SECTION 4: Equipment, Chemistry-specific (cont'd)

F. Light Sensor/Probe

There are some differences in the light sensor/probe available through the various VRC. The TI Light Probe (as seen on the right) is a simple sensor that measures the illumination in a general area. Its application may be more appropriate for use in Physics experiment.

However, the Light Sensor (on the left) has greater accuracy and can be set to measure illumination in three different "lux" ranges.

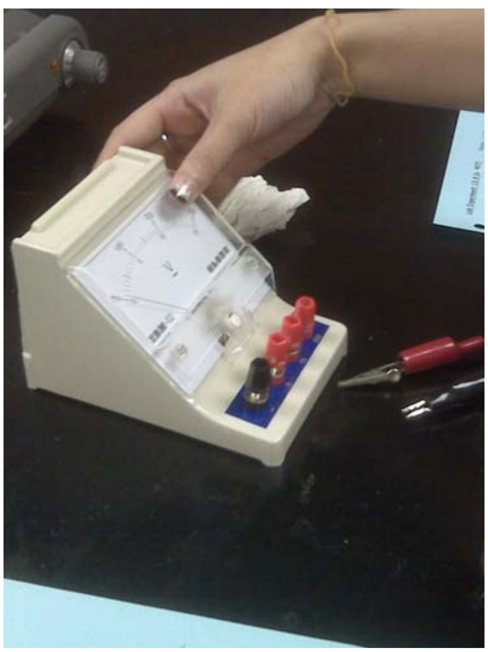
For chemistry experiments where a colour change is anticipated (due to a pH indicator) or a precipitate should form, the student who is blind or severely low vision will miss this visual clue. However, with this sensor immersed in the solution (encased in a test tube), the student can compare the lux data prior to adding a reagent to the lux data after adding.

When a colour change begins or a precipitate forms, the illumination data should significantly decrease. An additional task light may be required for optimal results in this type of experiment – refer to the sample lab on titration.

SECTION 4: Equipment, Chemistry-specific (cont'd)

G. Voltage Probe

This probe tests the voltage as it passes through various metals. In Chemistry, many experiments call for testing the voltage passing between two differing metals in various solutions. Of course, similar testing can be also done in the Physics classroom to compare the conductivity of differing metals. This probe can also be used in conjunction with circuit board testing (e.g. using the Vernier Circuit Board) when called for in the curriculum.



A traditional voltage tester, with a visually-readable display only

The Vernier voltage probe, connected to a laptop and used with a magnification program for the student to read the data

SECTION 4: Equipment, Chemistry-specific (cont'd)

H. Conductivity Probe

This probe measures the capability of a solution to conduct electricity. As previously cited, when connected to the LoggerPro software on a computer or laptop with a magnification program or the JAWS text-to-speech program, students with visual impairments can use this probe independently.

Compare this to the light-bulb conductivity test used in Chemistry – where the two parallel leads are lowered into solution and the light bulb (powered by a 110-volt outlet) illuminates brighter or dimmer depending on the solution's conductivity. The student who is blind cannot participate, and a student who is photophobic would have difficulty observing the qualitative differences between solution illuminations. There is also a potential shock-hazard with the traditional light-bulb conductivity test as a student with a visual impairment may inadvertently grasp the parallel leads. None of these occur with the use of the conductivity probe and computer peripherals.

J. Salinity Sensor

Similar to the probe above, this sensor measures the amount of salinity within a solution. As previously cited, when connected to the LoggerPro software on a computer or laptop with a magnification program or the JAWS text-to-speech program, students with visual impairments can use this sensor independently.

SECTION 5: Equipment, Biology-specific

A. Dissolved Oxygen Probe

This probe measures the concentration of dissolved oxygen in water as well as the changes in dissolved oxygen concentration resulting from photosynthesis and respiration in aquatic plants. It is useful for an accurate on-site test of dissolved oxygen concentration in a stream or lake survey.

Regarding portability, it is recommended for field studies to bring either a laptop computer with LoggerPro software, or remote collection of data using the interface powered by AA batteries. Refer to documentation in the LoggerPro help menu, or refer to the appendix on “Using LabPro Remotely”.

SECTION 5: Equipment, Biology-specific (cont'd)

B. Blood-pressure Sensor

This set of equipment measures and records diastolic, systolic and beats-per-minute using the LoggerPro software. Once the data collection begins (with the press of the spacebar), it automatically releases cuff pressure. Each piece of data can be read aloud after collection, or viewed in chart form, or printed off as a graph.

Again, through the use of magnification software or the JAWS text-to-speech program, the data collected is rendered completely accessible to the student who is blind or has low vision.

SECTION 5: Equipment, Biology-specific (cont'd)

C. Respiration Monitor

Along with the Gas Pressure Monitor, this chest belt measures the volume of lung capacity during breathing. In conjunction with the data collection vest and LoggerPro interface powered by batteries, one could collect respiration data during different physical activities.

SECTION 5: Equipment, Biology-specific (cont'd)

D. Heart Rate Receiver with Chest Belt

This device does not require the data vest or remote data collection mode of the LoggerPro interface – it measures the wearer's heart rate wirelessly, and he/she can be fully active while monitored!

SECTION 5: Equipment, Biology-specific (cont'd)

E. Digital Microscopes

Pictured above is the Boreal2 HM series of digital microscopes which connects via USB to a computer using the Motic software program. With the software, the student with low vision – who may have difficult viewing the magnified image using the eyepiece – can manipulate, enlarge and/or save the slide image on the computer screen. There are several brands and models of digital microscope capable of the above features.

Although not appropriate for use by a student who is blind, the saved image from the microscope image can be manipulated (in this example, by using the Motic software) to isolate just the outline of the image – which then can be printed off, reproduced on special thermal-reactive paper, and rendered as an embossed tactile image for the student who is blind to view.

Screen capture of the Motic software and the image seen under the microscope

SECTION 6: Equipment, Physics-specific

A. 3-Axis Accelerometer

The 3-Axis Accelerometer is useful for data collection of acceleration along one, two and/or three directions of movement. Using the data vest and the interface independent of a computer (powered by four AA batteries), the accelerometer can easily do remote data collection – on a roller coaster, for instance. It can also be used in the lab interfaced to the computer software as the cabling provided is extra long.

Be sure to follow the calibration instructions in the appendix prior to conducting experiments with the accelerometer.

SECTION 6: Equipment, Physics-specific (cont'd)

B. Sound Level Meter

This device can be used with or without the interface to the computer – for the data to be accessible to a student who is blind, it does require connection to the LoggerPro software via the interface. However, if the LCD display is large enough, a student with low vision could use it independently as a stand-alone unit. Recordings are measured in decibels (dB).

C. Motion Detector

The Motion Detector can detect movement from to 15 cm (6 inches) to 6 metres (20 feet). It uses ultrasound to measure the position of carts, balls, people, and other objects in motion.

SECTION 6: Equipment, Physics-specific (cont'd)

D. Dual-range Force Sensor

A number of Physics experiments require measuring the amount of force (typically in Newtons) to move an object. However, most spring scales are not easily marked with braille for students who are blind. The dual-range force sensor can measure both push and pull forces. Held vertical, it can be used as a spring scale, whereas mounted horizontal it can be used to study cart collisions. Again, the data results are rendered accessible through the LoggerPro software and either the JAWS text-to-speech program or magnification software.

SECTION 6: Equipment, Physics-specific (cont'd)

E. Photogates

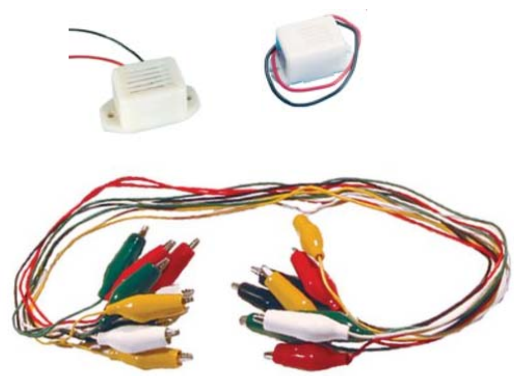
The type of Physics experiment will determine which configuration of photogate is used. Pictured above left, tandem gates at a set distance connected in succession can measure the start and end points of a small moving object, and thereby its velocity. The setup at above right can either use bar tape (and the tape guide attached to one photogate) to measure acceleration of horizontally moving object, or by using the picket fence measure vertical acceleration due to gravity.

Similar to the first configuration described, tandem photogates can also be used to measure the velocity of larger moving objects with the use of the laser pointers and stands.

Again, as these are connected via the interface to the LoggerPro software, a student with visual impairment can be independent in data collection and analysis if using either magnification software or the JAWS text-to-speech program.

SECTION 6: Equipment, Physics-specific (cont'd)

F. Circuit Board



The Vernier circuit board is designed to explore resistors and capacitors in a simple layout; by swapping out the light bulbs for various low voltage buzzers, the student who is blind can explore the same concepts as sighted peers.

SECTION 7: Sample Labs – Grade 7 (Biology / Botany)

Checking the pH

Adapted from *Science Focus 7* - Unit 1 p. 52

~ This lab has been adapted for students who are **blind** or who have **low vision** ~

Lab Objectives	By the end of this lab the students will be able to: - Use a pH sensor to determine the pH levels of various samples of water - Compare the pH readings and determine which samples are basic, acidic or neutral - Use these findings to develop a theory on whether or not the water samples in the area have been affected by acid rain
Safety Precautions	Wash your hands after working with soil
Additional Notes	Rain is naturally acidic because of CO_2 that dissolves in the water to form Carbonic Acid. The degree to which rain or water has been affected by "extra" CO_2 from additional greenhouse gases (including the NO_4 and SO_4 which also will lower pH) is virtually impossible to determine, especially at this grade level
Standard Materials	• Samples of rainwater collected from various areas • Samples of water from water systems in your area • A sample of tap water • A collection of small beakers in which to collect the water samples
Additional Equipment (i.e. adapted or specialized for accessibility)	• A **laptop** with the LoggerPro software & LabPro interface; laptop software should include either a magnification program (such as ZoomText, for students with low vision), or the JAWS software & JAWS/LoggerPro scripts • Vernier **pH sensor** – please ensure that the pH sensor is stored in its solution & in an upright position when not in use; be advised to calibrate the pH sensor before use (refer to pH calibration instructions in the APPENDIX)
Procedure	**1.** Collect water samples from different sources in your area (puddles, streams or nearby sloughs, or melted snow). **2.** Place the pH sensor into the sample. Listen as the software announces the results. Have the software record the pH of the sample. **3.** Repeat the procedure for each sample of water that you have. **4.** Clean your work area if necessary, and wash your hands after this activity. **Place the specialized equipment/software on one cafeteria tray to isolate from potential liquid spills; for students with low vision, select the tray providing him/her with the best contrast.
Assessment	Analyze **1.** Were your samples acidic, basic, or neutral? **2.** How does the pH of the tap water compare with the pH of the samples you collected? **3.** Based on your results, do you feel the water in your area has been affected by acid rain?

SECTION 7: Sample Labs – Grade 7 (Biology / Botany)

Growing Conditions for Healthy Plants

Plants growing in natural conditions are well suited to their environment and the amount of light, heat, and water they naturally receive. Plants grown by people, however, are often helped a bit so that the health and yield of the plants (how much is harvested) is maximized.

Adapted from *Science Focus 7* - Unit 2, p. 102

~ This lab has been adapted for students who are **blind** or who have **low vision** ~

Lab Objectives	In this lab, the students will attempt to grow the healthiest plants possible by varying the light, temperature, and water that the plants receive. By the end of this lab the students will be able to: - Design an experiment that allows them to determine the impact of certain variables by holding two of those variables constant and measuring the other. - Determine which combination of light, temperature and water would result in the growth of the healthiest plant
Safety Precautions	Wash your hands after working with soil
Standard Equipment	• A thumbtack ruler • A graduated cylinder • A thermometer • Plant grow lights (optional) • A space heater (optional) • Seeds sprouted between layers of moist paper towel • Paper cups, or small peat pots • Potting soil or garden soil • Water
Additional Equipment (i.e. adapted or specialized for accessibility)	• A **laptop** with the LoggerPro software & LabPro interface; laptop software should include either a magnification program (such as ZoomText, for students with low vision), or the JAWS software & JAWS/LoggerPro scripts • Ohaus **Scout Pro scale** with USB interface • Vernier stainless steel **temperature probe** • An **auto-pipette** (e.g. Rainin AutoRep M) • A **braille** and/or a **large print ruler** • Oversized **cafeteria tray** (white and/or black)
Procedure	• Each student will be given nine sprouted seeds from one type of plant. The students are to divide the seeds into three groups and plant them at the same depth in the same type of soil and in the same type of container. Use a peat pot or a paper cup with holes poked in the bottom (use a thumbtack) • The students will then design an experiment that shows how the amount of light, temperature, and water affects plant growth • Instruct the students that they may change only one variable for each group of plants. (For example, if you are varying the amount of light, the temperature and water should stay the same) • The students will review the design of their experiment with the teacher

	• The students will design appropriate graphs and tables for recording their data • The students will then measure and graph the growth of their plants daily for a week or more • They will record the temperature, amount of water, and approximate amount of light daily. ** Place the specialized equipment/software on one cafeteria tray to isolate from potential liquid spills; for students with low vision, select the tray providing him/her with the best contrast. Have the student use the temperature probe to record the temperature data. They can also use the auto-pipette to measure water amounts and the braille ruler to measure any growth. This student may require additional information as to how much the light the plant is receiving or you have the option of using the light sensor probe with the software as well. (Note: The LoggerPro software can also be used to construct any of the desired graphs.)
Assessment	Analyze **1.** Why was it important that all of your seeds were planted at the same depth, in the same soil, and in the same type of container? **2.** Why was it was important to begin your experiment with sprouted seeds? **3.** Which combination of light, temperature, and water would result in the healthiest plant? **4.** Is a healthy plant always the tallest plant? **5.** Describe and ~~draw~~ the condition of a healthy plant. ** The student with a visual impairment would only describe the plant **6.** What other factors might have affected the growth of your plant other than those tested?

SECTION 8: Sample Labs – Grade 8 (Physics)

<table>
<tr><td colspan="2"><h1>Light Reflection</h1>Adapted from Science in Action 8: Unit C, p.192</td></tr>
<tr><td colspan="2">~ This lab has been adapted for students who are blind or who have low vision ~</td></tr>
<tr><td>Lab Objectives</td><td>By the end of this lab the students will be able to determine what material is the best reflector of light</td></tr>
<tr><td>Safety Precautions</td><td>Heat from the light source could cause burns</td></tr>
<tr><td>Standard Equipment</td><td>Light source
Large selection of sample materials such as coloured construction paper, wax paper, cloth, pieces of wood, tin foil, glass, and plastic</td></tr>
<tr><td>Additional Equipment
(i.e. adapted or specialized for accessibility)</td><td>A laptop with the LoggerPro software & LabPro interface; laptop software should include either a magnification program (such as ZoomText, for students with low vision), or the JAWS software & JAWS/LoggerPro scripts
Oversized cafeteria tray (preferably black to not interfere with the reflectivity of the experiment)
Vernier TI light probe
Large print and/or braille ruler</td></tr>
<tr><td>Procedure</td><td>Question and Prediction: What material is the best reflector of light? Based on this question and the materials you have collected, form a hypothesis for this investigation.

Procedure
Organize the materials you have chosen to test for reflectivity.
Predict which materials you think will reflect the best and which the worst. (In step 3, you will shine the light source onto the materials and make a qualitative measure of reflectivity. This type of measure is one in which you decide on characteristics and attributes. For example, you may choose to rank the materials against each other from “least reflective” to “most reflective.” In step 4, you will use a light meter to obtain a quantitative measure of reflectivity. This type of measure determines an amount using numbers and units.)
Collecting Data:<ol start="3">
Hold the light source 15 cm away and shine it directly onto one of your chosen materials. Looking from behind and to the side of the light source, observe how much the light reflects from the material. In a table, record the reflectivity of the material. Repeat for the other materials. Make sure that the distance between the object and the meter stays the same.
Next, aim the light meter at the material so that it receives the reflected light. Hold the meter just to the side of the light source, so no light from the source strikes the meter directly. In a table, record the meter reading. Repeat for the other materials.
**Place the specialized equipment/software on one tray to keep equipment in one definable area. Although is best for students with low vision to select the colour that provides him/her with the best contrast, a white tray may give off additional glare in this experiment and impede results.</td></tr>
</table>

	Have the student work within a group for step three. The other students can describe what is happening and allow the student who is blind or who has low vision to make their own predictions based on their descriptions. For step 4, the student with the visual impairment can use the light sensor paired with the LoggerPro interface in order to read the light reflections accurately. The software is capable of recording this data for each of the different materials.
Assessment	Analyzing and Interpreting 1. Decide on the best way to present your findings. For example, you might generate a list, or use a bar graph, or create a computer spreadsheet. 2. Which materials reflected the best? Did this agree with your prediction? Why or why not? 3. Which materials reflected the worst? Did this agree with your prediction? Why or why not? 4. Were there any instances where your qualitative results did not match your quantitative measures? If there were discrepancies, explain. Forming Conclusions 5. Write a summary sentence or two that answers the questions: "What material is the best reflector of light?" and "What properties of a material would make an ideal reflector?" **The LoggerPro software is capable of generating a graph for the data.

Pond Water Safari

In this investigation, you will observe and draw various micro-organisms found in pond water. Some of these tiny organisms are like animals, some are like plants. They move and feed in different ways. You will record which characteristics of living organisms you observe in unicellular organisms. You will probably also see small organisms made of more than one cell in the pond water you observe.

Adapted from *Science Focus 8:* Unit 2, p.116-117

A suggestion for teaching cellular structure to students who are **blind**:

- Use raised line diagrams from the textbook provided by the Learning Resource Centre (LRC)
- Better yet, have the students create their own diagram (perhaps using a Sewell Raised Line Drawing Kit, also available at the LRC), or see next suggestion

Here are some ideas from the *Texas School for the Blind* (www.tsbvi.edu):

- Use posterboard, large, maybe 2x3 ft or so
- Use glue gun to make the cell membrane- a thick circle almost as large as the posterboard
- Make labels, both in print and in braille labels
- For a more complex diagram, use different tactile objects to represent the cell organelles (nucleus, etc.) and hot-glue each item to poster.

Please note that for the lab below, the microscope images can be saved to the computer software and manipulated as simple line drawing, which then can be rendered as tactile drawings when printed onto microcapsule paper and thermally treated to emboss

~ This lab has been adapted for students who have **low vision** ~

Lab Objectives	By the end of this lab the students will be able to determine how cellular organisms meet their basic needs
Safety Precautions	Be careful when using sharp objects such as tweezers; dispose of materials according to your teacher's instructions.
Standard Equipment	• Microscope, microscope slides, cover slips • Medicine dropper, tweezers • Pond water • Cotton fabric
Adapted or Specialized Equipment	• A **laptop** with the Motic 2.0 software and possibly a magnification program (such as ZoomText, for students with low vision) • Boreal2 **USB microscope**
Procedure	• Obtain a sample of pond water from your teacher. Using a medicine dropper, place a drop of the pond water in the centre of a clean microscope slide • Pull two or three cotton fibres from the cotton fabric and place them on the water drop • Place a cover slip on the sample. • Examine the slide under low power, looking for different unicellular organisms. (a) Draw several different organisms, putting in as much detail as you can observe. Try to identify the organisms from the photographs in Figure 2.5 on page 115.

	(b) Record which characteristics of living organisms you observe in unicellular pond organisms. (c) Wash your hands after this investigation. **The student with low vision will do this procedure using the USB microscope connected to the laptop. If necessary, this student can be paired with a student who is sighted in order to assist them with the delicate work of preparing the slide(s). Keep in mind however, that lab partners should each assume their share of the responsibilities. Afterwards, the student with low vision can use whatever methods they usually do in order to draw the organisms (CCTV, thick black marker, etc.)
Assessment	Analyze 1. Suggest why you were asked to add cotton fibres to the water drop. 2. Describe what evidence you saw that shows unicellular organisms are able to feed. Recall that organisms may feed by ingestion — taking in substances, or by photosynthesis — producing food themselves (using energy from sunlight). *Conclude and Apply* 3. What methods of movement did you observe? 4. Describe any evidence of growth or reproduction you saw. 5. Do unicellular organisms respond to stimuli (changes in their environment)? Explain. Extend Your Knowledge 6. If you also observed multicellular organisms, describe how they differ in general from unicellular organisms. How are they similar to unicellular organisms? Extend Your Skills 7. Keep a sample of pond water in a safe place exposed to sunlight for about a week before returning it to the pond. Use a microscope to observe the microscopic life in the water every day or two. Record any changes you see. Suggest an explanation for these changes.