Making Science Accessible: Strategies and Tools Used to Teach Students with Visual Impairments

Patrick Van Geem, TVI
Assistive Technology Consultant
Outreach Department
512-206-9464
vangeemp@tsbvi.edu

Developed for
Texas School for the Blind & Visually Impaired
Outreach Programs
Contents

SETT ..............................................................................................................................................1
Student ...........................................................................................................................................2
Environment ......................................................................................................................................4
Tasks ................................................................................................................................................5
Tools ................................................................................................................................................8
American Printing House for the Blind (APH) Low Tech Solutions ..............................................10
Computer Generated Tactile Graphics ..........................................................................................19
Stand-Alone Software Applications for Tactile Graphic Production ...........................................23
Other Accessible Science Resources .............................................................................................25
High Tech Solutions for Accessible Science Laboratories ..........................................................29
Accessible Science Website Resources ........................................................................................37
Making Science Accessible: Strategies and Tools Used to Teach Students with Visual Impairments
Patrick Van Geem, TVI / Assistive Technology Consultant
Outreach Department

SETT

Pedagogical research has shown that all students learn scientific and abstract concepts best when they are active participants, and students who are visually impaired are no exception.

Evaluating a science classroom and laboratory environment for a student with a visual impairment has to include an assessment protocol that includes SETT.

- Student
- Environment
- Tasks
- Tools

**According to Joy Zabala, when the needs, abilities, and interests of the Student, the details of the Environments, and the specific Tasks required of students in those environments are fully explored, teams are able to consider what needs to be included in a system of tools that is Student-centered, Environmentally useful, and Tasks-focused.

**Using the SETT Framework to Level the Learning Field for Students with Disabilities
Joy Smiley Zabala, Ed. D., ATP
Student
Observing the student is the most important component when evaluating needs. We talk to other professionals, read reports, examine IEP paperwork, and talk to others that might know the student, but until we observe the student in the classroom environment followed by an interview of his concerns, we will not get the full story of how we can help him be successful within the instructional environment he has to access.

Profile Information
What does the student need to be able to do that is difficult or impossible to do independently? We need to know information that could factor in making a science classroom a successful environment for the student.

- Etiology (acuity, medical, other health impairments, motor,…)
- Social/Emotional
- Motivation/Independent Learning (homework, class assignments)
- Self-advocacy (asking for help, explaining vision etiology)
- Organization/Management (keep lots of paper organized, lab space, classroom desk, equipment upkeep and storage, textbook storage area).
- Cognitive Load
  - Formatting structure of the content (accessibility)
  - Knowledge base of content (science, lab, prerequisite content)
  - Knowledge of the assistive technology used to access the instructional materials

Behavior in the Instructional Environment
- Learning Science Skill Set (varies according to activities)
- Social Skills (age-appropriate, friends, conversation, teacher aide intervention)
- Using equipment (safety)
- Peer Interaction (able to work in a collaborative lab/class activity)

What does all this mean for a student with a visual impairment?
- Science Concepts (complexity)
- Importance of Experiences (needs to learn and have access to hands-on experiences)
- Science Skills & Vocabulary (mass-practice)
- Motor Skills (able to handle science lab equipment)
- Impact of Specific Visual Impairment (adaptation and accommodations)
- Able to handle equipment
- Able to listen and take verbal instruction (listening comprehension)
- Able to accept hand-under-hand demonstration and instruction
- Teacher(s) verbal description and instruction ("it's over there")
Impact of Specific Visual Impairment

- Ability to Access Information
- Literacy Skills
- Expanded Core Skills

Advance Preparation Checklist: Observable Skills and Behaviors

The Advance Preparation Checklist is a listing of skill sets a student with a visual impairment needs to have when participating in a science lab. This checklist is included in the APH book, “Adapting Science for Students with Visual Impairments; A Handbook for the Classroom Teacher and Teacher of the Visually Impaired.”

- Behaviors Particular to the Student (eye poking, rocking, bringing close to eyes)
- Familiarization with experimental procedure(s) (Reading through experiment protocols)
- Organizational tray for devices and lab ware (Sorting equipment and using trays)
- Lab ware and stabilizing equipment (clamps, containers, stands)
- Lighting Considerations (florescent, stand lamps, natural)
- Location of Safety Equipment and Supplies (aprons, gloves, fire alarms, goggles)
- Magnification Devices (Video Magnifiers, hand held magnifiers, microscopes)
- Room/laboratory Orientation (desks/tables, chemical storage, exits, receptacles, safety equipment)
- Clean-up Considerations (waste disposal, latex gloves, chemical, glass/plastics)

Interview the Student

- Let the student do most of the talking.
- Parents and teachers are not present.
- Ask what is used now.
- Ask for suggestions how he can access assignments.
- Determine needs from wants.
- Keep to science-specific issues.
Environment

It makes sense that evaluation has to take place in the customary natural environment where the student’s needs are met. Environment issues are also about information related to anyone (teachers, students, related support) who is around the student or anything (instructional materials) that is provided to the student.

Physical Environment

- Lab and the Classroom
- Lab as the Classroom
- Tables used as desks (Lab is the classroom)
- Storage (braille textbooks/equipment)
- Assistive Technology
  - Electrical outlets
  - Large/small
  - Laptop/note taking devices

Classroom Teachers

- Expectations and Attitude (how invested is the classroom teacher of her students?)
- Organized (All teachers)
- Compensatory skills (TVI, O&M)
- Collaboration (All Teachers)
- Lesson Planning (Science Teacher)
- Classroom Support (Para-professionals assistance and intervention)
- Classroom Management (Science Teacher)

Role of the TVI

- Planning/Collaboration
- Pre-Teaching Skills
- Adapting/Modifying
- Advising Para-professionals working with the student
Instructional Environment

- Equipment (unique to science lab that does not generalize to other classes)
- Multimedia
- Tasks/Activities
- Method of instruction (traditional, collaborative group study, flipped)

Instructional Demands

- Vocabulary (defining terms used in today’s lesson)
- Background (information about the lesson or concept)
- Purpose (reason(s) for the experiment)
- Materials (things needed to complete a task)
- Procedure (step-by-step process to reach a conclusion)
- Questions/Conclusions (analysis of the results or findings)

Instructional Materials

- TEK’s /Common Core/Local ISD curriculum
- Laboratory Set Up
- Science Laboratory Equipment
- Enrichment Instruction (multimedia)
- Classroom/Lab Instructional Materials

Tasks

Tasks are usually group activities, assignments, or individual studies required of a student in the classroom or laboratory. In the sciences, task are imposed interactive demands resulting from worksheets, laboratory experiment and activities, homework assignments, and exams.

Tasks Needed in General Education Science

- Form questions about the natural world
- Devise hypotheses that address those questions, including predictions
- Design experiments to support or refute hypotheses
- Gather data using appropriate devices and measurements
- Interpret data and form conclusions
- Suggest alternative hypotheses to explain data
- Relate data and information to current and new models
- Communicate scientific information
Tasks Needed in the Lab

- Use tools for understanding the natural world
- Identify formation of new substances
- Measure and compare substances
- Compare between elements and compounds
- Practice safety in laboratories or in field
- Build models to illustrate concepts, ideas, or objects
- Collect and record data
- Analyze information

Advance Preparation Checklist: Tasks Skills Set

Figure 2: Adopting Science Document: Advance Preparations Check List, Front Cover Page where student name is entered.

- Dissection (identification and magnification)
- Force (definition, measuring)
- Length (definition, measuring)
- Liquid Measurement (Pouring, measuring, meniscus)
- Making Solution (stirring, measuring, safety)
- Mass (defining, measuring)
- Microscopy (care, preparing, understanding parts, searching)
- pH (defining, measuring, testing, analyzing)
- Temperature (defining, performing)
- Time (measuring, reading)
- Unit of Measurement (comparing, measuring, defining)
- Volume (defining, performing, analyzing)
- Weight (defining, performing)
Making Science Accessible

Figure 3: Front Binder Cover of the Making Science Accessible Book

Perkins Products@Perkins.org
- Adaptive Equipment
- Science as Inquiry
- Structure and Properties
- Motion and Force
- Energy and Matter
$24.95 (from the Perkins Product Website)

Adapting Science for Students with Visual Impairments

Figure 4: Front Cover of the Book: Adopting Science for Students with Visual Impairments

- VI Background information
- Adapting equipment
- Constructing tactile models
- Collecting data
- Reporting data
$31.00 (APH Quota Fund)
Tools
According to Joy Zabala, tools include devices, services, training, accommodations, modifications; everything that is needed to help the student succeed. Some tool can address specific needs of the student (note taking devices, braille, voice output software) while other tools can address issues in the instructional environment (microscopes, magnifiers, measuring tools).

Laboratory Equipment Used
According to Science 6-8 Grade Texas Essential Knowledge and Skills (TEKS)

- calculators
- computers
- timing devices
- chemical splash goggles
- aprons
- gloves
- pH probes
- collecting nets
- insect traps
- globes

Laboratory Equipment Used
According to Science 6-8 Grade Texas Essential Knowledge and Skills (TEKS)

- journals/notebooks
- beakers
- Petri dishes
- meter sticks
- graduated cylinders
- hot plates
- test tubes
- triple beam balance
- microscopes
- thermometers
Mainstream Equipment Adaptations

Some equipment used in the science lab can be adapted, instead of having to buy some fancy “specialized” equipment. Here are some methods mainstream equipment can be adapted.

- Puff paint: to indicate measuring point
- Push pins: as stopper points on a syringe
- Braille Labels: on various pieces of equipment, chemical and storage facilities
- Voice Output Devices: alarms timers, calculators
- Drilled holes in beakers and graduated cylinders: to indicate maximum fill point
- Cardboard or paper models: plant study, cells, or geologic models, etc….

Adapted Beakers and Syringe

Adapted Beakers

Figure 5: Two Pictures: Adapted Beaker is displaying a Spillover Indicator and an adapted syringe is displaying a stopper indicator.

Braille Thermometer and Geologic Model

Figure 6: Two Pictures: Braille Temperature indicator is showing braille indicators and a geologic model is showing two sheets of paper coming out of a slot on top of the box. One sheet is going right and the other is going left to simulate sea floor spreading.
American Printing House for the Blind (APH) Low Tech Solutions

Braille and Large Print Rulers

Figure 7: Two rulers are displayed: One is a 18” white soft plastic ruler and the other is a black hard plastic 12” ruler.

1-Foot Braille Rulers
Metric-English 1-03100-00  $11.00
English 1-03070-00  $11.00

- Raised lines
- Braille number every 2 cm or 1/4 inch

Meter stick 1-03000-00
$25.00

- Plastic
- Drilled for hanging
- Raised lines every cm
- Braille every other cm

Braille/Large Print Yardstick 1-03002-00
$20.00

- White plastic
- Drilled for hanging
- Raised-line marking along one edge in 1/4” increments
- Braille marker every inch
- Large print in 1/4 inch increments
Sense of Science - Plants

Figure 8: A picture that is displaying all components in the Sense of Science-Plants kit.

Catalog Order Number 1-08980-00
$195
- It contains raised-line plastic overlays.
- A light box is included or it can be used as a stand-alone product.
- It contains large print and braille text.
- The instructional approach is multi-sensory.
- It can be used for late elementary students (4-6th grades).

Sense of Science - Animals

Figure 9: A picture that is showing all components in the Sense of Science-Animals kit. A light box is also included.

Catalog Order Number: 1-08990-00
$325.00
- This is a hands-on series.
- Use a step-by-step instructional procedure.
- Materials are visual adapted.
- It uses a math and language connective instruction approach.
- A light box is included.
- Raised-lined hard plastic overlays are included.
- It can be used as stand-alone instruction or with a light box.
Life Science Tactile Graphics

Figure 10: The Life Science Book is open to a page showing a tactile display of virus relocation.

Catalog Number: 1-08840-00
$240.00

- Materials contain raised-line tactile graphics.
- Materials depict organisms and science concepts.
- It geared for middle and high school general education placement.
- The book contains 56 graphics (Cell, Mitosis).
- Some examples include
  - Water Molecules
  - Botany
  - Some Anatomy
Basic Tactile Anatomy Atlas

Figure 11: The Basic Tactile Atlas is open to a tactile graphic of a skeleton with a student's hands on the page reading the content.

Catalog Order Number: 1-08845-00
$149.00
- The kit includes a two volume set.
- It contains thermoformed tactile graphics.
- Braille and print labels are included.
- Each example contains a brief braille description.
- Instruction is geared for students age 12 and up.

Azer's Interactive Periodic Table Study Set

Figure 12: The Azer's Periodic Table is displayed with all components showing.

Catalog Order Number: 1-08856-00
$355.00
- It consists of interactive components
- Braille and large print guidebooks are available.
- The kit contains all atomic elements.
- It is a very comprehensive hands-on approach to learning the periodic table.
Mini Lite Box

![Mini Lite Box](image)

Figure 13: The photo is displaying a mini lite box.

Catalog Order Number: 1-08661-00
$135.00

- It is small and lighter than the regular size light box.
- It can be easily placed on a student's desk.
- It comes with a nylon case (optional).
- The transparent color overlays are optional.

Quick Draw Paper

![Quick Draw Paper](image)

Figure 14: Photo displays the Quick-Draw paper and pens.

Catalog Order Number: 1-04960-00  $32.00

- It can be used for art projects, O & M skills trainings, diagramming and other educational use.
- Swelling of the lines (embossed) is produced by drawing on the paper surface with a water-based marker.
- It includes 10 8.5 x 11” drawing sheets and two water-based markers.
- Instructions are in large print.
The Draftsman Tactile Drawing Board

Figure 15: Photo displays the Draftsman tablet, ruler guide, two pens, and the manual.

Catalog Order Number: 1-08857-00  $177.00
- This is a drawing board containing special film paper and a stylus.
- The device can be used for all types of activities, especially math, science and social studies.
- The board has a plastic frame that encases a double-layered rubber surface.
- A sheet of the paper is clamped on the board to hold paper steady on the drawing surface.
- Student is able to draw lines and shapes on the paper a stylus.
- The pressure of the stylus on the paper will produce raised line objects/shapes as a tactile graphic illustration.

Graph Paper

Figure 16: Photo displays braille embossed and large print graph lines paper.

Bold Line Graph Paper  8.5 x 11 Catalog Ordering Number: 1-04062-00  $10.00
Embossed Graph Paper  8.5 x 11 Catalog Ordering Number: 1-04061-00  $10.00
Embossed Graph Paper: Braille dot grids on manila paper.
Bold Line Graph: Thick unit lines and thin sub-unit lines.
The Wheatley Tactile Diagramming Kit

Figure 17: Photo displays various tactile graphic parts, the manual and the display board that are contained in the Wheatley Tactile Diagramming Kit.

Catalog Order Number: 1-08838-00
$118.00
- This is a tactile board that includes a felt covered board which measures 20.75 x13".
- It contains Velcro pieces that attach to the board and are used to produce many different patterns.
- There are over 100 pieces in several shapes, sizes, textures and color.
- Guide books in braille and large print are provided.

Braille Labels and Sheets

Figure 18: Photo displays the front cover of the Braillable Labels and Sheets package.

Catalog Ordering Number: 1-08871-00 $46.00 (label assorted pack 5 large and small labels, 10 Full-Size sheets, and 30 Pin-Fed sheets)
- These are clear blank self-adhesive labels, large and small, that are used for labeling items.
- Each label accommodates 15 braille cells wide with four lines on the large sheet and two on the small labels.
- Full line sheets offer more room for braille.
Feel 'n Peel Sheets: Carousel of Textures

Figure 19: Photo displays all the different sheets contain in a package of Feel 'n Peel Sheets.

Catalog Ordering Number: 1-08863-00
These are multi-use tactile sheets that are printed and embossed on clear, durable plastic sheets.

Sheets in a Set
- Translucent "Rough" Vinyl (non-adhesive)
- Translucent "Bumpy" Vinyl (non-adhesive)
- Corrugated (non-adhesive)
- Craft Foam (adhesive)
- Foam Glitter (adhesive)
- Velour (adhesive)
- Vivelle (adhesive)
- Double-Backed (used on back of non-adhesive sheet)
- 1 Package of Sticky Dots (adhesive)
- Storage/Carrying Box

Recommended ages: Preschool and up.
APH Tactile Graphic Image Library

http://imagelibrary.aph.org/aphb/

- Free service containd templates for tactile design.
- Many graphic provide only starting points for tactile design.
- Most are not finished products suitable for instant tactile graphics.

- Figure 20: Screenshot of the Tactile Graphic Image Library Web Login Portal

- Figure 21: Screenshot displays the science web section in the Tactile Image Library showing links to agriculture, anatomy, astronomy, biology, chemistry, ecology, family life, meteorology, and physics.

**Meteorology: Approaching Cold Front**

- Figure 22: A tactile graphic line drawing of an approaching cold front, showing cloud build-up and arrows indicating advection (horizontal) and convection (vertical) air movement.
Biology: Animal Cell

Figure 23: A tactile graphic line illustration shows an animal cell contain various parts such as the nuclei, etc...

Computer Generated Tactile Graphics

Most computer generated tactile graphics are produced with a scalable vector drawing application program software. The simplest drawing application is QuickTac. The open source application developed at Duxbury Systems is in still in beta. A document is drawn in QuickTac, saved as a .sig file, and closed. A braille format Duxbury file is open and the QuickTac file is imported as a picture "add" bitmap in the DBT document.

QuickTac Open Source Application from Duxbury Braille Translation

A shape is drawn on the QuickTac layout drawing window. Several parameter options are available (thin-thick lines, solid-no fills).

Shape Drawn in QuickTac

Figure 24: A screen shot shows the QuickTac drawing layout area.

The illustration is saved as a .sig file and closed. Duxbury is activated in braille mode.
Importing .SIG file in a Duxbury Document

Figure 25: A screen shot of the Duxbury "Layout" file menu item activated with an arrow locating "Picture" in the list of menu items and a circle highlighting the "Add.." choice in the submenu list.

- Select "Layout" from the DBT File Menu.
- Select "Picture" from the list of items in the menu.
- Select "Add.." from the "Picture" submenu.
- The QuickTac drawing is placed at a cursor entry point as a braille picture.

Shape Imported in Duxbury 11.1

Figure 26: Screen shot of the QuickTac object (rectangle) imported into a Duxbury document.

Scalable Vector Drawing Application Programs

Standard computer-generated vector-base drawing of tactile graphics is produced in Microsoft Word 2007, 2010, or 2013 and Corel Draw 5 and 6. Because of the availability in schools and offers a milder learning curve, most computer generated tactile graphic production is in Word.

The reason for using vector-based application programs is because the mathematical calculation of line weight. Line weight in Word can vary from 1/4 to 6 point weight. At this time, a Tiger embosser is the only embosser that can take a mainstream vector line drawing and turn it into an embossed tactile graphic by way of a regular print driver. The embosser can interpret about three thicknesses of lines. Having this capability can result in more detail and precise tactile graphics.
Encapsulated “Swell” Paper Production

Computer generated tactile graphics are also produced by encapsulated "swell" paper production. Copying a Word document illustration on to special rubberize encapsulated paper then sending it through a heating device such as a Tactile Image Enhancer or Picture-In-A-Flash, will cause the black areas (conductors of heat) to swell up. The swelling elements on documents make the raised (embossed) illustration into a tactile graphic which becomes accessible to a student with a visual impairment.

Tactile Graphic Examples Produced in Word and Embossed in Swell Paper

Here are some tactile graphic documents produced by a Word document and embossed by either a Tiger embosser or swell paper production.

Phases of the Moon

Figure 27: Tactile graphic line drawing shows different phases of the moon while revolving around the earth. The graphic contains braille text that labels the different phases.

Refraction of Light in a Liquid

Figure 28: Illustration shows how a line of light (an arrow) is bent as it enters a liquid.
Three States of a Liquid

Figure 29: Three swell paper tactile graphics are display each showing molecules in gas, liquid or solid.

Differentiating Atomic Sizes

Figure 30: A swell paper tactile graphic shows the water molecule with the hydrogen atoms having dash line borders and the oxygen atom having a solid line border. Each atom contains a two letter label.
Stand-Alone Software Applications for Tactile Graphic Production

These are software drawing application that can change a computer drawing into a simple line drawing for embossing on a specific embosser as a braille/tactile graphic.

**TactileViewer**

![TactileViewer](image)

Figure 31: Screen shot of the heading information of the Tactile View website.

TactileViewer software application is a design software for creating line vector graphics that can be embossed as a hardcopy tactile graphic by using an Index Basic D (version 4) embosser or as a swell (microcapsule paper) document that can be embossed by a Picture-In-A-Flash (PIAF) or Tactile Image Enhancer (TIE) heating device.

**Firebird Graphics Editor**


Firebird is a stand-alone software application where an image, such as a jpeg, tiff, or png, is imported into Firebird document layout.

**JPEG Image Imported into a Firebird Document**

![JPEG Image](image)

Figure 32: Screen shot of the Firebird layout window is displaying a bitmap image of an line outline map of Texas.

A function in the Firebird software will transform the image into a "visual" braille line image on a separate editable document. At this point the image can be edited by adding more braille dots and labels or erased if there is some unrelated information on the document.
Figure 33: Screen Shot of the Braille Edit Display window of the Firebird application displays the braille outline map of Texas.

It is now ready for embossing into a hardcopy tactile graphic by a Phoenix embosser.
Other Accessible Science Resources

Before deciding on procuring mainstream science models and enrichment equipment, make sure it is appropriate for your student. This is expensive equipment to be sitting on a shelf. Sometimes the science teacher will acquire equipment to enhance instruction for the entire class. This is an opportunity for students with visual impairments. Here are some examples of equipment that a science classroom teacher will acquire for a class or lab environment.

Carolina Science Equipment: Interactive Atom Class Set

http://www.carolina.com

Figure 34: Photo of Tactile Objects used to Represent Atomic Cell Structure from Carolina Science Equipment

3D Magnetic Skeleton

Delta Education

www.deltaeducation.com/

Figure 35: Picture of a young boy who is adding a plastic representation of an arm bone to a plastic skeleton located on a wall magnet board.
Multi-Sensory Lab Gear Kit

http://www.sciencefortheblind.com/#multi-sensory-lab-gear-kit/c1v69

Figure 36: The picture displays several pieces of equipment used in a science lab.

- Plastic beakers with tactile marks
- Wide mouth plastic bottles.
- Measuring spoons
- Talking Thermometer
- Scales with tactile markings and Braille
- Price: $249 + s/h

SAVI/SELP

http://www.lawrencehallofscience.org/cml/saviselph/
(Science Activities for the Visually Impaired/Science Enrichment for Learners with Physical Handicaps)

Figure 37: The picture displays a plastic syringe that includes a metal pin stopper inserted at about the 90 ml mark.

At the 90-ml mark, a metal stopper is inserted so that when the plunger is pulled all the way to that mark (stopper), exactly 90 ml of liquid has been measured.
Measuring Devices from Maxi-Aid Independent Living

http://www.maxiaids.com/store/default.asp

Figure 38: Two photos are displayed, one shows a temperature probe that includes auditory feedback. The second photo displays a tape measure containing holes at every quarter inch mark and braille on some of the number increments.

Among other adapted objects and devices, there are several types science and math tools in the Maxi-Aid Independent Living website.

Universal Design for Learning: Dynamic Cell Models Kit

www.cellzone.org

Figure 39: The picture is displaying various plastic parts all representing certain parts of a cell.

The kit is used for students, through a collaborative effort, assemble a model of a cell. Together they learn the components of a cell that are visible under a microscope. The student with a visual impairment is able to work with his sighted peers in the collaborative interaction.
Carolina Biological Supply Science Models

http://www.carolina.com/

Figure 40: The picture displays a plastic display of a heart that is opened revealing the inside parts.

This resource website contains many different science models for purchase.
High Tech Solutions for Accessible Science Laboratories

Talking LabQuest 1

- The Vernier Equipment is mainstream science equipment.
- Only the LabQuest 1 can be made to talk.
- The Logger Pro application also can be made to talk (with JAWS).
- Need Sci-Voice from ILAB* to make both the LabQuest and Logger Pro talk.

*Independent Laboratory Access for the Blind

http://ilab.psu.edu/

Cost of High Tech Accessible Science Equipment

http://www.vernier.com/products/interfaces/talking-labquest/

- LabQuest (1st Edition) $399
- Sci-Voice for LabQuest Sci-Voice $995
- Logger Pro Data Collection & Analysis Software $189
- Sci-Voice for Logger Pro (PC screen reader required)
  - Window-Eyes® Voice Access App $499
  - JAWS® Voice Access Scripts $599
- Sensor Probes ($80-200)

Talking Lab Quest 1 Component

Facing the Front Side of the Talking LabQuest 1

![Talking LabQuest 1 Component Diagram](image)

Figure 41: The picture displays the front side of the Talking LabQuest 1. More detail about the picture are explained below.

With the device facing the front side and the LED screen facing upward starting from top to bottom here are the components.

- Internal Microphone is on the right side.
- LED Rectangular screen is just below the microphone.
- Start Data Collection Button is just below the LED screen and in the center of the device.
- Below the start data button is a circular set of buttons, these are the navigation buttons.
Facing the Top Side of the Talking LabQuest 1

Figure 42: The picture shows the top side of the Talking LabQuest 1. Details explaining the parts of this side of the device are explained below.

- In the middle of topside there is a SD card slot.
- Right Side Below the SD Card Slot are four Analog Ports for Sensors.
- Next to the leftmost analog port is a stylus storage slot, containing a stylus.
- To the right of the stylus storage slot are two USB port (big and small).

Facing the Right Side of the Talking LabQuest 1

Figure 43: The photo shows the right side of the Talking LabQuest 1. Details of this photo are described below.

On the right side of the Talking Lab Quest 1 are two digital sensor ports for digital sensors.
Facing the Left Side of the Talking LabQuest 1

Figure 44: Photo displays the left side of the Talking LabQuest 1. More detailed description of the photo is explained below.

- Starting left is an audio-in slot. This is used to add an external microphone.
- The middle is an audio-out slot. This can be used with headphones or speakers.
- The right slot is an external power slot.

Facing the Bottom Side of the Talking LabQuest 1

Figure 45: Photo of the bottom side of the Talking LabQuest 1. Details of this area of the device are explained below.

The bottom middle contains a charging connector for a charging dock.

Sensor Attachment for the Talking LabQuest 1

The Talking LabQuest is compatible with over 70 Sensors. The cost of these sensors depend on the complexity of their individual function. Website containing all 70 sensors and a description of each is found on: [http://www.vernier.com/products/interfaces/talking-labquest/](http://www.vernier.com/products/interfaces/talking-labquest/)

Some of the more common ones are:

- Ammonium Ion-Selective Electrode: measures Ammonium concentration in liquids
- Anemometer: measures wind speed.
- Barometer: measures air pressure.
- Blood Pressure Sensor: measures blood pressure.
- CO2 Gas Sensor: measures gaseous carbon dioxide.
- Differential Voltage Probe: explores electricity both AC and DC.
- Temperature Probe: measure range of temperatures.
- Gas Pressure Sensor: measures the change of a gas.
- Light Sensor: used to study polarizers, reflectivity, or solar energy.
- Magnetic Field Sensor: study the field around permanent magnets, coils and electrical devices.
- Motion Detector: used to measure position, velocity, and acceleration of moving objects.
- pH Sensor: used to measure pH balance (acid/base) in various experiments.
- Relative Humidity Sensor: measures relative humidity.
- Salinity Sensor: measure salt particle in a solution.
- Voltage Probe: measures direct voltage.

**JAWS and the Logger Pro 3 Interface**

**Sections of the Logger Pro 3 Layout Window**

![Image of Logger Pro 3 Layout Window]

Figure 46: Screen shot is displaying the sections of the Logger Pro layout window. Details are explained in the following bullet points.

- The Spreadsheet Table on the Left Side: table with two columns showing no rows or cells are selected.
- The Panel below the spreadsheet: displays digital meter temperature and number of degree Celsius.
- The Graphing Panel: Cartesian graph displaying latest temperature relative to time.
Logger Pro 3: Data Collection Start Point

![Graph showing temperature results relative to time.

Figure 47: Screen shot of the Logger Pro layout windows shows a graph of temperature results relative to time. The letter "A" indicates the point of time when temperatures rapidly rises.

- Collecting data for the rise in temperature relative to time.
- Sensor probe was placed in the liquid at point A
- Point A is at the 10 sec mark.

Logger Pro 3: Data Collection End Point

![Graph showing temperature results with a blue rectangle.

Figure 48: Screenshot displays a graph and temperature result from an experiment. The spread sheet of temperatures have numerical readings in Celsius. The temperature panel reads 44.8 degrees Celsius which is the voice output reading. There is a blue rectangle on an area of the temperature table indicating where a temperature increment is repeated.

- Temperature rose between the 10 and 50 second marks
- Data collection stopped when the reading repeated five times.
- Data collection stopped at 48.4°C and at 55 second mark (Point B).
JAWS Reading the Results of a Salt Water Temperature Test

Figure 49: Photo displays a temperature probe in a measuring cup that is filled with a salt water solution.

A temperature probe is connected to Talking LabQuest 1. The LabQuest device is also connected via USB to a computer that is running the Logger Pro software. The Logger Pro software will display data of the experiment. JAWS will notify where the focus is on the Logger Pro application, whether it is on the spreadsheet, the graph or the temperature reading.

Logger Pro 3: Completed Data Collection

Figure 50: Screenshot displays the three panels of the Logger Pro application. The temperature spreadsheet panel shows a red circle around a list of temperatures numbers that are repeat five times. The graph panel contains a red circle around the point the graph holds a steady line that is not rising or falling in temperature. The temperature panel shows the word “temperature” with a reading of 24.8 degrees Celsius.

JAWS will stop reading when data is reading when the same data is repeated more than five times. When this occurs, it becomes the recorded data for this experiment.
Microscope External Video Cam

![Microscope with an arrow pointing to the external video cam](image)

Figure 51: Photo displays a microscope with an arrow pointing to the external video cam that is covering the viewing lens.

- Attaches to an analog microscope.
- Power via USB connection.
- Displays image on a computer monitor.
- Displays image on an LCD projector (connected to a computer).
- Magnifies the X-Powr of the microscope.
- Software may have special viewing features.

Microscope USB Cam Software Application

![Applied Vision 4 software interface](image)

Figure 52: Screen shot displays a layout window of the Applied Vision 4 software, the software that interfaces with the Microscope USB cam. The object in the software layout view is a cell that is dividing.

- Draw on the photo.
- Measure
- Magnify
- Rotate/Flip
- Compare images
Earthworm (400x)

Figure 53: Photo displays an earthworm magnified to the point where internal organs are visible.

Spirogyra (110x)

Figure 54: Photo displays the algae, Spirogyra, magnified to reveal the cellular structure of the plant.

Sunflower Stem (400x)

Figure 55: Photo displays a sunflower stem and is magnified as to reveal the stoma cells of the plant.
Accessible Science Website Resources

Science Information and Resources
The Resources of the Expanded Core Curriculum (RECC) http://www.tsbvi.edu/recc/select
APH Tactile Graphic Image Library http://imagelibrary.aph.org/aphb/
Perkins Scout - Science Education http://www.perkins.org/resources/scout/education/science-education/
Perkins – Accessible Science Webcasts http://support.perkins.org/site/PageServer?pagename=Webcasts_Accessible_Science_Life_Science
ILAB (especially go to classroom tools) http://research.chem.psu.edu/mallouk/ilab/
Barrier Free Education http://barrier-free.arch.gatech.edu/
Sharing the SETT Framework by Joy Zabala http://www.joyzabala.com/

Science Equipment and Tools for the Blind and Visually Impaired
American Printing House for the Blind (APH) http://www.aph.org
SAVI (great adapted lab supplies) http://www.lawrencehallofscience.org/cml/saviselph/
VIEW International Foundation (tactile diagrams ready for PIAF, TIE, or Tiger) http://www.viewinternational.org/
Independent Living Aids (esp. adapted measuring supplies) http://www.independentliving.com/
Carolina Biological Supply (source for science models) http://www.carolina.com
Talking LabQuest 3 from Vernier Labs http://www.vernier.com/products/interfaces/talking-labquest/
Texas School for the Blind & Visually Impaired
Outreach Programs

Figure 56 TSBVI logo.

This project is supported by the U.S. Department of Education, Special Education Program (OSEP). Opinions expressed here are the authors and do not necessarily represent the position of the Department of Education.

Figure 57 IDEAs that Work logo and OSEP disclaimer.