in court by environmentalists who argue that offset developers will earn money for actions that they would have taken even if the program did not exist.

"If there is a loss of confidence because there is a sense that people have been cheating and the offsets are not real, that will be a problem," said Kevin Kennedy, an economist with the World Resources Institute in Washington.

That is why there is such a need for qualified verifiers. This summer, four foresters from around the country gathered in a Los Angeles suburb for a $2,900 test-preparation

course to master the new system in advance of a required state test.

All had experience in verification in other carbon trading systems — so much so that they offered their instructors sharp critiques on the 111 pages of rules. One even challenged the algorithms central to the forest benefit calculations.

“If they don’t get the equations right, there could be a real problem,” said Terese Walters, a forester from Oregon. She is hoping that having California credentials will lead to lucrative opportunities. Ms. Walters and Caitlin Sellers, a forester from Florida in the class, both work for Environmental Services of Jacksonville, Fla., one of the country’s largest environmental consulting firms. David Bubser, another student, is a Minnesota forester and a regional manager for the nonprofit Rainforest Alliance.

There are several basic requirements for a forest offset. Credits cannot be granted for preserving trees that were going to be left standing anyway. The change must be long-lasting: trees must be left intact for a century. And owners must hire accredited verifiers to audit their claims.

The offset marketplace is already beginning to hum as companies gear up for California’s rollout.

Independent verifiers can make $800 to $1,200 a day, according to Mr. Bubser. Scientific Certification Systems, Mr. Hrubes’s employer, which verified 4.2 million tons of carbon offsets around the world last year, added two foresters this summer, for a total of six.

Sacramento’s municipal utility recently held a conference call with potential vendors of credits to offset some of the 1.2 million tons of carbon dioxide emitted annually from its gas-fired power plant — possibly by buying 200,000 credits annually.

Utility officials made it clear during the call that the more measurable and reliable the offset, the more valuable it would be. The administrators of California’s program have set a floor price for allowances at $10 per metric ton of emissions during the first auction in November. Once the program gets going, the actual value of allowances will fluctuate as they are traded.

The Redwood Forest Foundation, created to promote sustainable forestry but also to keep timber jobs in Mendocino County, is considering selling offset credits. Its biggest asset is the 50,000-acre Usal Redwood Forest, where Mr. Hrubes was working, which the foundation acquired in 2007 with a $65 million bank loan. The foundation needs to pay down its debt. It reaped $19.5 million selling a conservation easement last year, but the idea of a new revenue source is alluring.

“When you need an economic return, one way is to maximize timber harvest,” said Tom Tuchmann, the group’s acting executive director. “The other way is to look at nontraditional value streams.”

But making strategic decisions about how many trees to harvest and how many to use to lock up carbon is an uncertain business. Other carbon markets have generally not done well by investors, and some brokerages have closed their carbon desks.

“There are so many people who are disappointed,” said Thaddeus Huetteman, the president of Power and Energy Analytic Resources of Atlanta. “What they are really looking for is for California to show we can create a new market of significance in the world’s ninth-largest economy.”

A version of this article appeared in print on October 14, 2012, on page A23 of the New York edition with the headline: A Grand Experiment To Rein In Climate Change.

GK-12 Science Research Class: Article 1

Name _____ Date_____

"Human Benefits of Green Spaces" Article Worksheet

Fill in the blanks:

1. Green spaces reduce instances of _____ and _____.
2. People living in near green spaces managed problems _____.
3. Cities with high numbers of parks battle _____ and _____.
4. Air under a tree's canopy can be _____ compared to full sun
5. Maintained green spaces _____ crime.

True or False: (Circle One)

1. A view of nature can improve recovery	True	False
2. Desk workers without views of nature are relaxed	True	False
3. People like to shop in barren, un-landscaped districts	True	False
4. Further research is needed to help recognize the advantages of green spaces	True	False

Questions:

1. What is "Heat Island Effect?"

2. Do you agree that green space can reduce crime? Why or why not?

3. What is your favorite green space?

4. Do you think you get enough green space exposure? Why or why not?

5. What points in the article were the most significant to you? Why?

6. Which points do you disagree with or find insignificant to you? Why?

Free Write: Write a paragraph about one of your favorite experiences with green space. This can include a class trip, family vacation, friendly outing, or the first experience that you think of. What do you think made it so memorable to you?

Green Space

N V D H S H R N X J D O S L P
E E W G F T E E O Q H H U E L
R B G J J D I A F B V H S N A
D X U W R N N F L A H T T V N
L A L A I O I J E T S N A I T
I Z G U Z I A U V N H V I R S
H X N O I T A R T N E C N O C
C H C C N A T U R E G B A N W
R M Y M D I J R N Q J H B M A
P R O D U C T I V I T Y I E H
H G F T C E K C F J Y P L N M
S W M Y G R E N E J R E I T A
K W Z Q P P G H X S P I T P N
P B I Q R P B D E K H N Y A C
P O S E G A T N A V D A G R D

ADVANTAGES
APPRECIATION
CHILDREN
CONCENTRATION
ENVIRONMENT
GARDEN
NATURE
PLANTS
SAFER
SUSTAINABILITY
BENEFITS
ENERGY
HEALTH
PRODUCTIVITY