LESSON MODULE

MODULE TOPIC:
Scientific Measurement

RATIONALE:
- To collaborate on their work, scientists use a common system of measurement: SI Units (Système International d'unités), which is derived from the metric system.
- The scope of scientific endeavor encompasses both the very tiny and the very large, all of which must quantified.

STANDARD(S) & INDICATOR(S):
(Note: This section should include all standards listed in the lessons.)
5.1.8.B3. Collect, organize, and interpret the data that result from experiments.
5.3.4.A2. Recognize and comprehend the orders of magnitude associated with large and small physical quantities.
5.3.4.B2. Use a variety of measuring instruments and record measured quantities using the appropriate units.

OBJECTIVE(S):
(Note: This section should include all objectives listed in the lessons.)
Students will be able to:
- Describe how scientists worldwide use common units to understand each other's data and share information.
- Make measurements with the SI units.
- Describe how science requires measurements that range from extremely small to extremely large.

LIST OF LESSONS:
1. Learning SI Base Units and Prefixes
2. Using SI Units: Measurements Lab
3. Appreciation of Scale

BACKGROUND INFORMATION:
- Students will learn the SI system of measurement.
- They will learn to convert between US and SI units, and among SI units.
- They will also study the dimensions of various objects, both large and small, comparing and contrasting sizes.

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LESSON # 1
Learning SI Units

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STANDARD(S) & INDICATOR(S):
5.3.4.B2. Use a variety of measuring instruments and record measured quantities using the appropriate units.

OBJECTIVES: Students will be able to:
- Express quantities in SI base units, prefixes and abbreviations.
- Perform conversions among SI units and between SI units and US units

CLASSROOM ACTIVITY DESCRIPTION
(LABORATORY/EXERCISES/PROBLEMS) including detailed procedures:
Group work *20 minutes*
Students will work in pairs to learn the base units and prefixes, plus the abbreviations for each. They will quiz each other to reinforce their knowledge.

Class work *10 minutes*
Student volunteers will perform sample conversions on the chalkboard, which the class will copy down in their notebooks as they follow along.

Homework
Students will complete a conversions worksheet, which they will hand in the following class period.

Assessment
Worksheets will be graded. Students will also take a 10 point quiz.

STANDARD(S) & INDICATOR(S):
5.1.8.B3. Collect, organize, and interpret the data that result from experiments.
5.3.4.B2. Use a variety of measuring instruments and record measured quantities using the appropriate units.

OBJECTIVES: Students will be able to:
- Use scientific measurement equipment
- Record data using SI units
- Perform calculations with SI units

Lab *40 minutes*
Students will work with their lab partner to take and record measurements of volume, length and mass.

Materials and equipment
Per team: 1 50 ml beaker, 1 25 ml graduated cylinder, 3 test tubes of different sizes, 1 triple-beam balance, small quantity of sodium chloride, 1 meter stick, 1 wooden block, 1 small rock. Per class: one wall thermometer.

Procedure
Measuring Temperature: At some point during the lab, go to the wall thermometer, read the temperature and record it along with time on the board. At the end of the lab, copy down the class data and make a graph (time vs. temperature)

Measuring Length: Create a data table with length (cm), width (cm), height (cm) and volume (cm^3) as column headings, and trials 1, 2, 3 and average as row headings. Measure the dimensions of the wooden block, three times, calculate the averages, then calculate the volume of the block

Measuring Mass: Create a data table with 3 column headings: mass of beaker and NaCl (g), Mass of beaker (g), Mass of NaCl (g), and trials 1, 2, 3 and average as row headings. Place the beaker on the balance and measure its mass. Add the NaCl, record the total mass. Calculate the mass of the NaCl by subtracting the mass of the beaker from the total mass. Do this three times and calculate the average.

Measuring Volume: Create a data table with one column heading, Volume (ml), and tubes 1, 2, 3 and average as row headings. Fill each test tube with water, pour the water into the graduated cylinder and record the volume for each. Calculate the average.

Measuring Volume by Liquid Displacement: Create a data table with 3 column headings, total volume (ml), volume of water only (ml), volume of rock (ml); and trials 1, 2, 3 and average as row headings. Pour about 10 ml of water into the graduated cylinder and record the volume. Gently drop the small rock into the graduated cylinder without splashing any water out. Record the volume. Determine the volume of the rock by subtracting the volume of the water alone from the volume of the water and rock. Do this three times and calculate the average.

Assessment
Each team will write a lab report in the standard format, which will be due the following class period.

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LESSON # 3
Appreciation of Scale

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STANDARD(S) & INDICATOR(S):
5.1.8.B3. Collect, organize, and interpret the data that result from experiments.
5.3.4.A2. Recognize and comprehend the orders of magnitude associated with large and small physical quantities.
5.3.4.B2. Use a variety of measuring instruments and record measured quantities using the appropriate units.

OBJECTIVES: Students will be able to:
- Compare the sizes of very small to very large objects
- Create objects of varying sizes
- Compare the approximate sizes of common objects

Videos *15 minutes*

As a class, students will watch two short videos, one showing microscopic objects and their sizes, and the other on the relative distances between planets, stars and galaxies in the Universe. After the videos, students will break into small groups to discuss what they have seen, comparing the differences in scale among the various objects, and any new understandings they have gained. They will each record the important points in their notebooks.

Activities *25 minutes*

Materials: Chart paper, construction paper, scissors, meter sticks, tape, colored markers

Activity 1: Students will work in small groups with meter sticks, paper, scissors and tape to create two-dimensional objects with specific measurements and post them around the classroom, writing the dimensions of each on the object. Students will move around the room, recording the dimensions of each object in their notebooks as they observe its size.

Activity 2: Each group will take a piece of chart paper and head it with a size range of their choice, in a specific SI unit. They will then list one item that would fall within that size range and post their group's paper on the classroom wall. The groups will move around the room, from list to list, writing another item that they can think of for each size range. Each group will use a different colored marker. They will then discuss the lists as a class, noting whether the items appear to be listed in the correct size category.

Assessment *40 minutes*
Students will be tested on what they have learned in the entire module (three lessons), which will assess their knowledge of SI units, prefixes and abbreviations; the appropriate use for each type of unit; and their understanding of the relative scale of objects, both large and small. The test will include conversions between SI units and also between SI units and US units of measurement.

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