Science Education:
Large scale problems and local solutions

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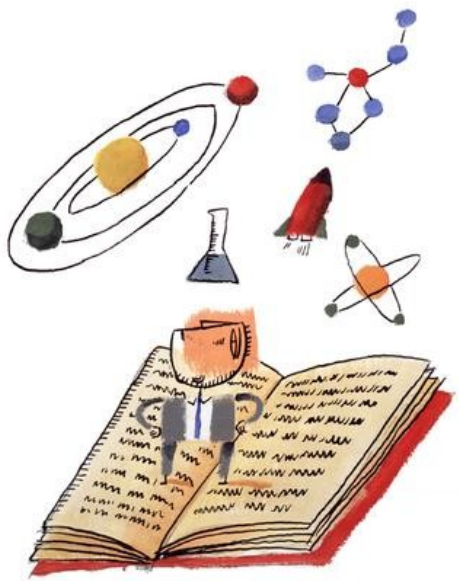
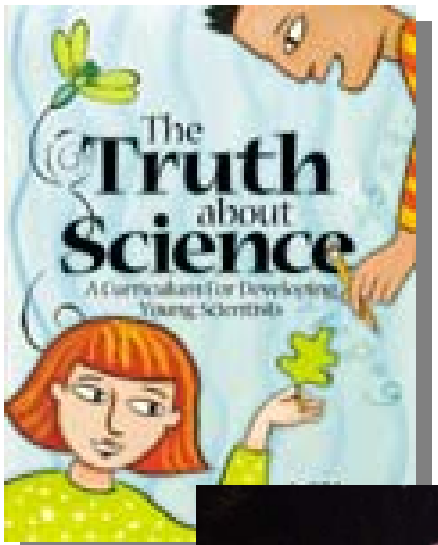
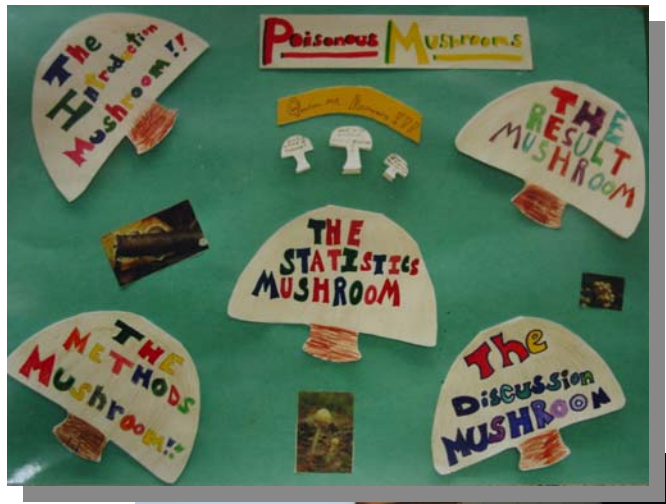


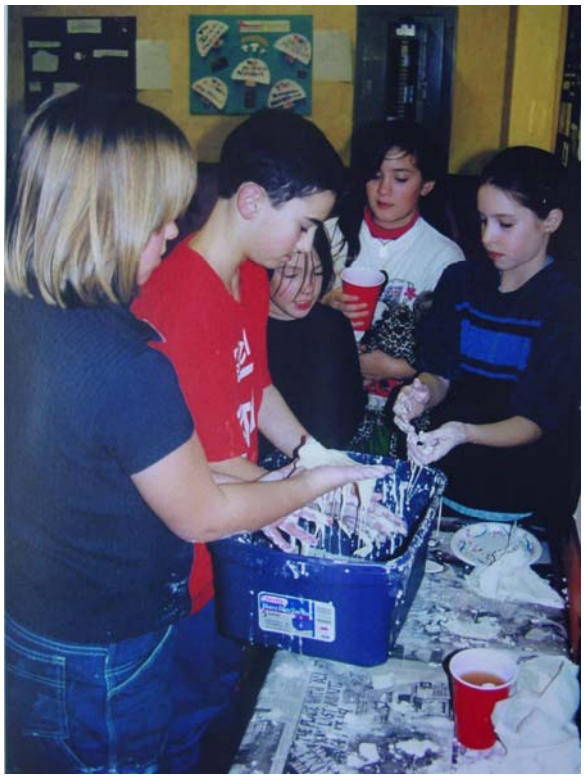
Science is not a series of facts but an exciting process

The Truth About Science





Section I: Research Questions and Hypotheses

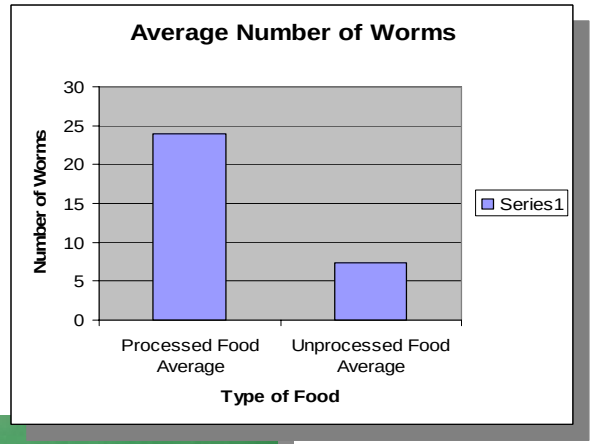


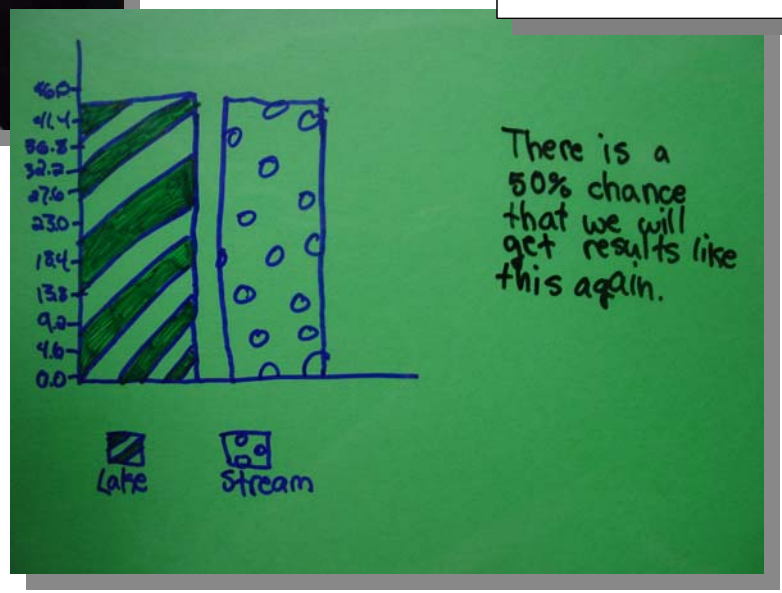
Section I: Research Questions and Hypotheses

- Do more ferns grow on the ground or on logs?
- Do more bugs live under conifer or deciduous trees?
- Is there a difference between the number of birds by the lake or by the buildings?
- Are there more pill bugs found in rotted wood or under rocks?
- Is there a difference in mushroom health (height) by the path or away from the path?

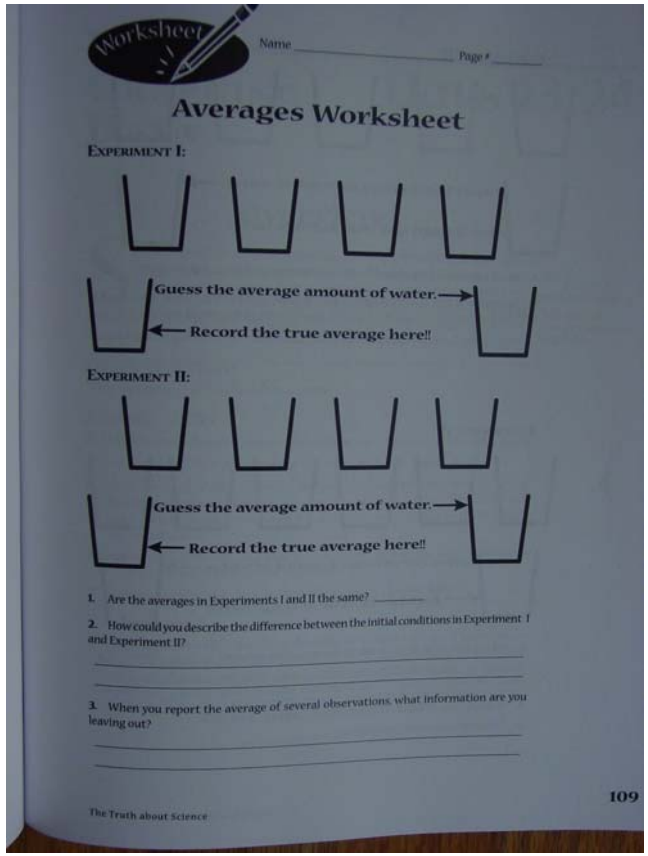
Section II: Experimental Design

Section III: Summarizing and Analyzing Results





Section III: Summarizing and Analyzing Results



Worksheet

Name _____ Page # _____

Averages Worksheet

EXPERIMENT I:

Guess the average amount of water.

Record the true average here!!

EXPERIMENT II:

Guess the average amount of water.

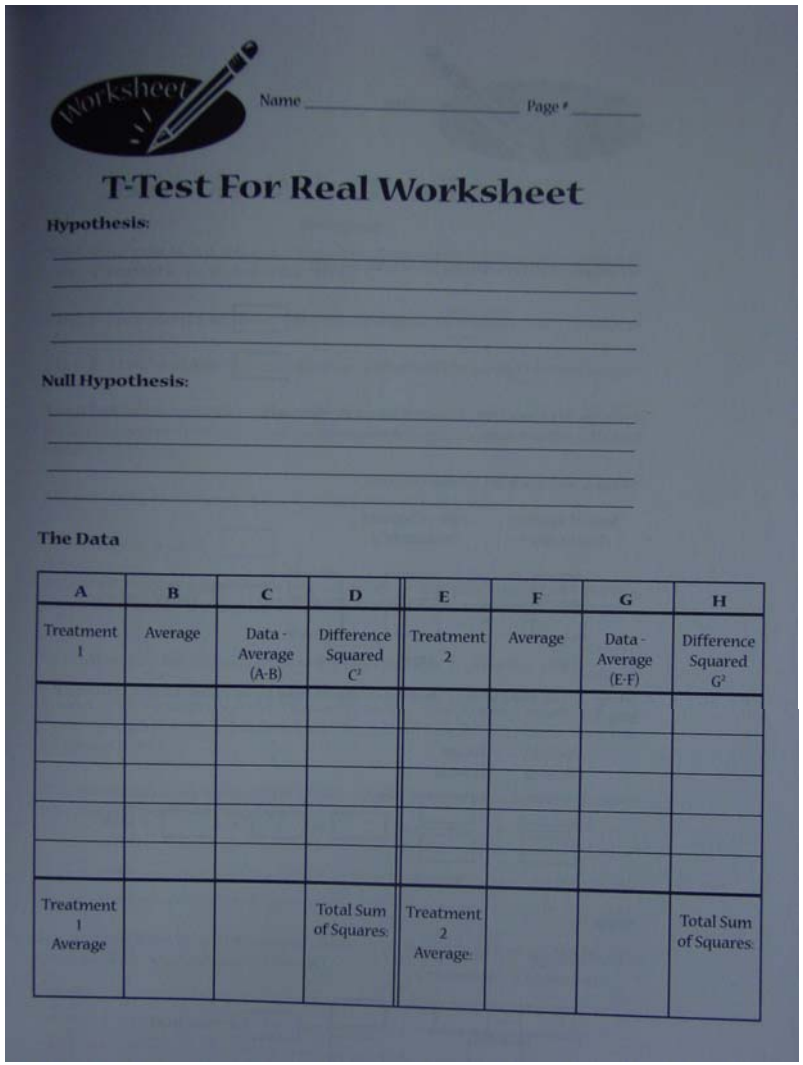
Record the true average here!!

1. Are the averages in Experiments I and II the same? _____

2. How could you describe the difference between the initial conditions in Experiment I and Experiment II?

3. When you report the average of several observations, what information are you leaving out?

Section III: Summarizing and Analyzing Results



Worksheet

Name _____ Page # _____

T-Test For Real Worksheet

Hypothesis:

_____

_____

_____

_____

Null Hypothesis:

_____

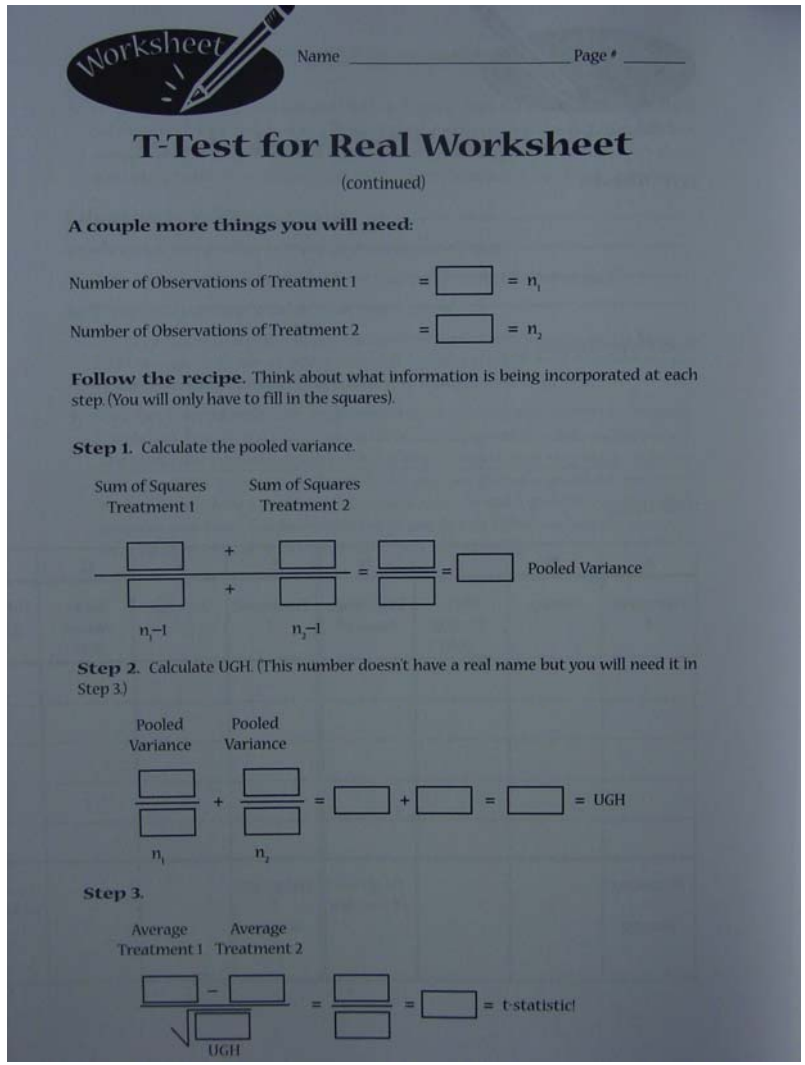
_____

_____

_____

The Data

A	B	C	D	E	F	G	H
Treatment 1	Average	Data - Average (A-B)	Difference Squared C^2	Treatment 2	Average	Data - Average (E-F)	Difference Squared G^2
Treatment 1 Average			Total Sum of Squares:	Treatment 2 Average:			Total Sum of Squares:



Worksheet

Name _____ Page # _____

T-Test for Real Worksheet

(continued)

A couple more things you will need:

Number of Observations of Treatment 1 = ☐ = n_1

Number of Observations of Treatment 2 = ☐ = n_2

Follow the recipe. Think about what information is being incorporated at each step. (You will only have to fill in the squares).

Step 1. Calculate the pooled variance.

Sum of Squares Treatment 1 + Sum of Squares Treatment 2 = ☐ = ☐ Pooled Variance

n_1-1 + n_2-1

Step 2. Calculate UGH. (This number doesn't have a real name but you will need it in Step 3.)

Pooled Variance + Pooled Variance = ☐ + ☐ = ☐ = UGH

n_1 n_2

Step 3.

Average Treatment 1 − Average Treatment 2 = ☐ = ☐ = t-statistic!

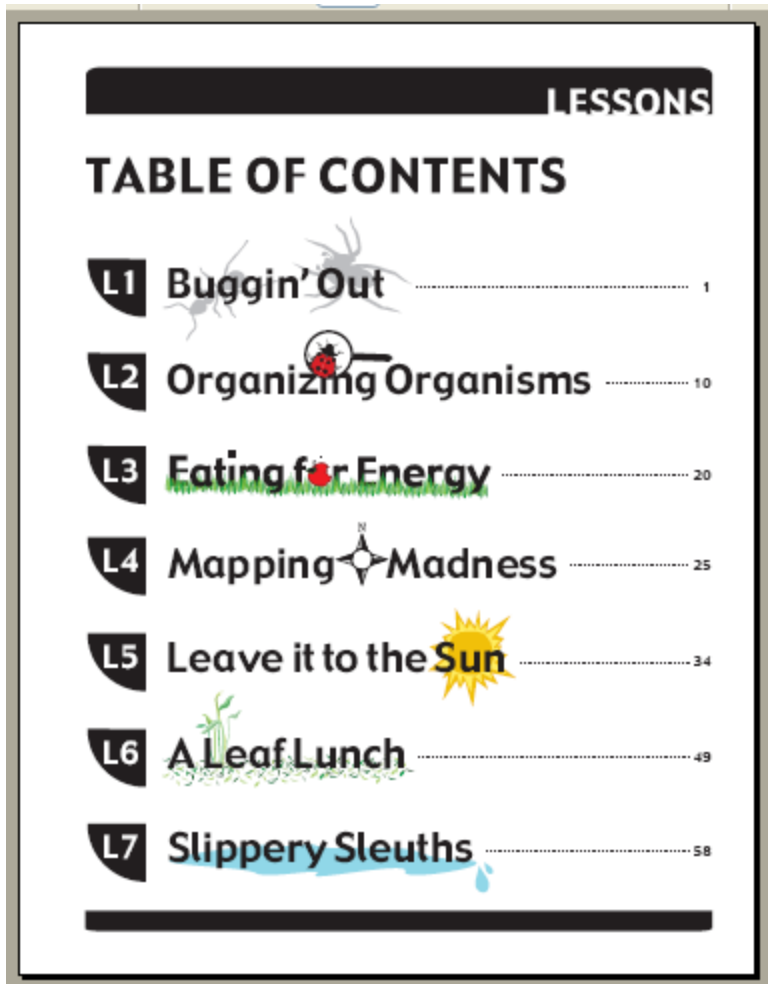
$\sqrt{\text{UGH}}$

Section IV: Presentation of Research Projects

The Truth About Science

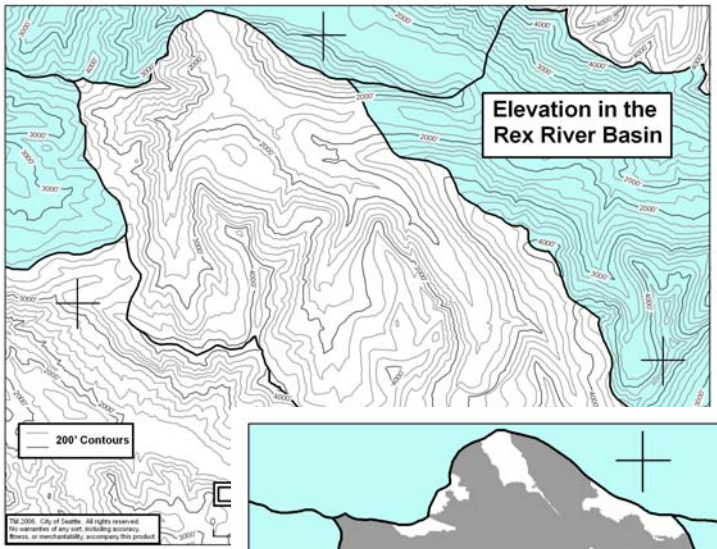
National Science Education Standard (NRC 1996)	Ooze	Science Boxes	Toughest Towel	Stat Savvy	Research Project
Using evidence	✓			✓	✓
Evidence and Explanations	✓			✓	✓
Communicate procedures & explanations	✓		✓		✓
Use math in science inquiry			✓	✓	✓
Identify questions		✓	✓		✓
Design & conduct scientific investigations			✓		✓
Gather, analyze, & interpret data			✓	✓	✓
Alternative explanations & predictions			✓	✓	✓

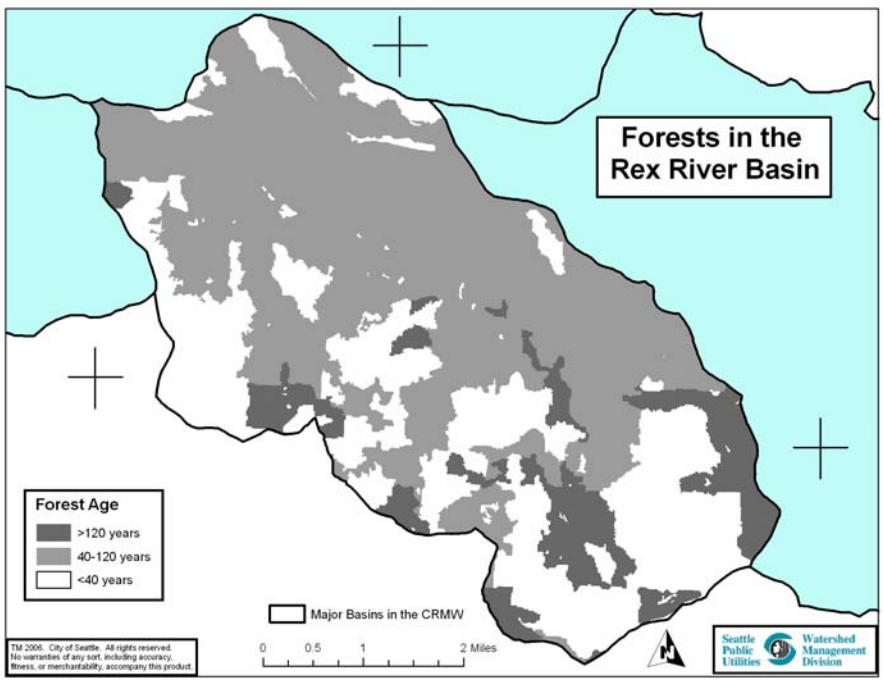
NOAA Education Mini-Grant: Ecology by Inquiry



http://www.nwfsc.noaa.gov/education/index.cfm

NOAA Education Mini-Grant: Ecology by Inquiry





L4

Mapping Madness Worksheet

After reading the tailed frog information sheet, answer the following questions.

1. Describe the perfect tailed frog habitat.

2. What elements on a map would be useful to identify tailed frog habitat?

or working with maps and mylar overlays:
p the registration marks (crosses) on all of your maps.
the maps and overlays. Discuss with your group members where you think the best tailed
itat is found. You must be able to state why it is good tailed frog habitat.
nk transparency, outline the area with the best tailed frog habitat. Be sure to label it or to
key. Draw a registration mark to help you line up the overlays.
with your group areas that could become good tailed frog habitats if certain improve-
ere made. What improvements would you recommend to create good tailed frog habitat?

ond blank transparency, outline the area(s) that could be improved to create good tailed
itat. Be sure to label the area or to make a key. Draw a registration mark to help you line
verlays.
formation (map layer) was the most helpful in creating your tailed frog habitat maps?

your top priority recommendation for restoring parts of the area to good tailed frog habitat?

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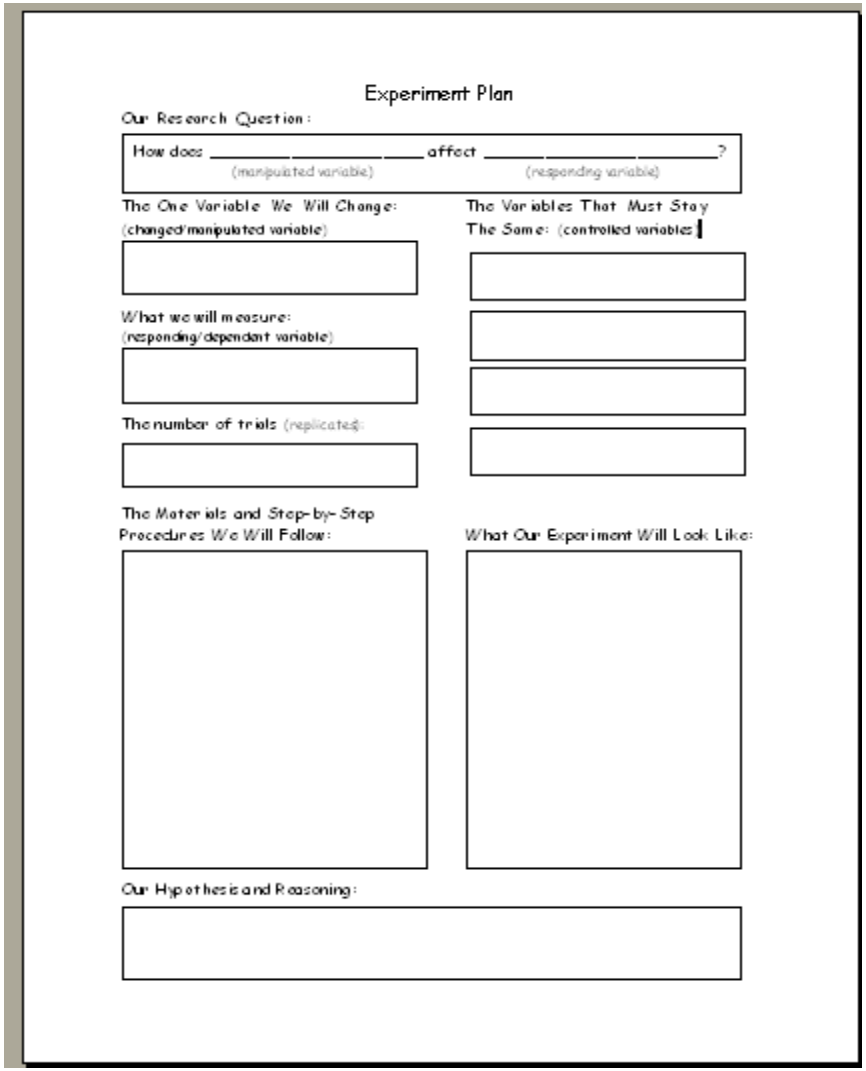
NOAA Education Mini-Grant: Ecology by Inquiry



Experiment Plan

Our Research Question:

How does _____ affect _____?
(manipulated variable) (responding variable)

The One Variable We Will Change:
(changed/manipulated variable)

The Variables That Must Stay The Same: (controlled variables)

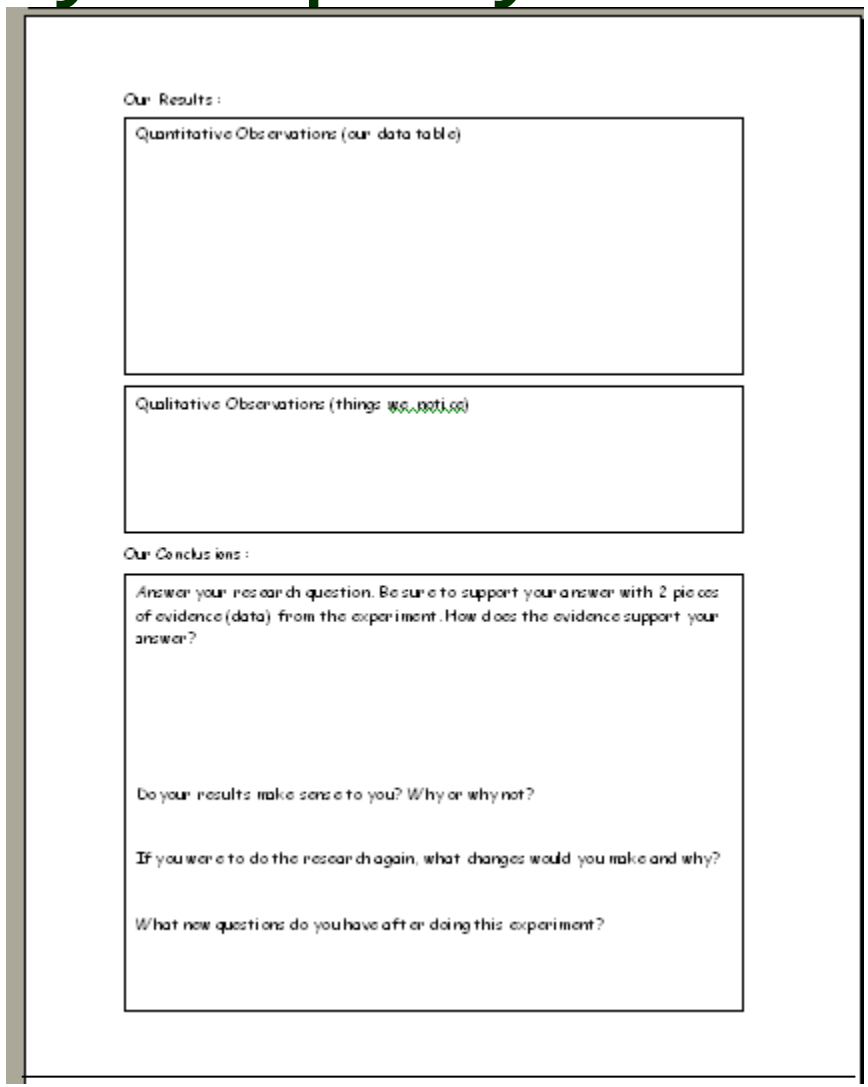
What we will measure:
(responding/dependant variable)

The number of trials (replicates):

The Materials and Step-by-Step Procedures We Will Follow:

What Our Experiment Will Look Like:

Our Hypothesis and Reasoning:



Our Results:

Quantitative Observations (our data table)

Qualitative Observations (things we notice)

Our Conclusions:

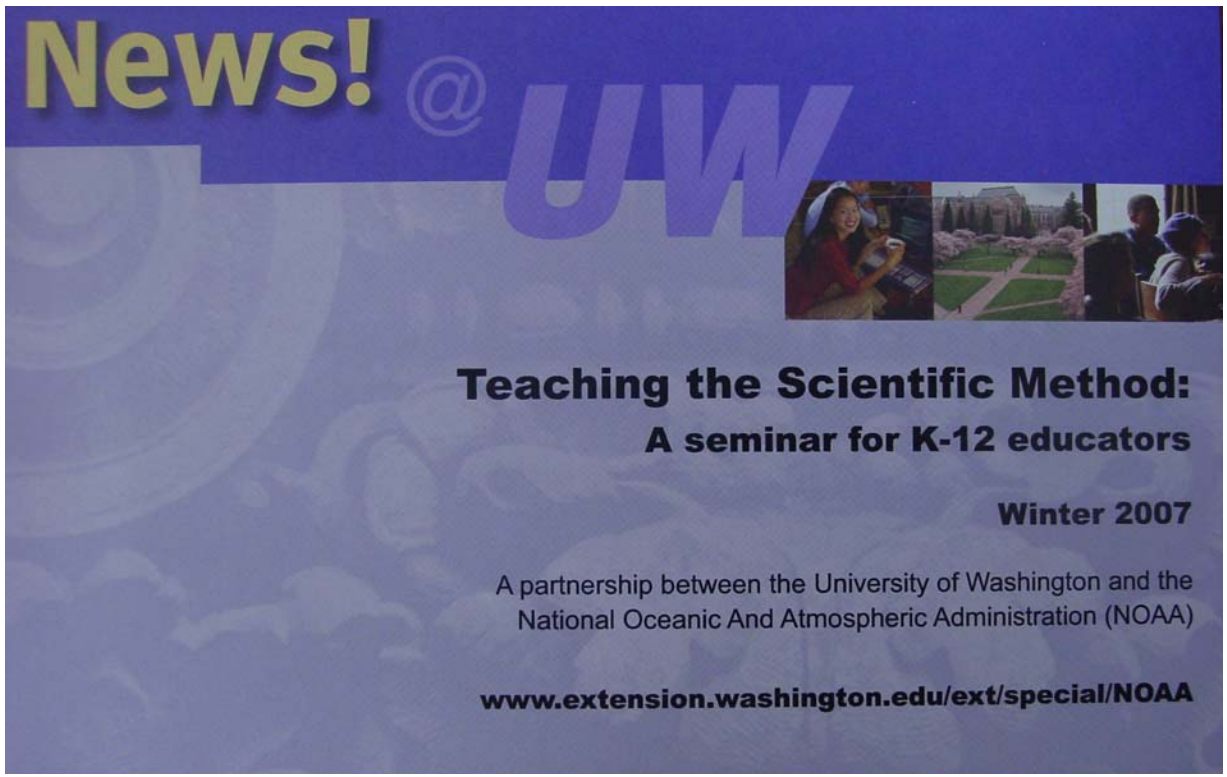
Answer your research question. Be sure to support your answer with 2 pieces of evidence (data) from the experiment. How does the evidence support your answer?

Do your results make sense to you? Why or why not?

If you were to do the research again, what changes would you make and why?

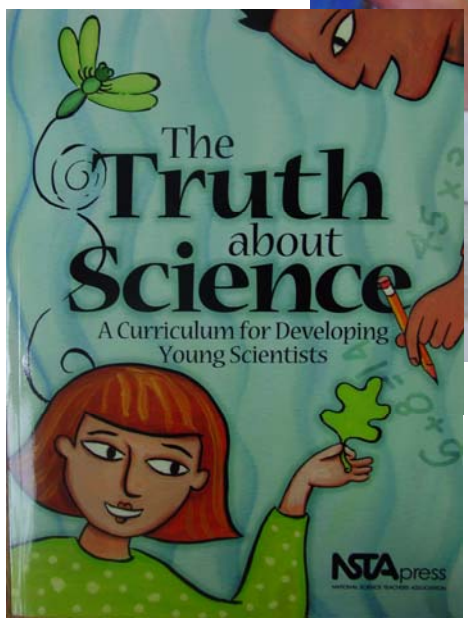
What new questions do you have after doing this experiment?

NOAA Education Mini-Grant



NOAA Education Mini-Grant: UW Course

- Introductions; logistics
- Hands-on activity from TAS or EbyI
- Inquirizing Lessons
- NOAA Guest Speaker



NOAA Education Mini-Grant: UW Course

Bill Peterson, FE, NWFSC – Zooplankton and pelagic fish

Veronique Robigou, UW – Deep-sea volcanoes

Sarah Morley, EC, NWFSC – Urban streams

Beth Sanderson, EC, NWFSC – Salmon and GIS

Christy Semmens, REEF – Coral reef fish database

Jeff Laake, National Marine Mammals Laboratory – Fur seals and statistics

Brice Semmens, CB NWFSC / UW – Nassau grouper

Phil Levin, NWFSC – Six gill sharks

Kerri Haught, EC, NWFSC – The Bridge, NOAA Education Resources on the Web

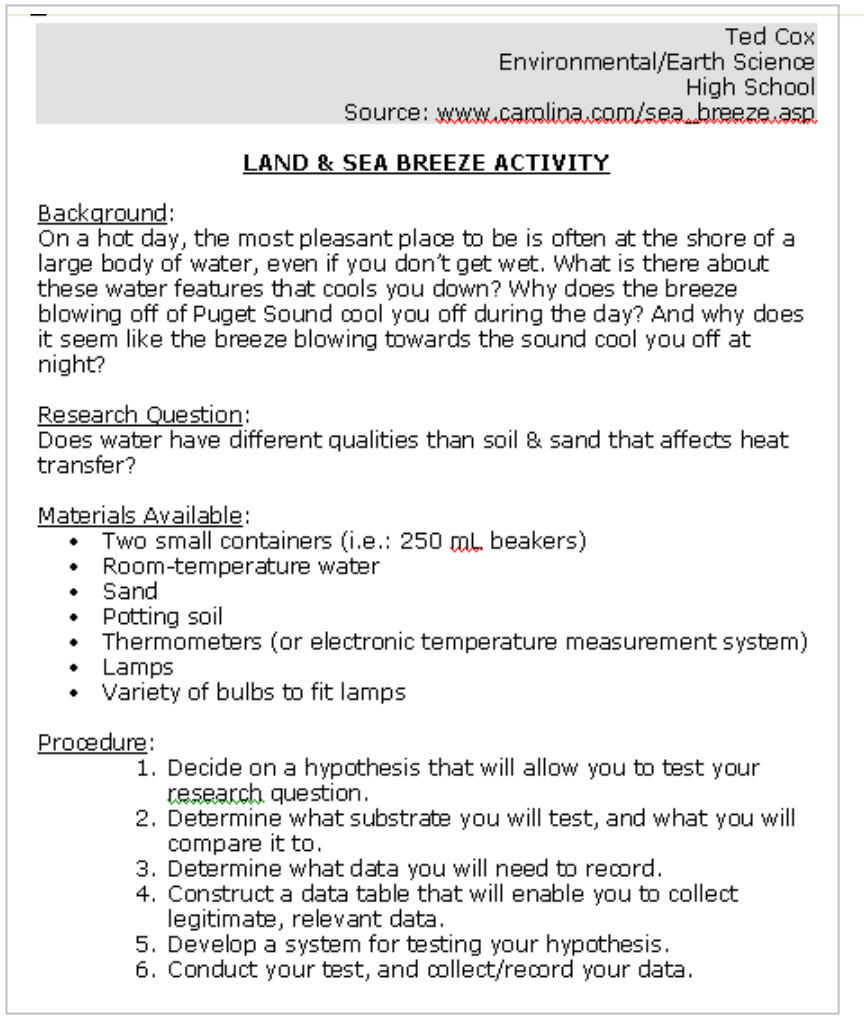
Janet Duffy-Anderson, Alaska Fisheries Science Center – Ichythyoplankton Dynamics

NOAA Education Mini-Grant:

Moving Lab Activities Along the Inquiry Continuum

Inquirizing Lessons

- Acids in fruit
- Butter making
- Earthquake Tower
- Growing bacteria
- Natural Selection
- Sprouting monocots
- Measuring fatty acid molecules



Ted Cox
Environmental/Earth Science
High School
Source: www.carolina.com/sea_breeze.asp

LAND & SEA BREEZE ACTIVITY

Background:
On a hot day, the most pleasant place to be is often at the shore of a large body of water, even if you don't get wet. What is there about these water features that cools you down? Why does the breeze blowing off of Puget Sound cool you off during the day? And why does it seem like the breeze blowing towards the sound cool you off at night?

Research Question:
Does water have different qualities than soil & sand that affects heat transfer?

Materials Available:

- Two small containers (i.e.: 250 mL beakers)
- Room-temperature water
- Sand
- Potting soil
- Thermometers (or electronic temperature measurement system)
- Lamps
- Variety of bulbs to fit lamps

Procedure:

1. Decide on a hypothesis that will allow you to test your research question.
2. Determine what substrate you will test, and what you will compare it to.
3. Determine what data you will need to record.
4. Construct a data table that will enable you to collect legitimate, relevant data.
5. Develop a system for testing your hypothesis.
6. Conduct your test, and collect/record your data.

NOAA Education Mini-Grant:

WASL Hypothesis

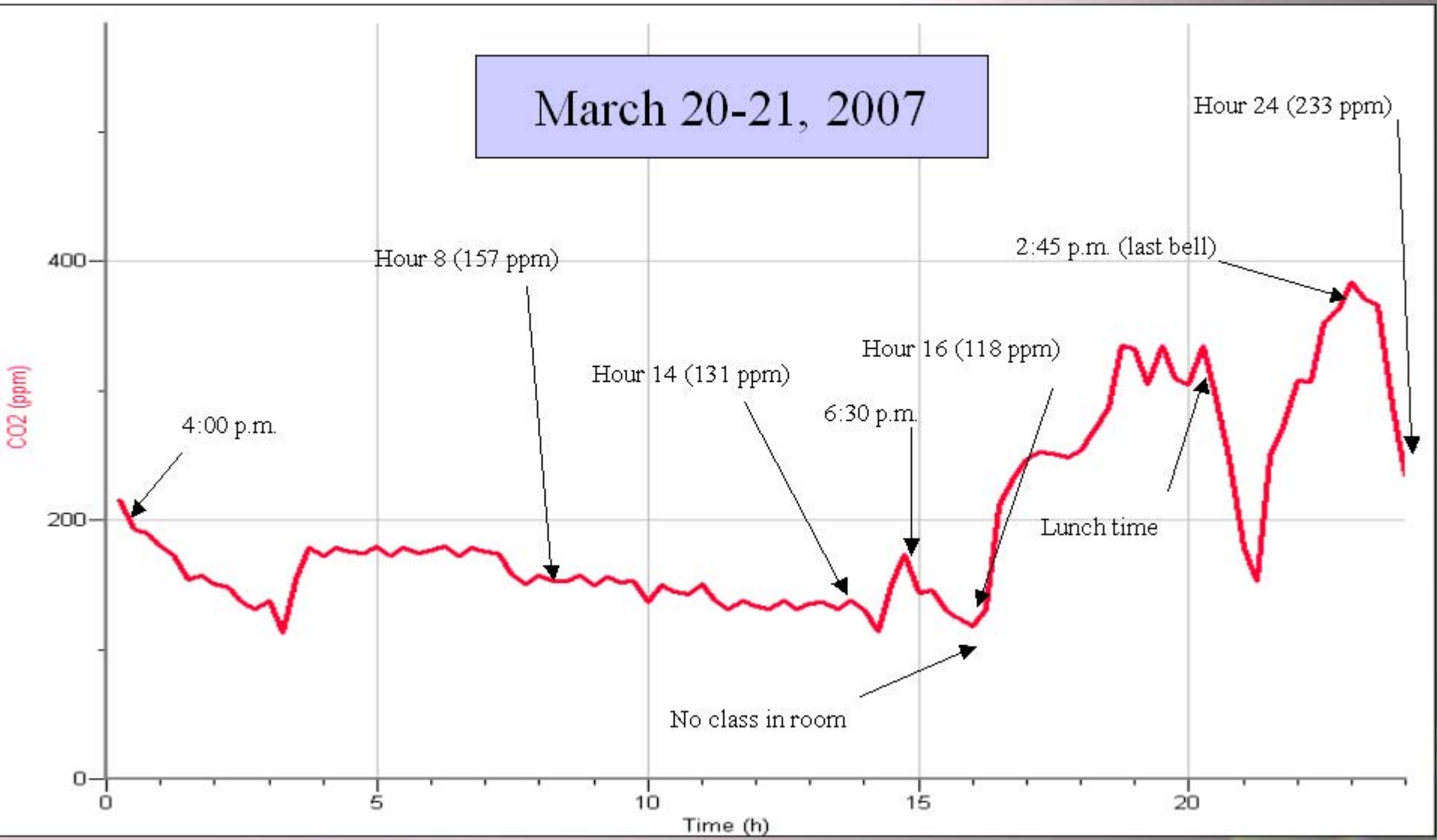
I predict that refrigerated coffee will have more moisture content than non-refrigerated coffee because the moisture in the non-refrigerated coffee might evaporate in the warmer environment.

Research Question

- Do CO_2 levels increase in Room 422 during the school day as a result of the presence of 25 to 30 high school students each class period?

Is there a difference in the number of water droplets held on the heads and tails side of a penny?

24 hours of CO2



P-Value

Safeway Verses Chips Ahoy and Keebler

- P-Value=.0001
- There was a . 01% chance of data like this if the null hypothesis was true.

Keebler Verses Chips Ahoy

- P-Value=.01
- There was a 1% chance of data like this if the null hypothesis was true.

Gosh, Mrs. Hooper, It don't mean a thing!

You were wrong!

Oh, Eddie, I wasn't "wrong." It's just that this set of data seems to support the null hypothesis, that there isn't any difference in the way boys and girls use computers. That's information, too.

NOAA Education Mini-Grant: UW Course

"I always taught better on Tuesdays"

NOAA Education Mini-Grant: UW Course

4 months later …