Grade 6
Science
Unit 1: Building a Better Scientist

Time Frame: Approximately two weeks

Unit Description

This unit is designed to build a foundation of learning and investigation that will serve the teacher and the students in the units that follow.

Student Understandings

The students will develop a foundation of science skills that include measurement, classification, setting up and using a science learning log, investigation procedures, safe science practices, documenting science observations, and working in cooperative groups. Students will also practice note-taking skills using the literacy strategy of split-page notetaking.

Guiding Questions

1. Can students accurately use measurement tools to collect quantitative data?
2. Are students able to describe and classify common objects by their attributes?
3. Does the student's science learning log reflect their attention to the details of science, a consistent and legible recording of their observations and investigations, and does it adhere to the guidelines established by the teacher for format?
4. Does the student create concise, legible notes when using a written resource or text?
5. Do students practice safe science, and are they able to identify safety concerns?

Unit 1 Grade-Level Expectations (GLEs

GLE #	GLE Text and Benchmarks
Science as Inquiry	
Note: The following Science as Inquiry GLEs are embedded in the suggested activities for this unit. Other activities incorporated by teachers may result in additional SI GLEs being addressed during instruction.	
1.	Generate testable questions about objects, organisms, and events that can be answered through scientific investigation (SI-M-A1)
2.	Identify problems, factors, and questions that must be considered in a scientific investigation (SI-M-A1)
4.	Design, predict outcomes and conduct experiments to answer guiding questions (SI-M-A2)

GLE #	GLE Text and Benchmarks
5.	Identify independent variables, dependent variables, and variables that should be controlled in designing an experiment (SI-M-A2)
6.	Select and use appropriate equipment, technology, tools, and metric system units of measurement to make observations (SI-M-A3)
7.	Record observations using methods that complement investigations (e.g., journals, tables, charts) (SI-M-A3)
8.	Use consistency and precision in data collection, analysis, and reporting (SI-M-A3)
10.	Identify the difference between description and explanation(SI-M-A4)
11.	Construct, use, and interpret appropriate graphical representations to collect, record, and report data (e.g., tables, charts, circle graphs, bar and line graphs, diagrams, scatter plots, symbols) (SI-M-A4)
12.	Use data and information gathered to develop an explanation of experimental results (SI-M-A4)
19.	Communicate ideas in a variety of ways (e.g., symbols, illustrations, graphs, charts, spreadsheets, concept maps, oral and written reports, equations) (SI-M-A7)
22.	Use evidence and observations to explain and communicate the results of investigations (SI-M-A7)
23.	Use relevant safety procedures and equipment to conduct scientific investigations (SI-M-A8)
25.	Compare and critique scientific investigations (SI-M-B1)
31.	Recognize that there is an acceptable range of variation in collected data (SI-M-B3)
32.	Explain the use of statistical methods to confirm the significance of data (e.g., mean, median, range) (SI-M-B3)
33.	Evaluate models, identify problems in design, and make recommendations for improvement (SI-M-B4)
34.	Recognize the importance of communication among scientists about investigations in progress and the work of others (SI-M-B5)
36.	Explain why an experiment must be verified through multiple investigations and yield consistent information before the findings are accepted (SI-M-B6)
37.	Critique and analyze their own inquiries and the inquiries of others (SI-M-B5)
Physical Science	
1.	Measure and record the volume and mass of substances in metric system units. (PS-M-A1)
19.	Identify forces acting on all objects)PS-M-B3)
20.	Draw and label a diagram to represent forces acting on an object (PS-M-B4)
33.	Predict the direction in which light will refract when it passes from one transparent material to another. (e.g. from air to water, from prism to air) (PS-M-C4)
35.	Determine through experimentation whether light is reflected, transmitted, and/or absorbed by an object or material. (PS0M-C4)

Sample Activities

Activity 1: Questions, Questions! (SI GLEs: 7, 19, 22, 23, 31, 34)

Materials List: We're all Different! We're the Same BLMs**,** pencils, group sets of assorted objects (i.e., buttons, carnival trinkets, shells, dried beans, old mis-cut keys from the hardware store, etc.), loose-leaf paper. Each set should be in a small sealable bag and should include 20-30 objects for each group of students. It is preferable for each group to have the same kinds of items.

This activity is completed over two days. Use three days if the students are extremely involved in the classification process.

Day 1
Arrange all students into groups of four to six. Give each group page one of the We're all Different *graphic organizer* (view literacy strategy descriptions) BLM. The BLM will accommodate two students, so distribute enough so all group members will have a space to record their information. Each member of the group writes their name near a box on a page. Challenge them to talk and ask questions of each other to identify how each member of the group is different from all the others in that group. This activity does get a little noisy if it is really working well.

Each student must record eight (8) things that make them different from everyone else. Keep the group paper moving as team members identify attributes to record so that no one student is waiting for another to complete their list. Challenge them to consider personal experiences, families, pets, likes, dislikes, accomplishments, trips, transportation, birth order, and such to really dig for the differences. Give the groups about 20-30 minutes to go through this process.

When groups have completed all member lists, have each person select two items from their list to share with the entire class; however, if something they have chosen to share is said by another member of the class, they must chose again from their list. (This keeps everyone listening, a great science skill!) Move quickly through the sharing so that page two can be completed during this first class period.

When all have shared, give each group copies of the next graphic organizer, We're All the Same! BLM and have them identify ten (10) things that make them all the same. They may be able to use some of the information they tossed out in the first exercise in questioning. This process usually goes more quickly but if it slows down and time is a concern, stop the activity when teams have listed 6 or 8 similarities. Have each group share two ways in which they are all the same, and again, do not allow repeat information.

These are the points to be made during closure of this activity:

- Scientists sometimes ask questions to collect information, keeping the usable information and putting aside that information they cannot use at that time. Good questioning gets better information.

- Sharing information is part of the scientific process and allows us to add to the bigger pot of information.
- Scientists classify everything in our world and looking at details, differences, and similarities is the process they use to construct classification systems.

Day 2

Use the same teams already established for the Day 1 activity. Give each team a bag of objects. The teacher will model good safety practices and should begin by establishing safety guidelines for the use of small objects, respecting toys as science tools, staying on task, and using the materials as intended. It is preferable to have the same types of objects for each group, but if difficulty is encountered in gathering this large collection, use several smaller ones.

Have each group identify as many different ways to classify the objects as possible (i.e., keys that have square holes in the top), listing all attributes used for classifying to compare with the other group lists. Have the students list all groupings on the loose leaf and label with their group number or student names. Color can be eliminated as a classification so as to challenge the students to think beyond the obvious and to look to the smaller details for classification ideas.

Move amongst the students and guide them to look for not-so-obvious details to group. If they seem to be "stuck," guide the group members to consider identified details to get them back on track. Example: "Why did I group these five keys together?" (*Answer: They all have a number 4 on them.*) Leave them with the challenge and only tell them the answer after they have struggled with the challenge and ask for the answer. Move around the room while they work on their solutions. Students may separate the whole collection into several groups and then not look any further. Encourage them to always put the entire collection back together to look for new classification patterns.

When they seem to have exhausted as many ways to group or classify the objects, have each group select three ways to classify the objects to share with the rest of the class, remembering to choose a new grouping if someone names one they have selected to share. This works best if all groups have the same types of items in their bags (keys, bottle tops, doubloons, buttons, etc.).

Points for closure include the following:

- Scientists have to keep looking for details to make certain every attribute of an object is considered for classification.
- Scientists working together can pool their observations to include better information.
- Observations, like questioning, can lead scientists to information that can be used or that makes it necessary to re-evaluate and do more observations.

This activity can lead very nicely into constructing dichotomous keys. Students would divide their bag of items into two groups, then take one group and divide that by attributes into two groups, then select one of those groups to divide into two groups by attributes, and so on and so on, until they are down to one item. This skill is introduced in grade 5 but more exposure strengthens it significantly.

Activity 2: Collecting Data (SI GLEs: 2, 6, 8, 11, 12, 19, 22, 23; PS GLEs: 1)

Materials List: scales (triple beam balance recommended), coffee filter papers, large spoons or measuring scoops, disposable paper bowls, colored aquarium gravel, sand, charcoal
Optional additional materials: plaster of Paris (1 cup or a metric equivalent for each group), water, stirring (craft) sticks, graduated cylinder to measure water, measuring cup /scoop for plaster, goggles for each student, paper and pencils to use for making data charts

The teacher is still *modeling* good safety practices and sets the safety standards at the beginning of this unit. Review safety concerns for this lab (e.g., carefully scoop and measure all materials, provide for clean up in case of a spill, do not sniff or taste any materials, use goggles during the entire lab, and keep materials away from the edge of the table).

Distribute the scales to each group or set up a station at which measurements can be made. Set all materials out at a supply table and include a scoop in each container. Put the 1 cup measuring cup scoop in the plaster of Paris powder, if used. Students need to consider all problems they may have with collecting measurement data and maintaining consistency with their measurements. Teach each group to "zero out" the scales so they can be certain their data is always as accurate as possible when using this measuring tool.

Have students take one scoop of each material and place it in a coffee filter paper to be measured on the scale. Students should measure one scoop of each material in a separate coffee filter paper each time. Instruct students to create a data table with a column for each material (sand, gravel, charcoal, filter, bowl, optional water and plaster, total) and a place to record the measurements of each in grams. When they have collected and measured each substance, have them pick up a disposable paper bowl and place the empty bowl on the scale to measure, also. Record this measurement on their chart.

Each group will then total the mass on the chart of all materials they have measured, including the bowl. Have each group combine all ingredients in the paper bowl and measure all again. Have students measure the mixture to see if the combined masses of each part of the mixture total the whole when combined.

At this time, offer 100 ml of water for each group to stir into the mixture they made *if* the plaster of Paris was used. Students must find the mass of the water so as to add the correct water measurement to the mixture data. Students need to stir until the plaster of Paris looks like mashed potatoes in consistency, add a small, measured amount of water if it is too thick. Let the mixture harden and measure the whole mass. (Bonus experience – Can they feel the heat when the plaster sets?)

The emphasis is on the measurement and the use of the scales. Since students are measuring several different types of materials, they will get more practice measuring and the teacher will have plenty of time to circulate and check their accuracy in measuring.

When all is mixed ask "Does the mixture, with the bowl, equal the same as all individual ingredients measured separately?" Point out that this is a type of *heterogeneous* mixture! This is

a mixture in which parts of the mixture are discernible – except for the water and plaster part, which is a *homogeneous* mixture!

If their measurements are way off, now is a good time to check HOW they measured. This is also the time to initiate a consistent means of reporting data, always labeled with the correct units of measure, and neatly recorded in a data table. The table should reflect that time and effort were used in its construction and the information recorded makes sense.

Check their materials handling skills, also. Can they carry a scale safely back to its storage place? Can they "zero out" a scale before they use that scale to collect data? Can they describe why it was important to measure the containers that held the materials that were added to the mixture?

Activity 3: Science Learning Logs That Swing! (SI GLEs: 5, 6, 7, 8, 12, 19, 25, 32, 36, 37; PS GLE: 19, 20)

Materials List: for each student**:** student-made science learning logs or marble notebooks to use throughout the year or semester, pencils, separate ½ page teacher-generated rubric to adhere inside front cover as a reminder to students of how these science learning logs are to be kept, several balls of string, 1 box small size paper clips, pennies or small metal washers (1 for every 2 students), stopwatches (1 for every 2 students, if possible) or class clock with second hand, 1 metric ruler or meter stick for each 2 students, several pair of scissors and several rolls of masking tape to be shared or one for each group, Learning Logs That Swing BLM setup illustration for each group

Generate a guide sheet or rubric that will provide consistency in the use of the science *learning logs*. Consider the following suggestions for the guide:

- always use pencil and date each page
- use descriptive language to document observations and avoid pronouns
- make certain all charts are neatly drawn and labeled
- always include units of measure for the numbers recorded
- whenever possible include predictions before the investigation
- include conclusions and summaries at the close of the investigation
- make sure the steps of any investigation are written so someone else may follow them

Provide a copy of these guidelines for each student to adhere to the inside cover of his or her log or notebook.

Review the use of the science *learning log* (view literacy strategy descriptions) for recording observations and data, making predictions, and tracking investigations. (The key is to get the students to record their observations and ideas, to write descriptions in detail, to build and fill charts, and to draw clear, understandable diagrams and illustrations.) Then distribute the remaining supplies.

This activity will be done in partner teams of two. Give each team a length of string about 50 cm, a paper clip, either a washer or penny, a stopwatch, and a meter stick or metric ruler. Provide the

Learning Logs That Swing BLM, if needed. To make the pendulums, have each team tie a paper clip to the end of their string, then measure from the end of the paper clip to 40 cm and make a loop in the other end of the string. They can use the tape to secure the loop at 40 cm. Extra string can be cut off, if desired. Have each team tape a pencil (eraser end out) to the edge of their desk and slip the loop over the pencil. Clip the penny or washer to the paper clip and a pendulum is ready for testing.

The teacher should include the students in a discussion about safety concerns for the investigation. Together, establish safety rules that should be observed throughout the lab. (e.g., Do not swing the pendulum around, make certain the pencil point is facing inward and the eraser is facing out, and stay in the assigned area to avoid disrupting the investigation of other groups.)

Have students set up their science *learning log* to record how many complete swings they count through the trials of their pendulums. They will release the pendulum, level with the table and count the number of complete swings (when the pendulum returns to the release point) in 15 seconds (dependent variable). Each trial is recorded and an average is calculated at the end of the trials. (Ask students to explain why an average is an appropriate data selection to use for this investigation.) Each partner team should record their averages on a class chart on the board or on large chart paper.

Once all averages are posted, students should consider the groupings of averages and decide what "variable" or change they could make to get different response. The independent or manipulated variables they could possibly change are string length, release position, and adding or removing mass on the end of the pendulum.

Have each team select a variable to change and record their thoughts on what effect the change will have on their results. Once they have recorded their plans, allow each team to construct a new pendulum or change the system they used before to run a new investigation. They should also run this investigation multiple times, and be able to explain why experiments must be verified through multiple investigations to be considered acceptable. To conclude the investigation, have students identify what forces are working on the pendulums as they move (friction, gravity) and draw a diagram in their log that illustrates these forces at work on the pendulum. Students should also be able to identify the dependent and independent variables.

Have the teams identify the independent variable that truly had an effect on the number of swings in 15 seconds (string length). Make sure they have used their science *learning log* to record predictions, data collections, conclusions, variables, etc. The information gathered here can be used later when they investigate motion and forces.

Activity 4: *Split Page Note-Taking* (SI GLEs: 7, 19)

Materials List: notebook, textbook, resources, pencils, rulers (if requested)

Sometimes teachers need to refer to the textbook to ensure students are getting adequate reading for information and note-taking skills. The teacher presents the material to be covered in the textbook with the *split-page notetaking* format (view literacy strategy descriptions).

This is done by drawing a straight line from top to bottom of a piece of paper (preferably a sheet of normal-sized, lined notebook paper) approximately 2 – 3 inches from the left edge. The page should be split into one-third/two-thirds. In the left column big ideas, key dates, names, etc. should be written and supporting information in the right column. Students should be urged to paraphrase and abbreviate as much as possible. The teacher shows students how they can prompt recall by bending the sheet so that information in the right or left columns is covered. The teacher can also get a quick idea of who is having difficulty harvesting pertinent information from their textbooks.

See example below for use of *split-page note taking* using the science textbook.

Atoms and the Particles That Are Involved (Science Textbook Notes)

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Parts of an atom→	-- nucleus -- electron cloud (shells)
Three kinds of particles→	-- neutrons, protons, electrons
Atomic number→	-- number of protons in the nucleus
Atomic mass→	-- total number of particles in the nucleus, protons + neutrons

Activity 5: Lab Rules and Safety Contracts (SI GLEs: 23, 33)

Materials List: one large piece of plain paper or chart paper for each group, markers, science learning logs, Safety Contract BLM (*Alter the contract as needed to fit needs of the classroom.*)

Now that the teacher has modeled how to plan for safety concerns and students have experienced hands-on labs and the use of science materials in their investigations, the teacher will lead

students in a class discussion of all safety concerns to be considered during these and all future investigations.

Have the students contribute to a class set of lab rules to identify general safety procedures for lab investigations. Each group will create a list and all lists will be combined to form the class list. Limit rules to 6 or 8 main concerns. Post the final set of safety rules. Have the students also copy the lab rules into their notebooks or science *learning logs* (view literacy strategy descriptions) for reference and reiteration. Send the safety contract home for parent and student signatures.

Now is also a good time to check class thermometers. Do not use any older, mercury-type thermometers in class investigations. If the school has any mercury thermometers, follow proper disposal procedures to remove them from the classroom immediately.

Activity 6: Cooperative Groups & the Power of Light (SI GLEs: 1, 2, 4, 7, 10, 11, 12, 19, 22, 23; PS GLEs: 33, 35)

Materials List: Provide one plastic tub for each group, labeled with the group name or number to hold all of the supply needs for each lab. Set up each tub with 3 small mirrors for each group (unbreakable, if possible, otherwise purchase inexpensive, framed mirrors), 3-4 clear plastic cups for each group, one flashlight with batteries for each group, transparent colored plastic report covers or colored cellophane to cut into about 4" X 4" squares (enough for two colors for each group), pencils, colored pencils or crayons, paper on which to draw a target shape

Set up the following at a supply table or counter: water source, pitchers, or jugs of plain water, 2 jugs of colored water (one red and one blue), jug of cloudy water (weak powdered milk solution, but do not keep after class has ended), materials for clean up (paper towels, old towel, etc.), and meter sticks.

Students will need science learning logs. Lab Role Cards (Use the Cooperative Groups BLM to run one set of cards for each of group, and one copy of The Power of Light Lab Instructions BLM for each student in the class

Introduce the Cooperative Groups and the responsibility of each role the day before the light investigation is to be done. See Cooperative Groups BLM. Make certain students know that roles with the word "manager" mean that this student must coordinate the jobs within the group, but not do all the work themselves. Other jobs are done within the function of group tasks and can be shared, if needed. Each time students do an investigation requiring set up, running the investigation, and clean up, they should do a different job. The group or the teacher may wish to keep a record of who has done which jobs to avoid arguments.

It is also advisable to review procedures for cleaning up a spill in the room. Encourage students to avoid spilling by being careful and following the class safety plan. Just in case there is a spill, plan for its immediate clean-up so students don't lose their focus and create a bigger disruption. Plan for disposal of the water used by each group.

Review safety concerns. By now students are experienced in identifying areas in which safety takes priority. Have them explain what safety issues must be in the action plan for all groups. Flashlights are a new addition to their experience base for investigations and they must agree not to shine them in the faces of other people.

Set up a central materials station with clear water, colored water, cloudy water, paper towels, clear plastic cups, and meter sticks. Have students take out their colored pencils or crayons, their science *learning logs* (view literacy strategy descriptions), and a pencil. Have them set up a page in their learning logs for this investigation.

This activity focuses on building cooperative group skills which are essential for a successful lab experience. The activity uses an exploration of reflecting and refracting light as the vehicle to train students to work cooperatively through (1) being responsible for a portion of the lab, (2) getting materials from a central supply station, (3) setting up, staying on track, working through an organized investigation, (4) recording their observations and data, (5) reporting their findings, and (6) cleaning up. (All done without making the teacher crazy!)

Distribute the Cooperative Group cards before the students enter the room, if possible. Otherwise, place a card face down at each student's seat in the group. They may only switch roles, if the teacher decides that it is necessary. If there are fewer students in the group than there are roles on cards, the primary roles that must be covered are Materials Manager, Clean-Up Manager, Reporter / Recorder, Project Manager, Time Keeper (in order of importance). Double-up jobs if there are three or four students instead of five and split the roles of recorder (oral report to the class) and reporter (turns in all written work or posts group results on the board) if there are six in a group.

Distribute a copy of the *Power of Light* lab instructions to each student to read. This is suggested for this first investigation so that all students get the feel for what they must do, what they will need, and what the reporting will involve. The teacher may choose to create his/her own lab instructions for future investigations and it is recommended each group be given two copies, one for the Project Manager and one for the Materials Manager. Identify one counter, a shelf, or a cabinet that can serve as the supply station for the year so students will always know where to return supplies.

Once all students have read their copy of the lab instructions, the Materials Manager may assign other group members to help gather the group supplies. The investigation does not begin for the group until all supplies are ready, all science *learning log* pages are set-up, and all investigation goals or plans have been noted in writing. The key to success is to make certain all students have a role and that they work within the time frame to accomplish the task. This is a simple self-guided lab and the results will be recorded in the science *learning logs* and reported to the whole group. The information acquired through this investigation can be connected to the study of light later in the year. Have students focus on a description of what occurred. Build time for discussion to provide an opportunity to identify the explanation for what the students observed. Can they discriminate the difference between description and explanation? Have them use diagrams where possible.

Investigation activities can include the following:

- Predictions should precede observations for all parts of this investigation.
- Viewing light as it passes through cloudy water. What happens to the light?
- Viewing light as it passes through colored water and then coloring the light with the cellophane or plastic folder material and shining it through the different waters.
- Viewing a pencil sticking out of a cup of clear water and drawing what they see when they look at the pencil above the water and then through the water.
- Once students have completed their investigations sending light through various medium, have them use the mirrors to send the light around the room (*not in someone's eyes!*).
- Have them hold the flashlight in one direction and place a target somewhere behind the light. Challenge them to use the mirrors to bounce the light from the source back to the target. The more mirrors involved the better!

After all light investigations are completed, students must return all materials to a designated area, clean up, dispose of disposables, re-set the supplies if needed for another class and be seated with their results. Closure at the end of class is also the key to making cooperative groups work for the students and the teacher. Make certain there is time to hear or visit results of the investigation and to commend groups for particular behaviors observed. If time runs short, give the commendations and do the reporting at the start of the next science class period.

Sample Assessments

General Guidelines

Assessment will be based on teacher observation/checklist notes of student participation in unit activities, the extent of successful accomplishment of tasks, and the degree of accuracy of oral and written descriptions/responses. Science learning log entries provide reflective assessment of class discussions and laboratory experiences. Performance-based assessment should be used to evaluate inquiry and laboratory skills. All student-generated work, such as drawings, data collection charts, models, etc., may be incorporated into a portfolio assessment system.

- Students should be monitored throughout the work on all activities.
- All student-developed products should be evaluated as the unit continues.
- When possible, students should assist in developing any rubrics that will be used, and provided the rubric during task directions.
- Students should contribute to the class safety rules.

General Assessments

- The students will use questioning to collect information and compare similarities and differences amongst their peers.
- The students will identify and describe the properties of various objects while classifying the objects into groups.

- The students will accurately measure different materials and create a mixture which will then be measured again for comparison.
- The students will investigate pendulum and assess which variable affects the number of swings in 15 seconds.
- The students will create and maintain a science *learning log* to document what they observe in the pendulum investigations and later investigations.
- The students will utilize split-page note taking to summarize important information from resources.
- The students can identify and name common safety concerns faced in the classroom.

Activity-Specific Assessments

- Activity 1: Students will identify, through effective questioning, similarities and differences among group members. They will classify objects according to visible attributes and record their observations, communicate the groupings, and evaluate through listing and listening which attributes are similar.

- Activity2: Students will correctly measure the mass of materials provided and identify how mass is affected when materials are combined.

- Activity 3: Students will observe the performance of a standard pendulum and construct a plan to alter the pendulum that will affect (increase or decrease) the number of swings the pendulum completes in 15 seconds. Students will identify all dependent and independent variables and evaluate the average and median number of swings in 15 seconds.

- Activity 6: Students will work cooperatively to execute the investigation and will correctly identify the direction light takes when it passes through a transparent source, a translucent source, and is reflected by a mirror.

Resources

- Classification activity on Teacher's Net.
  http://www.teachers.net/lessons/posts/1228.html

- Investigations and information regarding reflection and refraction of light
  http://www.uen.org/Lessonplan/preview.cgi?LPid=11556

- Promoting literacy
  Steenson, Cheryl 2006, Learning Logs In the Science Classroom, April/ May 2006, Science Scope