Salmon Field Office, Bureau of Land Management is involved in on-going collaborative education efforts with Salmon Junior High School emphasizing science, technology, and natural resource management. In March 2002, we were partners in the 8th grade science day where students learned about the Global Positioning System (GPS) and applied GPS technology to water quality sampling. BLM contributions to this effort included the work of two staff members for 30 hours, use of 10 BLM GPS receivers, and provision of field worksheets.

The use of GPS technology to record geospatial data pertaining to water quality sample sites requires the use of computers to download data, analyze results, and create computer generated maps. Having access to laptop computers would greatly benefit the students by allowing them to conduct these steps as part of their studies, further analyze their data, and better document their results. Partnership efforts with Salmon Junior High School are a critical part of the BLM's mission to enhance technology sharing and use of current science and promote community-based stewardship. The availability of technology provided by the Beaumont Foundation of America would greatly enhance the ability of Salmon Junior. High School and the BLM to educate students in current technological applications in science and natural resource management.

8th GRADE SCIENCE DAY – March 18, 2003 –
Nancy M. Cummings Research Ranch
Using GPS Units

Session Outline and GPS Leader Notes = information for the worksheet

11:30 a.m. Buses arrive

11:40 – 12:15 GPS training (35 min.)

11:40-11:45 General Introduction (5 minutes or less) **Diane**

Hello. My name is _____. I work for _____ as a _____.
We are going to be working with GPS units today.
They are very expensive (~$4,000). You could buy a four-wheeler for the price of one GPS unit.
Handle them carefully. Don't drop them. Keep them clean. Keep track of them.
You'll be breaking into 10 small groups with 8 students in each group.
A resource agency person will be assigned as leader of each group.
Your group leader will teach you how to use the GPS unit (30 min.)
We will break for lunch from 12:15 to 12:50
After lunch, you will complete a series of exercises using the GPS unit (35 min.).
At 1:25 we will all meet at the ranch house to review what we've done.
Go over rules of behavior (stay with your leader, listen, don't pull plants, throw rocks, etc.)
Introduce group leaders

11:45-11:46 Break into small groups and relocate (1 minute)

Leaders: Diane Schuldt, Ingrid Enschede, Kimberly McConnaghy, Amber Watkins, Dave Deschaine, Pat Hurt, Chuck Hoffman, Rick Schroeder, Pete Schuldt, Shannon Williams, Mike Overacker

11:46-11:47 Small group introductions (1 minutes)

Leader introduces self – name, agency, job title, brief job description
Students – give name
Review rules, your expectations of them.

11:47-11:48 Give brief outline of what you/your group will be doing (1 minutes)

1. Learn what a GPS unit is and how to use it
2. GPS Worksheet – hand them out. Point out:
   - Questions to answer
   - Map of Nancy M. Cummings Ranch with lat/long grid for reference
   - Group will record coordinates for water sampling sites on worksheet

Tell students to answer worksheet questions as information is provided.

3. Will do mapping exercises. Each student will take a turn with the GPS unit.
4. Group will take a GPS location at each spot they collect water quality samples.
5. Afterwards, Leaders will take the GPS unit back to the office, download the GPS data corresponding to the water quality sites, correct it, make a map of the students' work, and send it to school for their use.

11:48-11:53 Introduce GPS (5 minutes)

Why do we care about GPS? Where did it come from?

Trying to figure out where you are and where you're going is probably one of humankind's oldest pastimes.
Navigation and positioning are crucial to many activities (sailing, surveying, hiking) and yet the process has always been quite difficult.
Over the years all kinds of technologies have tried to simplify the task but they've all had disadvantages (using stars during the day, using landmarks that change appearance over time).

Finally, the U.S. Department of Defense decided the military needed a superior form of knowing where things were and how to get places so they created GPS to do this. Fortunately, they had the $12 billion it took to create such a useful and advanced system.

What does GPS stand for?

Global Positioning System
Have this spelled out in large print on a piece of paper to show the kids.

How do we use GPS?

We use GPS to collect exact information on the location of things on the face of the earth (us, roads, buildings, wells, timber stands, location of rare plants, **ANYTHING AND EVERYTHING! BRAINSTORM WITH THE KIDS)**
Ask the kids if they know what latitude and longitude are (hopefully they know)
Latitude (horizontal) & longitude (vertical) are a grid system laid over the earth so we can determine the location of something on the earth's surface when we don't have a name for that exact spot. **REFER TO ATTACHED MAP WITH LAT/LONG ON IT**.
The GPS unit collects latitude and longitude coordinates and allows you to map that spot on paper (like we will do today) and use it in computerized mapping software (GIS).
There is always some error associated with GPS data.

Make sure ***students are answering worksheet questions as information is provided.***

11:53-11:58 How does GPS work? (5 minutes)

How does GPS work with satellites?

The Global Positioning System (GPS) is a worldwide radio-wave navigation system formed from 24 satellites and GPS receiver units on the ground (like the units we have today).
The Department of Defense has injected each GPS satellite into a very precise orbit according to their GPS master plan. **SEE FIGURE 1 ON WORKSHEET**
GPS units use the satellites as reference points to calculate our position by measuring the distance between the satellites and us. **SEE FIGURE 2 ON WORKSHEET**

We need at least 4 satellites in order to receive an accurate position measurement.
The positions of these 4 satellites in the sky are very important. Most GPS units will only take position information from the satellites in the best position for your particular location.
The wider the angle between the satellites, the better the position measurement.

DO SIMPLE "HOW GPS WORKS" INACTMENT WITH THE KIDS TO ILLUSTRATE THESE POINTS. Show examples like if all 4 kids/satellites are stacked behind each other or close together at small angles can you figure out your location? Can you use the satellites in the southern hemisphere?

What affects satellite reception?

Many things can affect satellite reception and the quality of the signal.

Mountains and canyons, trees, buildings, yourself or your vehicle can block the radio waves from reaching the GPS unit. When this happens the GPS unit will tell you it is not receiving satellite information.

Weather can slow the movement of the radio waves through the atmosphere. When this happens, the GPS unit can't accurately measure the distance between us and the satellites.

Make sure ***students are answering worksheet questions as information is provided.***

11:58-12:15 Practical Applications – training students to use GPS unit (17 minutes)

Hand out the 3 GPS units with 2-3 students per GPS unit.

Go over the various features of the GPS unit:

How to turn on and off

The three tabs—Sys (system), Data, and Nav (navigation)

How to use the enter key to select something that's highlighted.

How to use the arrow keys.

Under the Sys tab:

How much battery power does your unit have?

How many satellites are you currently receiving information from?

Note how the screen shows not only how many satellites, but their location in the sky overhead relative to our location in the center. (Remember the enactment exercise?)

What lat/long are we at? What elevation?

Under the Data tab:

Under New Feature, discuss the three types of features the GPS unit can collect. Explain that each feature is a symbol representing the thing in real life you are recording data on.

Points (e.g. telephone pole, water quality site,)

Lines (e.g. fence, stream, ditch)

Polygons (also called area on the GPS units) (e.g. pond, weed patch)

Under the Nav tab:

Find the compass. Which way is North? Have the kids turn and observe how the location of North changes on the screen. It works just like a regular compass.

Have each student use a GPS unit to record features for practice and tie it in to earlier discussions. Challenge the students to get as many satellites as possible. They will collect GPS data to keep after lunch with their water quality data.

Gather up the units and head for lunch

12:15 – 12:50 Lunch (35 min.)

12:50 – 13:40 Data Collection, download, and presentation to group (50 min.)

12:50-1:20 Mapping exercises – as identified by Leslie Deschaine (teacher) (30 minutes)

At this point have only one GPS unit available per group.
In each small group, collect data on GPS receiver as per Leslie's directions (don't have these yet).
Make sure each student in your group operates the GPS unit.

1:20-1:23 Small Group Summary (3 minutes)

Summarize what has been discussed and the activities completed
Ask students if they have ever considered natural resource careers

1:23-1:25 Travel to ranch house

1:25-1:40 Reconvene at the ranch house with the other groups (15 minutes)

Pete Schuldt will demonstrate how to download the data from the GPS unit, correct it, and create a map. He will use a laptop and a projector for this exercise.

1:40 Gather up all equipment and return to office

Back in the office we will divide up the GPS receivers, download and correct the students' data, & create maps of their work. These maps will be sent to school via Dave Deschaine, so the students can see the "fruits of their labor".

8th GRADE SCIENCE DAY – March 18, 2003 –
Nancy M. Cummins Research Ranch
Field Worksheet

Name_____ **Class Period**_____
Date_____ **Group** _____ **Leader** _____

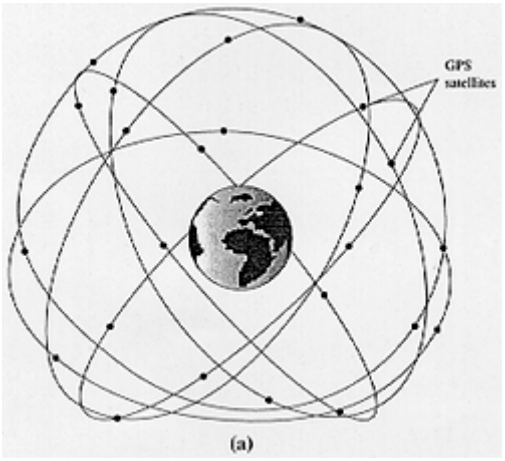

Figure 1. 24 GPS satellites in orbit.

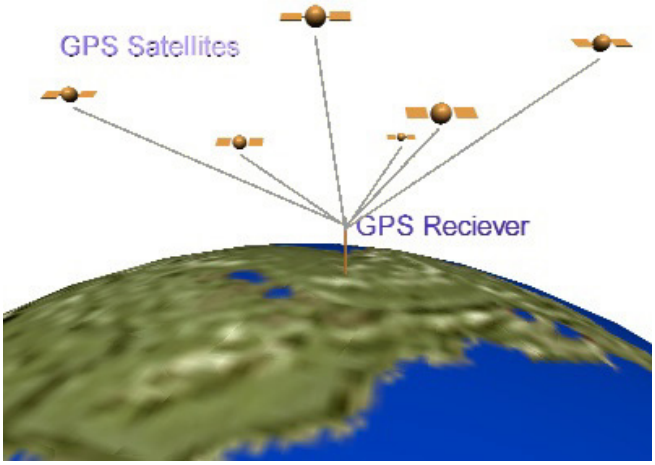

Figure 2. How the signal from multiple satellites is used to determine location.

1) What does GPS stand for? _____ _____ _____

2) Who is responsible for establishing and maintaining GPS? _____

3) List three things GPS can be used for:
   1. _____
   2. _____
   3. _____

4) How many satellites are there in orbit? _____

5) What is the minimum number of satellites needed to collect a GPS location? _____

6) List two major things that can interfere with satellite reception:
   1. _____
   2. _____

Using the GPS

7) How many satellites are you receiving now? _____

8) List the three ***kinds*** of features you can collect with a GPS unit:
_____, _____, _____

10) The compass screen is under the _____ tab.

11) Use the GPS to determine your current position in latitude and longitude and your elevation.
_____ N; _____ W _____ feet/meters (circle correct units)

FIELD NOTES

As your group conducts your fieldwork, work as a team to take a GPS point at the ranch and at each water sampling site. In addition to collecting the point on the GPS unit, note the latitude and longitude of each point in the space below. Describe the feature you are collecting coordinates for (lat/long) in the space provided. Note additional points your group collects information on as time allows. You will plot these locations on a map back in the classroom.

GPS Rover file:_____ **Describe Feature**

Location 1: _____ N; _____ W _____

Location 2: _____ N; _____ W _____

Location 3: _____ N; _____ W _____

Location 4: _____ N; _____ W _____

Location 5: _____ N; _____ W _____

Location 6: _____ N; _____ W _____

Location 7: _____ N; _____ W _____

Location 8: _____ N; _____ W _____

Location 9: _____ N; _____ W _____

Location 10: _____ N; _____ W _____

Notes:

8th GRADE SCIENCE DAY – March 18, 2003 –
Nancy M. Cummins Research Ranch
Field Worksheet-

Answer Key

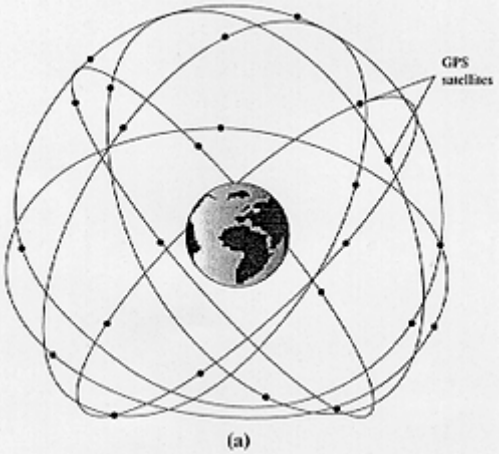

Figure 1. 24 GPS satellites in orbit.

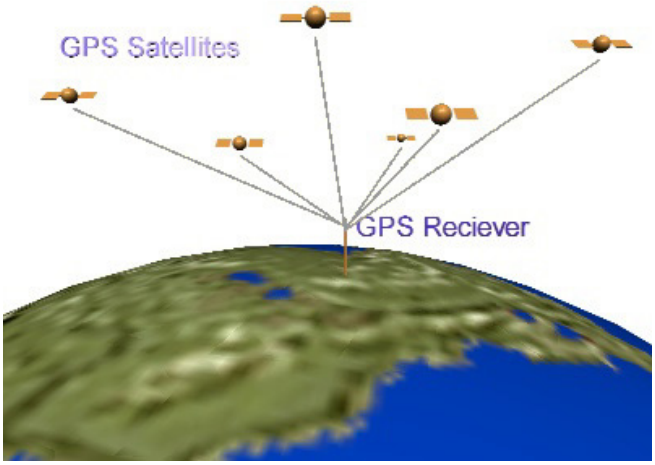

Figure 2. How the signal from multiple satellites is used to determine location.

1) What does GPS stand for? **Global Positioning System**

2) Who is responsible for establishing and maintaining GPS? **U.S Dept. of Defense or U.S. Military**

3) List three things GPS can be used for: **There are <u>infinitely many correct answers</u>. GPS can be used to collect the location information/coordinates for anything that exists on the face of the earth. Possible examples/answers are to record the location of: a road, timber stand, mine, water quality sampling site, rare plant or animal, building, weed patch, fence, wells, soil sample site, etc… Other ideas: conduct a land survey for property lines, to find your location on a map if you are lost, to navigate to a certain spot that you need to find, etc…**

4) How many satellites are there in orbit? **24**

5) What is the minimum number of satellites needed to collect a GPS location? **4**

6) List two major things that can interfere with satellite reception: **many correct answers: terrain (mountains, canyons), trees, building, people, cars/trucks, the weather, location of satellite (if over the Southern Hemisphere), etc..**

Using the GPS

7) How many satellites are you receiving now? **This will depend**

8) List the three ***kinds*** of features you can collect with a GPS unit: **points, lines, polygons (also called "area" on the GPS units)**

10) The compass screen is under the **Nav** tab.

11) Use the GPS to determine your current position in latitude and longitude and your elevation.
_____ N; _____ W _____ feet/meters (circle correct units)