WEST-GSL Water Quality Project Expenses
Revised 10/05/06

Trips to take place in October, 2006
60 students per trip
12 adults per trip

What	Who	Rate	Total per trip
Boat Charter	Salt Island Adventures	$15/pp	$1,080.00
Bus rental	Le Bus	$65/hr*6 hr	$390.00
Chemical kits for nutrient analysis	Fisher Scientific	$500 total	$50.00

Per Trip Costs $1,520.00
(without non-expendable supplies)

Non-expendable Supplies to be Purchased or Borrowed:		Lender
GPS for real time tracking	$400.00	USGS
Laptop for GPS/bathymetry map interface	$1,200.00	USGS
Flat panel monitor for display	$550.00	U of U
Field photometer	$1,000.00	USGS
Shrimp net	$300.00	USGS
In-Situ WQ minimonitor for depth profiling	$6,000.00	U of U
Multiple secchi disks and depth monitors	$500.00	USGS
Peristalic pump, battery, and tubing	$1,200.00	USGS
Field fluormeter and appropriate cells	$6,000.00	USGS

Trip Schedule	School
Oct. 3	Escalante Elem.
Oct. 5	Nibley Park Elem.
Oct. 9	Beacon Heights
Oct. 11	Hillside Middle
Oct. 17	Washington Elem.
Oct. 18	Hawthorne Elem.
Oct. 19	Ensign Elem.
Oct. 25	Bennion Elem.
Oct. 26	Parkview Elem.
Oct. 27	Rose Park Elem.

WEST Voyage to the Great Salt Lake Deep Brine Layer
Teacher's Guide

Lakeside Learning Onshore Activities (1 hour)

(Adapted from Project Slice: Friends of Great Salt Lake Initiative for Conservation Education)

Activity leader: *Elizabeth and Colby*

Description of activities:
Students will participate in onshore activities at the sandy beach just to the East of the GSL Marina parking lot. Improvisation depending on teachable moments such as storm clouds moving overhead, sea gulls catching brine flies along the water's edge, etc. should be expected, but three planned activities are outlined below:

Activity 1. Shoreline Comparison
Students will be provided with squares of plexiglass and dry erase markers. They will be asked to observe the outline of the hills to the south of our beach and then try to trace the outline on their piece of plexiglass, paying particular attention to the different steps or benches (ie. shorelines). We will discuss the different shorelines that we see, their history, and how they compare to the labeled picture of shorelines taken from Antelope Island (see picture attached).

Activity 2. Pickleweed Adaptations
There is a fairly large patch of pickleweed growing on the beach where we will be gathered. Students will be encouraged to taste a small piece and describe the taste. They will notice the saltiness and we then discuss how storing salt is an adaptation for the plant. We can also discuss other mechanisms used by different plants growing in salty environments or similar adaptations of animals (salt glands of sea gulls and sea turtles, etc.). Some background information on pickleweed can be found at http://people.westminstercollege.edu/faculty/tharrison/gslplaya99/pickleweed.htm#Adaptations

Activity 3. Ooid and Brine Shrimp Discovery
Students will compare oolitic sand found on the beach to "regular" sand found elsewhere. Oolitic sand is sand that is formed as calcium carbonate precipitates around a nucleus. The nucleus could be another sand grain, or, as is often the case at GSL, brine shrimp fecal pellets (students love poop!). Students will ponder its formation and test their hypothesis by applying a small amount of weak acid (vinegar or dilute HCl) to both samples. Students will also explore the waters for brine shrimp, cysts, and brine flies.

Learning objectives:
Utah's natural history (Lake Bonneville and Great Salt Lake)
Animal and plant adaptations
Rocks and minerals

Outgoing Cruise (Lunch 20 mins) (2 groups, 20 mins each)

Station 1. Introduction to GSL and Lake Bathymetry/Navigation

(One group will engage in navigation activity while the other group has free observation time on upper deck).

Activity leader: *Dave*

Description of activity: Prior to boarding the boat, the students will need to visit the USGS real time lake-elevation display at the marina and record the current lake elevation on their Station 1 data sheet. The rest of this activity will occur after lunch on the way to the deep brine layer (DBL) research site. Four to five slides of GSL will be shown to explain the "so what" of doing science on this system. After this introduction to the group, we will rotate small groups (4-5) of students downstairs two at a time. One group will use the GPS and computer monitor to estimate speed, direction, and ETA. A second group will look at the bathymetry map to make depth estimates at DBL before actual measurements at the moored station. The GPS navigation system and the concept of a bathymetric map will be briefly explained to the students. The students will need time to work on their data collection sheet for this exercise, and we will need to keep a public chart of various estimates of speed, direction, and ETA, eventually working out an average if there are some interested students.

Learning objectives:
Introduction to importance of GSL
Reading a contour map
Map reading (direction, speed, and distance)
Math (calculating a lake depth)
Math (calculating an average from multiple observations)

Equipment list:
Laptop computer with USGS bathymetry map loaded (USGS)
17" or larger monitor (USGS or U of U, to be decided)
Long distance extension cords 2 (U of U USGS brought last time)
Duct tape to secure extension cords onto floor (USGS)
Hand held GPS unit and PC attachment cord (USGS)
AC power source (U of U)
10 bathymetry maps of GSL marked with the location of the DBL station (USGS)
Large chart paper for public data record (U of U)

Data collection sheet and handouts: See following page(s).

Moored Stations (3 groups, 20 mins per station)

Station 2. Lake Profiling

Activity leader: *Bill*

Description of activity: Students will determine among three mystery samples which came from the deep brine layer of GSL, the shallow layer of GSL, and the Jordan River by determining their characteristics in terms of salinity, density, temperature, and stinkiness (hydrogen sulfide).

Learning objectives:
Students will learn about the layering in the lake, in terms of salinity, density, temperature, and stinkiness (hydrogen sulfide).

Equipment list:
3 tupperware containers (1/2 gallon)
3 placemats to protect carpet from spills
1 vase for density contrast
1 pump with tubing to reach deep brine layer
1 cc of bromophenol blue powder
1 50 ml plastic bottle for mixing pinch of bromophenol with shallow layer water
1 hotplate
1 extension cord

Data collection sheet and handouts: See following page(s).

Station 3. Lake Depth and Secchi Disk

Activity leader: *Ximena and Scott*

Description of activity: Compare our lake depth measurements to those estimated using the USGS lake level gauge and bathymetric map. The data in this activity are in meters, so a comparison to the lake level gauge and map will require a conversion (either map estimate to meters or measured lake depth to feet). This may be an appropriate activity to undertake in the classroom after the field trip. Issues raised by comparison of the various methods include error in measurement or calculation, exclusion of outliers from a data set, average of numerous measurements, and the possibility of topography (hills) on the lake bottom. This may be particularly fruitful as students will be able to generate a number of individual data points on their own. Students will also take a secchi depth measurement and will be queried to understand what impacts the visibility of a secchi disk, unfortunately there is only one secchi disk and students will have to be content with identifying the disappearance depth (probably by shouting- "I still see it") and reading the tape measure. The disappearance depth of the secchi disk will be measured numerous times and the same data management issues associated with lake depth will be encountered. Students should note that a number of factors control the secchi depth but that it is fundamentally an estimate of the penetration depth of sunlight in the lake. This penetration depth is important because the base of Great Salt Lake's food chain (algae) relies on sunlight. It can then be inferred that the upper layer of Great Salt Lake is much more biologically productive than the lower layer.

Learning objectives:

- Understanding the importance of sunlight and clarity/turbidity in a lake productivity
- Learn how to use measurement devices for depth and clarity
- Introduction to conversion units
- Math (calculating an average from multiple observations)
- Learn data availability to monitor lake level (USGS web page).

Equipment list:

- 2 graphs of realtime lake level for the last 7 days (WEST)
- 2 graphs of daily lake level for the last 12 months (WEST)
- 5 lake depth measurement cords with attached weight (WEST)
- Secchi disk (USGS)
- Flip chart for public data keeping (WEST)
- Marker for public data keeping (WEST)

Data collection sheet and handouts: See following page(s).

Station 4. Lake Sampling and Chemical Analyses

Activity leader: *Kim and Kevin*

Description of activity: Students will collect 2-5 water samples using a peristaltic pump at various depths all the way to the bottom of the lake. A field photometer will be used to analyze each water sample for sulfide concentration. Students will record this information and be queried about the observed changes. (Note: Conductivity will serve as a measurement of salinity. Conductivity is measured at station 2 with Bill)

Learning objectives and Questions:

Similarity of sulfide and selenium (similar properties, same column on periodic table)
Sources of sulfide and selenium: Inputs
Significance of sulfide and selenium: Role in GSL ecology, selenium is toxic to birds and brine shrimp in high concentrations
Variations in the chemistry (sulfide and selenium) of water due to depth and location in the GSL.
Controls of variation of these parameters

Equipment list:

Peristaltic pump

AC or DC power supply for pump

Photometer (USGS)

Reagents (U of U)

Sample containers (U of U)

Returning Cruise (2 groups, 20 mins per station)

Station 5. Brine Shrimp Sampling and Observation

Activity leader: *Dave*

Description of activity: Students will assist obtaining a brine shrimp net haul that will then be transferred into 1-liter, wide mouthed nalgene bottles. During the return cruise, students will examine and describe the contents of the net haul with hand lenses and answer the questions on the attached worksheet. Large test tubes will be distributed for students to bring some brine shrimp back home. Students will also be encouraged to make observations of the lake and surroundings using the spotting scope and binoculars on the lower front and back decks.

Learning objectives:

- Life cycle of the brine shrimp
- Interaction of brine shrimp with other members of the GSL ecosystem (algae and grebes)
- Recognizing the difference between cysts, young adults, and adults
- Recognizing other elements in the water samples observed under the microscope
- Understanding the importance of managing the brine shrimp cyst harvest to allow for the brine shrimp population to "start again" every spring
- Observe the environ of Great Salt Lake

Equipment list:

Petri dishes to contain shrimp samples (WEST)
Small tweezers/pin probes to manipulate shrimp samples (WEST)
Hand lenses/magnifying c=glasses (WEST)
ID cards for shrimp, flies, coroxid, etc (Scott)
Plankton net (USGS)
Large test tubes (USGS)
5 1-liter, wide-mouthed nalgene bottles (U of U)
Spotting scope and several pairs of binoculars (Colby, WEST)

Data collection sheet and handouts: See following page(s).

Station 6. Chlorophyll and the Food Web

Activity 1 leaders: *Kim and Kevin*

Description of activity: Students will be given some introductory information on what is chlorophyll a and how it can be used to estimate primary productivity in GSL. Students will be given 2-3 capped water samples that we collect when we are moored to measure on the field fluorometer. Water will be sampled from different depths so we can look at primary productivity as a function of depth. This can be compared with %light level from secchi disk data on the boat, time permitting, or back in the classroom.

Photosynthesis, chlorophyll, and primary productivity will need to be introduced to some classes- either front-loaded or taught on the boat.

Learning objectives and Questions:

What is chlorophyll?
What does chlorophyll a tell us about the lake ecology?
Does it vary with depth? If so, why?
Does it vary throughout the year?

Equipment list:

Fluorometer (USGS)
Power source
Sample vials

Data collection sheet and handouts: See following page(s).