LAND COVER/BIOLOGY– Basic & Advanced

GLOBE Inquiry Model: OUTLINE SHOWING TIME AND SEQUENCE

Total Time 15.25 hours (2 days, including max. travel time)
Day 1: Content 7.00 hours, Total time: 8.25 hours
Day 2: Content 5.75 hours, Total time: 7.00 hours
Prep time: 2 days

Breaks and lunches have been suggested in this plan but it is up to the trainer to decide the appropriate time frame(s) for these to occur during training; 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 component for both low and high tech data entry.

Logistics requirements: Trainer must survey workshop location to identify nearby soils pit and obtain local soil samples for study. Check for GLOBE data that has been gathered in the local area. Arrange for a local expert—this is critical to provide a balanced view of what is happening environmentally, ecologically and socially at the workshop site. Land Cover/Biology provides the context for all the other investigation areas and protocols covered.

Equipment requirements:

1. *Just Passing Through* transparencies showing interaction.
2. Materials needed for Land Cover/Biology training.
   a. Camera (digital preferred; Polaroid)
   b. MUC Field guides
   c. Densiometers and clinometers (or materials to make them)
   d. GPS
   e. Data sheet/field guides
   f. Landsat image—True color and IR prints and disc (1 each per participant).
   g. Landsat images for small group activity: 1 different image will be needed for each group of 5 at the workshop. Make 5 copies of each image so that each member of each group has a copy of the image. Make one overhead transparency of each Landsat image.
   h. Video: TV/VCR or Computer projector
   i. Blank transparencies, vis-a-vis marking pens—very fine points and in different colors, scotch tape
   j. Power Points
   k. Tape measures, flags, compasses
   l. Carry bags
   m. Calculators
   n. Grass shears, brown bags, meter sticks

o. Maps, aerial photos—1 for each group of 2 people. Download maps from the USGS website for the local area before the workshop (orthophotos, digital raster graphics, etc.)

p. Overhead projector

q. Computer projector, if available

r. Chart paper/white board and markers

3. Laminated copies of the field sheets for each group.
4. Copies of data entry sheets.

Pre-workshop preparation and materials needed:

1. Site background information and data:

a. Check for GLOBE data in the area.

b. Gather photos from the local sites: Encourage participants to constantly refer back to the air photo or topo map and cross-reference it to the image. Large topo sheets and road maps help a great deal but aerial photos (enough to go around for each group of 2 people), brings the relationship between the abstract remotely sensed image and real work together.

c. Land Cover issues from the site coordinator, local trainees.

d. Gather LC sites for assessment (MUC, photos, GPS).

e. Rental car/transportation to gather sites.

f. Make manual LC map from image.

g. Topographic maps and road Maps of the training area.

h. Aerial photos.

i. Instructions to observe land covers along the way (optional).

2. Review Basic land cover protocols and especially MUC for local area.

3. Trainers should go through the process to do the composite change image to be aware of changes. Also, be certain that you have both old and new images for change detection.

4. Contact a local expert that can provide participant with a general introduction to the area at the beginning of the training session.

Outcomes from Basic Land Cover Training

Investigation Questions:

1. What are the major landcover types? Perhaps show a globe and ask about major regions (oceans, deserts, forests). Participants will become familiar with major land cover types and locate them on the Landsat image.
2. What is the purpose of the map or any map? Generate research questions.
   a. Why do we need a base map? Understand why we need a base map.
   b. Other questions as posed by students.
3. What is remote sensing? Then provide a basic understanding of what a remote sensing image is, particularly with respect to true and false color.
4. Why is it necessary to obtain ground validation of remotely sensed data?

Skills

1. The participants will be able to create a meaningful manual land cover map.
2. The participants will be able to use the MUC guide to distinguish different classes.
3. The participants will be able to take, record, and report data.

4. The participants will be introduced to the GLOBE website, especially data entry and retrieval.
5. Participants will gain an understanding of the mechanics of Accuracy Assessment, and be able to perform.

Advanced Training:
Skills

1. Use MultiSpec to:
   a. Open an image.
   b. Change band combinations.
   c. Identify which band combinations are best for discriminating vegetation, urban areas and water bodies.
   d. Zoom in and out.
   e. Make spectral graphs.
   f. Compare multiple spectral graphs.
   g. Identify spectral signatures for water, vegetation and urban areas.
   h. Identify different land cover types.
   i. Perform an unsupervised classification of an image.
   j. Change the color and label of a cluster on a classified image.
   k. Save the clustered image as a TIFF file and send to GLOBE.
   l. Composite two registered images.
   m. View different band combinations in the composite image and detect changes in different land cover types.

Workshop format:

DAY 1:

1. Explain Land Cover/Biology structure and scope. (15 mins.) (classroom) 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.

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

b. Remind participants of the *Just Passing Through* (JPT) activity conducted at the beginning of the workshop.

i. Use JPT overhead transparency and allow participants to describe what is happening in relation to Land Cover/Biology.

ii. 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.

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

2. Discussion: Ask: *What types of land cover did you see on your way to the workshop?* (30 min.) (indoors)

i. Have trainees describe the landscape (forests, water, grasslands, etc.).
ii. Draw a rough map of the LC's observed on blank chart paper, view graph, etc.
iii. **Local Expert can describe the area and provide background that will help the participant during the remainder of the workshop.**

3. Locate the sites on existing maps**.** (20 min.)

a. Locate same sites on campus maps, road maps, topos, aerial photos, as available.

b. Ask: *Can you find the areas you saw on a map*? (Point out that maps are a model).

i. Begin with the hand drawn map, move to a road map, then to an air photo, and finally to an image. **In each step, the participants find the identical locations they drew on the map in step one**. If you work through the process sequentially, introducing the false-color image is very realistic and actually helps in doing the manual map.

ii. Emphasize that maps are inherently inaccurate because of date, distortion of projection, the maker, scales, etc. Highlight 1 or 2 examples from the maps they have just been working with to illustrate this. Asking them leading questions to find areas on a map also helps.

c. Locate the same sites on the True Color and False Color images. Remind participants that this is not a map, but another view of the area acquired by the Landsat system of satellites at heights of 705 km.

3. Develop research/inquiry questions. (30 min.)

Note: Questions should be tailored to the local needs, and this must be flexible.

a. Discussion of local issues (with expert).

i. Can they locate sites that are in local news?

ii. Are there landmarks that they can recognize that give them a reference to find other landmarks.

iii. Refer back to the information provided by the local expert.

b. Why look at land cover?

iv. Why do we need these maps?

v. What can we use these maps for?

vi. What kinds of decisions are made using maps?

vii. What kinds of land cover are important in this area?

viii. Does everyone need to make maps on the same theme?

ix. How is mapping related to land use decision. (Could relate to zoning)

5. Suggested Break. (15 min.)

6. Introduction to Remote Sensing. (40 min.)

a. Use video (Power Point overheads, and/or transparencies as needed during the discussion). Stop video at key points and discuss and ask for questions.

b. Focus on:

i. True and false color imaging.

ii. Pixels and how a pixel is made

iii. Images vs. pictures.

iv. Digital data from the satellite.

v. The Landsat channels are the parts of the electromagnetic spectrum that they represent.

vi. Stress the use of channel four in vegetative identification.

Note: An example of how you would stop the video to explain certain topics: Show the first 5 minutes of the video. When it begins describing MUC stop! At this point explain the satellite process. Point out that the *Eyes in the Sky* Learning Activity gets this point across perfectly. Have them look at the activity in the Teachers Guide, page . Show the picture of Abe Lincoln (sample picture that can be used for the activity) and discuss the digitizing activity (time permitting this activity can be done with participants).

c. We must look at sites that are 90 m x 90 m, and are homogeneous in composition.

i. Define homogeneous as having the same MUC value for all pixels in the area.

7. Manual mapping: "GIS by Hand"Activity. (40 min.)
   a. Form small groups with 5 participants in each group.
   b. Distribute Landsat images to participants. Each group will receive a different image with a separate copy of the image for each member of the group. Each member of the group must choose a specific color of marker to identify one of the following features on their overhead transparency. (A transparency is laid over the top of the Landsat image and they outline the specific feature on the overhead transparency).
      i. Water—black areas
      ii. Roads/major highways
      iii. Airports
      iv. Residential areas
      v. Forests or grasslands
   c. Have groups compare individual maps by group presentation using the overhead projector. Place the transparency of each Landsat image on the projector and they overlay their transparencies one by one on top of each other explaining the features that they outlined.
      i. Ask: *What differences are there*?
      ii. Ask: *How can we reconcile these differences*?

Note: By this point, people may have used different terms to describe the same land cover type. Bring out, if the participants do not get to it themselves, that we need a set of universal terms to describe land cover types. We will use a system called "MUC", more on which will be covered next.

8. Lunch (60 min.)

9. Show a land cover classification map. (20 min.)
   a. Use one that the trainer has done from the image.
   b. Ask: *How good is it? How can we find out?* (We can go there to compare.)
      i. We need to do ground validation as a source of data for Accuracy Assessment. (Note: This topic may come up in discussion earlier, and it is fine to cover it then)

10. Land Cover Sample Site – Introduction. (15 min.)
    a. Review the directions for reading a compass (Land Cover/Biology Protocol section of the Teachers Manual, Protocols page 12.
    b. Give a quick introduction to the MUC system, and the MUC field guide. MUC is a skill and therefore it is appropriate to show or tell participants the proper way to use the guide.
        i. Discuss necessary properties for a classification system (ie. exhaustive, mutually exclusive, etc.).
        ii. MUC: Go through the example on page 40 and have participants move through their MUC guide as they follow the activity.
    c. Introduce GPS, Biometry measurements, and metadata.
    d. Setup a logical framework of what they are going to be doing in the fieldwork—outline expectations.
    e. Optional: Prepare a PowerPoint of part of the image that shows where the workshop is taking place and were the field site is going to be.
        i. Identify several areas along the way to the field site that cannot be readily identified by just looking at the image and must be verified by actual observation.
        ii. When you go to the field site, plan to stop along the way and do land cover sample sites of these areas to provide a variety of MUC types (natural, urban, etc) so that participants get to MUC at least 4 or 5 areas in the fieldwork. This leads into some good discussion / reinforcement of accuracy assessment.

11. Land Cover Sample Site – Fieldwork: capturing the data.

Note: Trainer should investigate the area and pre-select sample sites. Ideally, there should be a couple different sites. One should be a natural site, where biometrics are to be taken, and may be a distance away. The other site should be developed, local, and on the way to the natural site.

    a. Travel to sites taking note of different MUC along the way.
    b. Reinforce that these sites must be within the 90m x 90m.
    c. All Land Cover Sample Sites include:
        i. MUC
        ii. GPS (5 min data must be taken at each site)
        iii. Photographs (one in each cardinal direction).
    d. Biometry data are taken at natural site.
        i. Participants should take any biometry data that are needed to accurately determine the MUC value of the site.
        ii. Participants should be able to carry out all the biometry measurements as outlined in the protocol.
    e. Take Metadata when applicable.
        i. Participants should gather any and all data that might be of importance in understanding the site, its history, etc.
    f. Help the Soils Trainer!! Prepare for the **Soils in my Backyard** activity conducted during Soils training by asking participants to collect different soil samples during the Land Cover/Biology training.

i. Provide participants with containers to collect different soil samples to bring back to the lab for a later activity (keep samples separated and note where they were found and other metadata as appropriate).

DAY 2:

1. Add data from sample sites to the map. (20 min)
   a. Review activities from previous day
      i. Ask: *What did we find out about the accuracy of our LC map yesterday? Do we need to adjust our map?*
      ii. Stress that making a land cover map is an *iterative process*.
   b. These site data are now used to make the land cover map more accurate.
2. Accuracy Assessment. (40 min.) This is a skill.
   a. Use the data gathered by the trainer.
   b. Construct the Accuracy Assessment matrix.
   c. Calculate overall accuracy.
   d. If there are sufficient data, point out how the matrix shows trends in errors or biases in estimating land cover types. If not, use a prepared matrix to show error patterns.
   e. It is important to note that visited sites used in the construction of the map may not be used in constructing the error matrix.
   f. Divide the group into teams to assess both the manual and electronic maps.
   g. Have a discussion about the differences between the results.
      i. Ask: Are there land cover types that the system does not separate in the clustering?
      ii. Ask: Are there land cover areas that are artificially split by the computer process?
      iii. Ask: Are their land cover types that the manual mapping distinguished that were not found in the computer-assisted mapping?

Note: Gather about 10 additional sample sites during prep days that can be used for Accuracy Assessment to provide participants with at least 4 or 5 sample sites that they just did in their field work. Participants need hands-on experience with this to be able to do it again in the future.

3. Data entry and related computer work. (60 min.)

Note: If this is a stand-alone module, or the first investigation area in the training (as it should be), then the participants need to be given their **GLOBE ID's** at this time.
   a. Enter data that has been collected.
   b. Explore the GLOBE website together (have them click on highlighted areas as you move through the site).
      i. Show the animations for the ESS Poster Activity. (GLOBE resource room under Instructional Resources).
   c. Retrieve data.

4. Recommended Break. (15 min)

5. MultiSpec tutorial and clustering. (1:20 min.) **This is a skill and therefore requires a complete demonstration. Move through the tutorial with the participants.**
   a. Objectives:
      i. Open an image.
      ii. Change band combinations.
      iii. Identify which band combinations are best for discriminating vegetation, urban areas and water bodies.
      iv. Zoom in and out.
      v. Make spectral graphs
      vi. Compare multiple spectral graphs
      vii. Identify spectral signatures for water, vegetation and urban areas.
      viii. Identify different land cover types.
      ix. Perform an unsupervised classification of an image.
      x. Change the color and label of a cluster on a classified image.
      xi. Save the clustered image as a TIFF file and send to GLOBE.
      xii. Composite two registered images.
      xiii. View different band combinations in the composite image and detect changes in different land cover types.

6. Recommended break for Lunch. (60 min.)

7. Change Detection. (60 min.)
   a. Composite two images.
   b. Demonstrate change and how to view.
   c. What questions can we answer at this stage?

8. Follow up and discussion. (25 min)
   a. Ask: *Where would you go from here in using land cover maps to answer the questions you posed at the beginning?*
   b. Ask: *Can you reach any conclusions yet*?
   c. Ask: *What other types of data would you need to help you answer your questions?*
   d. Ask: *As trainers, how are you going to translate this to your own area*?
   e. A methods discussion: *What questions/comments do you have on how the training was carried out?*
   f. Point out:
      i. Research of the PI
      ii. Student research
      iii. MUC-A-Thons
      iv. Training resources (learning activities, etc.)

9. Summary of Land Cover/Biology Training
   a. Reintroduce the participants to the Land Cover/Biology 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.

Note:

1. The training schedule for a basic training would consist of the above, except for sections XIV (MultiSpec tutorial and clustering) and XVII (Change Detection). Also, section XVI (Accuracy Assessment) would not include electronic maps.
2. Use Sidebars ("When you train this, you will have to……..") sprinkled throughout the day. Providing these sidebars to your audience will help them succeed.
3. Provide trainers with all necessary information that will enable them to train teachers.

Refer to sections of the Land Cover/Biology Section of the Teachers Guide throughout the training and point out appropriate learning activities as well as implementation strategies.