# GLOBE HYDROLOGY INVESTIGATION

**GLOBE Inquiry Model: OUTLINE SHOWING TIME AND SEQUENCE**

- Total Time 9 hours (including maximum travel time and pre-workshop preparation)
- 6 contact hours
- 1.5 hours break (lunch and 2 breaks)
- Up to 30 minutes total travel time

***Breaks and lunches have not been included; it is suggested that breaks occur at least every two hours.***

**Note:** *This outline provides a framework for agenda planning for implementation of the GLOBE inquiry-based training model as presented in* ***Inquiry and the National Science Education Standards: A Guide for Teaching and Learning,*** *Olson & Loucks-Horsley, 2000. It contains a basic content outline as well as a timeframe for completion of all activities.* ***Provide this plan to your participants so that they can conduct their trainings based on your model.***

**Staffing and support requirements:** 1 Master Trainer and 1 assistant trainer. Trainer(s) must be prepared to train all systems components for both low and high tech data entry. Hydrology training is best done in small field groups, therefore the trainers for the other protocol areas should be asked to lead a field group.

**Logistics requirements:** Trainer must survey workshop location to identify nearby water site. Check for GLOBE data that has been gathered in the local area as well as EPA, USGS, etc. for other data sources to provide more framework for developing a project about the area. Refer to the Hydrology section of the GLOBE Teachers Guide often during training.

**Equipment requirements:**

1. *Just Passing Through* transparencies showing interaction.
2. Specific equipment required for selected hydrology protocols.
3. Laminated copies of the field sheets as needed for each group.
4. Copies of data entry sheets, GPS, mapping grid, flags and tape measure.
5. 1 bag or bucket for each group containing all necessary instrumentation for conducting the protocols in the field. Depending on which protocols are to be trained, the list could include items such as (latex gloves and safety goggles, turbidity tube or secchi disc, water thermometer (a string or rubber band attached), pH strips or meter, TDS tester, hydrometer, Dissolved Oxygen kit, Alkalinity Test kit, Nitrate Test kit, etc. Make sure to check the materials needed for each protocol to be trained and include these items.

**Workshop format:**

1. Setting the Context for Hydrology TTT **(10 min.).**
   a. Remind participants of the *Just Passing Through* (JPT) activity conducted at the beginning of the workshop.
   b. Use JPT overhead transparency and allow participants to describe what is happening in relation to Hydrology.
   c. Record their ideas on a flip chart. Use the transparency overlay as a summary of their findings (make sure to add anything missing from their discussion onto the

overhead transparency) and encourage participants to record notes their on their handout.

d. Optional: Pour water through the JPT system again to initiate discussion.

**2.** Material to Cover

a. Explain Hydrology structure and scope. Begin by explaining what had to be done for set-up. This includes the time taken for exploring possible sites, Internet searches for material of local interest, and lab set-up logistics.

b. Hand out lesson plan used so that trainers can use this plan when conducting subsequent training sessions.

c. Tell participants what they need to bring for fieldwork. Post this information on the board and provide bags or a bucket to each team for carrying equipment. Each team is responsible for their own equipment.

i. Logistics/Equipment

1. Field notebook for taking notes.

3. **Travel to Site** (try to locate a site that is no farther than 15 minutes from the workshop location).

4. Assessing student knowledge and generating questions:

a. Observe the Hydrology Site (15 min.)

i. Investigation Questions

1. What is interesting about this water site?
2. Is it similar to anything with which you are familiar?
3. Do you think this site has seasonal properties?
4. What would you like to know about the properties of this water right now?
5. What are the main features of this site that you think are affecting the properties of this water? (inputs, plants, etc.)
6. What are some of the research questions you can ask about this and other) body(ies) of water?
7. What would you like to investigate/measure to answer some of these questions?

b. Equipment

i. GLOBE Science Log (field notebook)

**Note:** Ideally this is done in the field at the Hydrology Site but in case of inclement weather, it can be done using maps/photos in classroom or in the computer lab where participants can spend time (at least 15-20 minutes) researching about the site. Ie. An example of an EPA search discovered that – the site was monitored, but each 'monitoring event' was a one time sample. Sites were not revisited. Discussion could emphasize GLOBE's importance.

5. Making Field Observations: Characterize the Hydrology Site **(30 min)**

a. Material to Cover

i. What type of water body is this?
ii. How large is this body of water?
iii. Where does water enter the site?
iv. Where does water exit the site?
v. What surrounds this body of water? Bedrock? Development? Vegetation?

vi. Make a Map/Sketch the Hydrology Site.
vii. Use GPS to Take Latitude, Longitude, and Elevation.
viii. Fill out Hydrology Site Definition Sheet (one per person)

**Note:** If your study site is a lake, many of these questions can probably only be answered by research – not by standing on the shore. However, the site definition and sketch map can be completed on location at the same time that data is gathered.

b. Equipment Needed
i. GLOBE Science Log (field notebook).
ii. GLOBE Data Book (Hydrology Site Definition Data Sheet, GPS Data Sheet)
iii. GPS
iv. Compass
v. Measuring Tape
vi. Clinometer
vii. Camera (optional)

c. Logistics: Ideally this initial activity is done in the field at the Hydrology Site. However, in case of inclement weather this can be done with maps/photos in the classroom or at the computer lab.

6. Discussion **(20 min)**
a. Material to Cover
i. Go over the trainee generated research questions: Ask: *What were the research questions you asked?*
1. Questions can be generated from maps showing where inputs were, contamination sites, etc.
ii. Ask: *What measurements/data do you need to answer your questions*?
iii. Discuss questions developed by GLOBE to guide discussion towards doing the Hydrology Protocols.
1. How can we determine what is in the water?
2. Is it alkaline or acidic?
3. Is there anything living in the water?
4. What is the temperature? Etc.

b. Equipment Needed
i. Blank Overhead/ Board / Flip Chart on which to write questions or if you prefer to not formally write out questions, simply brainstorm research ideas, questions, and methodologies.

c. Logistics
i. This is best done in the field using a flip chart but can be done in the classroom in case of inclement weather.

7. Introduction to GLOBE Hydrology Measurements **(45 min.)**
a. Tell participants: Let's find out the answers to our questions. We can do this by implementing the GLOBE hydrology protocols.
b. Materials to Cover
i. Temperature/ Thermometer calibration
ii. Dissolved Oxygen/ DO saturation calibration
iii. Transparency

iv. pH/ pen or meter calibration
v. Alkalinity/ Standard check
vi. Conductivity/ Meter calibration
vii. Salinity/ Hydrometer technique
viii. Nitrate/ Standard check

**NOTE:** An alternate activity is to have the participants mix their own alkalinity and salinity standards as well as mix the nitrate since they are going to have to do it at their own workshops.

c. Equipment
i. Basic and Advanced GLOBE Hydrology Equipment
ii. Overheads/handouts as needed to teach scientific concepts
iii. Calibration Data Sheet
iv. Distilled Water
v. GLOBE Hydrology Protocols (from Teacher's Guide)
vi. Plastic bottle for waste disposal

d. Logistics
i. Demonstrate how to conduct all protocols allowing for **participant questioning in between each protocol demonstration**. Refer to their personal equipment in their bucket that they will be using to conduct protocols themselves during the presentation. Model proper collection and sampling techniques.
ii. Introduction and Instrument Calibration and Practice is best done in the field but can be done in the classroom in case of inclement weather.
iii. If this section is to be done in the field, a table and flip chart will be needed.
iv. Be sure to use latex gloves and safety goggles. Explain the importance of safety with trainees so that when trainers are working with teachers they will also address this issue.
v. Be sure to arrange for waste disposal at the site to dispose of waste from the test kits.

8. GLOBE Measurements in the Field **(90 min.)**
a. Materials to Cover – Data Collection
i. Temperature
ii. Dissolved Oxygen
iii. Transparency
iv. pH (calibration check)
v. Alkalinity
vi. Conductivity or salinity
vii. Nitrate
b. Equipment
i. Basic and Advanced GLOBE Hydrology Equipment
ii. Data Entry Sheet (download from Data Entry page)
iii. Distilled Water
iv. GLOBE Hydrology Protocols (from Teacher's Guide)
v. Plastic bottle for waste disposal
c. Logistics

i. Have all groups repeat measurements 3 times from separate buckets

**NOTE:** There needs to be some discussion before you go to the field site on organizing your group to be able to accomplish three measurements for each protocol. It is recommended that each group have 3 sample buckets. This should be folded into a discussion on classroom management – if the participants fail to carry out this task, they will not be convinced that their students can do it.

ii. Follow order of measurements from the Teacher's Guide.

**9.** Travel Back From Field **(15 min.)**

**10.** Break **(15 min.)**

11. Data Entry **(45 min.)** Explain to participants that before you all can dig into the data, it needs to be recorded or entered in the GLOBE database. For example, look at the data in the classroom before entering the computer lab (it is easier to keep their attention if they are not in front of the machines).

b. Materials to Cover:
   i. Look at the data and discuss
   ii. Logging in
   iii. Site definition
   iv. Web data entry
   v. E-mail entry (if applicable)

c. Equipment
   i. Computer lab with minimum of 1 machine per 2 people
   ii. Internet connection
   iii. Video projector (if available)
   iv. Whiteboard or flip chart
   v. If no computer available, then trainer should use viewgraphs to illustrate logging in, site definition and data entry

d. Logistics
   i. Train web data entry, and mention e-mail entry. Where appropriate, we train e-mail entry.

**12.** Looking at Your Data **(90 min.)**

a. Materials to Cover:
   i. Have participants report their data for 1 or more sites
   ii. Discuss results
      1. Do you see any patterns in your data?
      2. Are numbers reasonable?
      3. Are numbers typical? How can we find out?
      4. Discuss what to do with questionable numbers.
         a. Step One: check your calibration.
         b. Step Two: check your procedure.
         c. Step Three: Make observations about variables you think may have affected your results. Report these in your comments/metadata.

d. Step Four: If you still have questions or an interesting observation, contact the Hydrology Team. You may not always be able to answer your questions – mysteries are what science is about. But you need to document your observations!!

1. Compare sites if possible
2. How useful is data from a single day? Can we answer the research questions we asked based on these data? If no, what more do we want to know? (Discuss importance of longitudinal studies.)

iii. Make a hypothesis

**iv.** Blank Graphs – ask participants to put data point from today on graphs, predict pattern through time, consider variability, significant differences, and range of data.

v. **Visualizations: GLOBE tools to assist in looking at or exploring data.**

1. How to find a school's data
2. How to make a graph
3. How to make a map
4. Look at Similar Data
   a. Other schools in area
   b. Other schools at the same latitude
3. Data Mining
4. Ask participants to think of new questions they want to explore using data from the GLOBE database. Have them write down their questions and hypotheses for the outcome.
5. Have participants explore the GLOBE web site and look for schools that have sufficient data to answer the question you are asking. Ask them to compare two or more schools in different/similar locations, look at change over the seasons, changes from one year to the next.

NOTE: If the computer lab has poor connectivity, use the Research CD to look at some GLOBE data.

b. Equipment:

i. Blank transparencies or flip chart
ii. Computer lab
iii. Graphs of GLOBE data (data exploration)
iv. In a low-tech situation, trainers need graphs and data tables from a variety of schools (Source Books).

c. Logistics:

i. Ideally done using GLOBE website, if not available use Source Books and/or Research CD.

13. Student Investigations and Classroom Implementation **(15 min.)** Ask Participants how this can be implemented in the K-12 classroom.

a. Material to Cover:

i. Sample lessons from the Partner Implementation Guide.
ii. Ideas and examples of student investigations using GLOBE data
iii. Collaborative tools on the GLOBE website:

1. School search
2. GLOBE Mail
3. School-to-school collaboration

i. Publication tool – Student Investigations on website

*ii.* Ask: *What other investigations could we do using our local and GLOBE data?*

b. Equipment:

i. Sample units and lessons incorporating GLOBE from the Partner Implementation Guide.

ii. Student investigation project examples from website

c. Logistics:

i. Preferable to do this in the computer lab. Have examples on overheads if computers are not available.

14. Summary of Hydrology Training

a. Reintroduce the participants to the Hydrology Science team (using the GLOBE Teachers Guide). These are the people they will contact if further questions arise regarding specific protocols.

b. Answer any final questions.