Name_____Ian Heck_____

CASE

Activity 4.3.4 Testing for Quality

Purpose

Many factors determine the health and quality of pond, stream, and lake water. The lives of aquatic plants and animals rely on the quality and stability of the water in which they live. Several simple tests can help determine the quality of water. These tests include temperature, pH, dissolved oxygen, turbidity, and total dissolved solids.

pH is used to identify the acidity of the water. If the pH is not within a specific range, it will not support plant and animal life. All living things are dependent upon oxygen to survive. Low dissolved oxygen levels in water may signify poor water quality. Turbidity and total dissolved solids are used to identify potential pollutants contaminating the water such as sediment and salts.

What is the quality of surface water in your area?

Materials

Per pair of students:

- LabQuest2
- Temperature sensor
- Optical dissolved oxygen sensor
- pH sensor
- Turbidity sensor
- Turbidity cuvette
- Conductivity sensor

Per student:

- Water source or sample
- Sampling bottle with lid
- Rinse bottle with distilled water
- Lens paper
- 3ml pipet
- Paper towels

Per student

- Pencil
- *Agriscience Notebook*

Procedure

You will work with a partner to collect data on a water sample as instructed by your teacher. If you are collecting data on-site, take care to avoid dropping the LabQuest2 and sensors in the water.

Part One – Temperature

1. Water temperature must be measured on site by either placing the sensor directly in the stream or by collecting a sample and immediately measuring its temperature.
    - If onsite testing is not possible, your teacher will provide you with temperature data.
2. Connect the temperature sensor to LabQuest2 and choose **New** from the *File* menu.
3. Set up the data-collection mode.
    - On the *Meter* screen, tap **Mode**. Change the data-collection mode to **Selected Events**.
    - Select **Average over 10 seconds** and select **OK**.
4. Collect temperature data.

- Start data collection.

- Place the tip of the temperature sensor directly into the stream at Site 1 (or into a cup containing a sample taken from Site 1). Submerge the sensor tip to a depth of about 10 cm and hold for 30 seconds.
- Tap **Keep** to begin sampling. **Important**: Leave the sensor tip submerged while data is being collected for 10 seconds.
- Tap **Keep** to take a second reading for this same sample. Leave the sensor tip submerged while data is being collected for 10 seconds.
- Stop data collection and tap **Table** to view the data. Record the temperature values in Table 1 on *Activity 4.3.4 Student Worksheet*.

5. Remove the temperature sensor from the LabQuest2.
6. Average temperature data by adding reading one and reading two together and dividing the total by two.

$$\text{Average} = \frac{\text{Reading One + Reading Two}}{2}$$

Part Two – Dissolved Oxygen (DO)

The unit milligrams per liter (mg/L) is the quantity of oxygen gas dissolved in one liter of water. When relating DO measurements to minimum levels required by aquatic organisms, mg/L is used. When discussing water quality of a stream or river, it can be helpful to use a different unit than mg/L. The term percent saturation is often used for water quality comparisons. Follow the steps below to determine the percent saturation for the sample provided.

1. Change units on the cable box to *%* to measure the percent saturation.
2. Connect the dissolved oxygen sensor to LabQuest2 and choose **New** from the *File* menu.
3. Set up the data-collection mode.
    - On the *Meter* screen, tap **Mode**. Change the data-collection mode to **Selected Events**.
    - Select **Average over 10 seconds** and select **OK**.
4. Collect dissolved oxygen concentration data.
    - Remove the storage cap from the sensor.
    - Start data collection.
    - Place the tip of the sensor into the stream at Site 1, or into a cup with sample water from the stream. Submerge the sensor so the metal dot on the side is submerged.
    - Wait for the live DO readings on the screen to stabilize.
    - Tap **Keep** to collect the first data pair. **Important:** Leave the sensor tip submerged while data is being collected for 10 seconds.
    - Repeat data collection by again tapping **Keep**. Leave the sensor tip submerged for the full 10 seconds, then stop data collection.
    - Tap **Table** to view the data. Record the averaged DO values for readings 1 and 2 in Column A of *Table 2 Dissolved Oxygen Calculations* on *Activity 4.3.4 Student Worksheet*.
7. Record percent saturation for the water in Table 1 on *Activity 4.3.4 Student Worksheet*.
8. Remove the dissolved oxygen sensor from the LabQuest2 and place the cap on the sensor.
9. Average dissolved oxygen data by adding reading one and reading two together and dividing the total by two.

$$\text{Average} = \frac{\text{Reading One + Reading Two}}{2}$$

Part Three – pH

The pH value of streams and lakes is usually between pH 7 and 8. Determine the pH level of the sample by following the steps below.

1. Connect the pH sensor to LabQuest2 and choose **New** from the *File* menu.
2. Set up the data-collection mode.
    - On the *Setup* screen, tap **Mode**. Change the data-collection mode to **Selected Events**.
    - Select **Average over 10 seconds** and select **OK**.
3. Collect pH data.
    - Start data collection.
    - Remove the pH sensor from the storage bottle.
    - Rinse the tip of the sensor thoroughly with the stream water.
    - Place the tip of the sensor into the stream at Site 1 or into a cup with sample water from the stream. Submerge the sensor tip in the stream or in a cup to a depth of 3–4 cm.
    - Tap **Keep** to begin sampling**. Important:** Leave the sensor tip submerged for the 10 seconds that data is being collected.
    - Tap **Keep** to take a second reading for this same sample. Leave the sensor tip submerged for the next 10 seconds.
    - Tap **Keep** and stop data collection.
    - Tap **Table** to view the data.
    - Record the pH values in Table 1 on *Activity 4.3.4 Student Worksheet*.
    - Rinse the sensor with distilled water and return it to the storage bottle when you have finished collecting data.
4. Remove the pH sensor from the LabQuest2.
5. Average pH data by adding reading one and reading two together and dividing the total by two. See formula above.

Part Four – Turbidity

Turbidity is measured in *Nephelometric Turbidity Units,* NTU. The turbidity of surface water is usually between 1 NTU and 50 NTU. Turbidity is often higher than this, especially after heavy rain when water levels are high. Water is visibly turbid at levels above 5 NTU. How clear is the water sample you are testing?

1. Collect approximately 100ml of stream water or use the sample provided by your teacher.
2. Connect the turbidity sensor to LabQuest2 and choose **New** from the *File* menu.
3. Set up the data-collection mode.
    - On the *Meter* screen, tap **Mode**. Change the data-collection mode to **Selected Events**.
    - Select **Average over 10 seconds** and select **OK**.
4. You are now ready to collect turbidity data.
    - Gently invert the sample water four times to mix any particles that may have settled to the bottom. **Important:** Do not shake the sample. Shaking will introduce tiny air bubbles that will affect turbidity.
    - Use the pipet to rinse the cuvette with sample water, then fill it with sample water so the bottom of the meniscus is even with the top of the white line.
    - Place the lid on the cuvette. Gently wipe the outside with lens paper.
    - Check the cuvette for air bubbles. If air bubbles are present, gently tap the bottom of the cuvette on a hard surface to dislodge them.

- Holding the cuvette by the lid, place it into the turbidity sensor. Make sure the mark on the cuvette is aligned with the mark on the turbidity sensor. Close the lid.

- Start data collection.
- After 10 seconds, tap **Keep**. **Important:** Do not disturb the sensor during the 10 second sampling period.

6. Repeat Step 4 with a second sample of water.
7. Stop data collection and tap **Table** to view the data. Record the values in Table 1 on *Activity 4.3.4 Student Worksheet* (round to the nearest 1 NTU).
8. Remove the turbidity sensor from the LabQuest2.
9. Average turbidity data by adding reading one and reading two together and dividing the total by two.

Part Five – Total Dissolved Solids

TDS values in lakes and streams are typically found to be in the range of 50 to 250 mg/L. In areas of especially hard water or high salinity, TDS values may be as high as 500 mg/L. Determine the TDS of the sample by following the steps below.

Set the selector switch on the side of the conductivity sensor to the 0–2000 µS/cm range. Connect the conductivity sensor to LabQuest2 and choose New from the File menu.

1. Set up the data-collection mode.
    - On the *Meter* screen, tap **Mode**. Change the data-collection mode to **Selected Events**.
    - Select **Average over 10 seconds** and select **OK**.
2. Collect TDS concentration data.
    - Place the tip of the electrode into a cup with sample water from the body of water you are testing. The hole near the tip of the sensor should be covered completely.
    - Start data collection.
    - When the reading has stabilized, tap **Keep** to begin sampling. **Important:** Leave the sensor tip submerged while data is being collected for the next 10 seconds.
    - Tap **Keep** to take a second reading for this same sample.
3. Stop data collection and tap **Table** to view the data. Record the TDS values in Table 1 on *Activity 4.3.4 Student Worksheet*.
4. Remove the conductivity sensor from the LabQuest2.
5. Average conductivity data by adding reading one and reading two together and dividing the total by two.
6. Use your data and presentation notes from *Understanding Water Quality* to answer the analysis questions on the student worksheet.

Conclusion

1. What types of tests can you use to determine the quality of water?

2. Why do you use multiple types of tests to measure water quality?

Source: Johnson, R.L., Holmquist, D.D., & Redding, K. (2007). *Water quality with Vernier*. Beaverton, OR: Vernier Software & Technology.

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Activity 4.3.4 Student Worksheet

Table 1. ***Data Table***

	Reading One	Reading Two	Average	Level of quality
Temperature	0.83	0.83	0.83	Good
Dissolved Oxygen*	1.6mg/L 11.27%	1.6mg/L 11.27%	1.6mg/L	Good
pH	6.73	6.75	6.74	Good
Turbidity	98.0	91.9	94.95	Good
Total Dissolved Solids	294.8	294.7	294.75	Good

Analysis Questions

- Study your results and describe how each factor tested can be used to indicate water quality.
  - Temperature – I could over eat the pound
  - Dissolved oxygen – With no oxygen the wish and other organism would not be able to die
  - pH –
  - Turbidity –
  - Total Dissolved Solids –
- Do you believe this water sample is from a high quality water source? Why or why not?