# Building STEM Skills Using AnimalWatch Products

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## Background: AnimalWatch Vi Suite

Funding Agency:

* Institute of Education Sciences

Award to:

* Dr. Carole R. Beal, University of Arizona

Funding Period:

* July 1, 2012 – February 28, 2016

Available:

* App through the App Store
* <https://awvis.aphtech.org/>

## Goals of AnimalWatch Vi Suite

* Evaluate if access to an instructional package increases pre-algebra students’ math competence.
* Make math content, images and graphics accessible for learners with low vision and blindness.
* Develop appropriate hints and instructional scaffolding to support student learning.
* Evaluate how students gather information from tactile and large print graphics.

## Module 1

### Polar Bear

* Add and subtract integers
  + Sample computation: 1213 + 897 = 2110
* Add and subtract positive and negative integers
  + Sample computation: 623 + (-64) = 559

### Black Rhino

* Multiply and divide (basic)
  + Sample computations: 3 = 6 = 18; 60 ÷ 3 = 20
* Multiply and divide (challenge)
  + Sample computations: 18 x 32 = 576; 232 ÷ 4 = 558

## Module 1, Continued

### California Condor

* Averages (mean, median, mode)
  + Sample computation: average of data set [2, 3, 2, 4, 3] = 2.8
* Averages and range
  + Sample computation: range of data set [2, 3, 2, 4, 3] is 2 to 4

### Sea Turtle

* Form a fraction
  + Sample computation: One part of four equal parts is 1/4
* Solve problems using a fraction
  + Sample computation: Divide 12 into four parts; each part includes 3

## Module 2

### Poison Frog

* Add and subtract fractions with like denominators
  + Sample computation: 7/8 – 3/8 = 1/2
* Add and subtract like fractions and mixed numbers
  + Sample computation: 2 2/5 – 1/5 = 1 4/5

### Burmese Python

* Convert units of measurement (basic)
  + Sample computation: 27 feet = 9 yards
* Convert units of measurement (challenge)
  + Sample computation: 403 pounds = 6448 ounces

## Module 2, Continued

### Cheetah

* Convert fractions and percentages
  + Sample computation: 5% of 300 = 15
* Solve problems about distance, speed and time
  + Sample computation: 750 ÷ 50 = 15

### Hippo

* One-variable equations (basic)
  + Sample computation: If 4x = 80, x = 20
* One-variable equations (challenge)
  + Sample computation: If 10 + 5 + x = 80; x = 65

## Module 3

### Snow Leopard

* Add and subtract fractions with unlike denominators
  + Sample computation: 2/35 + 2/70 = 3/35
* Add and subtract unlike fractions and mixed numbers
  + Sample computation: 3 1/8 – 2 1/3 = 19/24

### White Shark

* Multiply and divide fractions (basic)
  + Sample computation: 11 x 2/5 = 4 2/5
* Multiply and divide fractions (challenge)
  + Sample computation: 6 1/3 ÷ 1/3 = 19

## Module 3, Continued

### Honeybee

* Probability (basic)
  + Sample computation: Probability of 1 in 4 = 0.25
* Probability (challenge)
  + Sample computation: Probability of 2 out of 200 = 0.01

### Gray Wolf

* Geometry: Shapes and angles (basic)
  + Sample computation: Value of a right angle is 90°
* Geometry (challenge)
  + Sample computation: ½(base = 13 x height = 4) = 26 (area of right triangle)

## Materials

<https://awvis.aphtech.org/>

* Accessible iPad app
* .brf of files of the content
* Graphics: PDF and ready for use on an infuser (e.g., PIAF)
* User guide (accessible PDF)
* Content of each unit uses authentic science data about an endangered or invasive animal species.

## User Guide

* Background information on the development of AWViS
* “Walk through” the features of the AWViS app
* Table showing the units and Common Core State Standards each addresses
* Content of each unit
* Does not include a print or braille copy of the graphics (2 per unit)

## Assumptions About the Students’ iPad Skills

The student can:

* Navigate to apps, open apps, and navigate within apps using buttons and pop-up menus to make selections
* Swipe left and right, tap, double tap, and triple tap
* Use 3-finger Zoom if the student has low vision and prefers magnification
* Use VoiceOver if the student is blind and uses the iPad's built-in screen reader
* Use a Bluetooth® keyboard or refreshable braille display if these are preferred access methods

## Considerations in Designing an iPad App for Students who are Visually Impaired

### For all users:

* Image / graphic descriptions
* All audio on/off, answer sounds on/off

### For blind users:

* Full functionality with VoiceOver
* Access to accurate Nemeth

### For low vision users:

* Customize look of app (background/font, artwork)
* Access to audio without learning VoiceOver
* Built-in scratch pad with a variety of features

## Features of the App

* Animal Sound
* Settings
* Glossary
* Scratch Pad
* Image Descriptions
* Score Report

## Each of the 24 Math Units Includes

### Introductory Screens

* Meet the Animal
* What the Animal Looks Like
* The Animal’s Habitat
* Math Skills

### Math Problems

* 6 problems per unit
  + 2 problems require use of a graphic
* 3 tries to answer a problem
* 2 hints (staggered on availability)
* Option to “give up” after first try

## User Settings (Video)

* The User Setting screen shows radio buttons for All Audio, Scratch Pad, and Answer Sound.
* Four font-background choices are provided for Answer Pad Button Style and Textbox Style.
* There is a slider to adjust the Audio Playback Speed.

## Introduction to the Animal (Video)

* Two iPad screens are shown.
* The iPad screen on the left is titled “Meet the Sea Turtle.” Text describing the sea turtle is shown on the left. On the right a picture of a sea turtle swimming is visible.
* The iPad screen on the right is titled “What the Sea Turtle Looks Like.” Text describing the sea turtle is on the left. A drawing of a sea turtle is shown on the right.

## Use of the Scratch Pad (Video)

* An iPad screen titled “Poison Frog Unit A Problem 1” is shown.
* On the left the problem is shown.
* On the right there is an picture of a yellow poison frog.

## Problem with Zoom (Video)

* An iPad screen titled “Sea Turtle Unit B Problem 1” is shown.
* On the left the problem is shown.
* On the right there is an picture of a sea turtle on the beach with a woman looking at it.

## Problem with a Graphic and Student Using a Hint (Video)

* An iPad screen titled “Sea Turtle Unit B Problem 3” is shown.
* On the left the problem is shown.
* On the right there is a picture of a circle graph divided into three equal sections.

## Hints

* The hints are scaffolded.
* First hint assists the student to set up the problem.
* Second hit is more specific and guides student to solve the problem.
* A hint for a problem is shown below the problem. It reads “Multiply 4 hours swimming in the ocean by 3 sections to find the total hours.”

## What Students Liked About the AnimalWatch Vi Suite App

* “I liked the app because it made the little sound when the answer was wrong.”
* “It would give you hints which was nice and you could have text read to you.”
* “I liked it because it read to me. I liked the scratch pad.”
* “It gave me a hint on how to solve the math problems.”
* “I liked the app better. I didn't have to use a pencil.”
* “It felt easier to enter the answer. It was easy to use.”

## At the End of Our Research Study a TVI Shared

“I got the student [in this study] as a 3rd grader. Our braillist would often omit graphs and I didn't know any better. Looking back, [I realize] what a disservice I did to him. Now that I know better I will start with my young students. If we teach those kids to read graphs in 2nd to 5th grade, they will be ready for middle school.”

## Summary

* AnimalWatch Vi Suite assists students at the 5th-6th grade math level to build their word problem solving skills.
* Accessible iPad app is available through the App Store
* Teacher curriculum, .brf files, PDF of graphics, and braille graphics files for fusing available from: <https://awvis.aphtech.org/>

## Research Articles

Beal, C. R. & Rosenblum, L. P. (2018). Evaluation of an app for math word problem solving by students with visual impairments. *Journal of Visual Impairment & Blindness*, 112(1), 5-19.

Beal, C. R. & Rosenblum, L. P. (2015). Development of a math-learning app for students with visual impairments. *Journal on Technology and Persons with Disabilities*, 1-9.

Beal, C. R. & Rosenblum, L. P. (2015). Use of an accessible iPad app and supplemental graphics to build mathematics skills: feasibility study results. *Journal of Visual Impairment & Blindness*, 109(5), 383-394.

## In 2015 as We Completed the AnimalWatch Vi Suite Research

* Students required more assistance from their TVI when solving problems that required they locate data in a graphic.
* In analyzing videos of students completing problems with graphics we noted:
  + Many students were not systematic in their approach.
  + Some students did not read the title or key.
  + Few students verified information they located in the graphic.
  + Students took “a long time” to locate necessary information.

## AnimalWatch Vi: Building Graphics Literacy

Funding Agency:

* Institute of Education Sciences

Award to:

* Dr. Carole R. Beal, University of Florida

Sub-award to:

* University of Arizona

Funding Period:

* July 1, 2016 – December 31, 2019

## Goals of AWVi: Building Graphics Literacy

* Support students at the pre-algebra level in building their efficiency and accuracy in gathering information from material presented in graphs and maps.
* Provide TVIs strategies and techniques they can TSVIs use to increase their students’ accuracy and efficiency in getting information from graphs and maps.

## Through 10 Units, Students Build Skills with

* Bar graphs (single & double bars)
* Line graphs
* Circle graphs
* Venn diagrams
* Coordinate planes (quadrant 1 & all 4 quadrants)
* Box plots
* Maps
* Data tables

## Materials

* Accessible iPad app (builds on AWViS)
* Teacher curriculum
* 4 graphics per unit available for purchase <https://adaptations.org/products/br600>
  + Print
  + UEB
  + Nemeth Code within UEB Contexts
* Content of each unit uses authentic science data about an endangered or invasive species in Australia or Africa

## Teacher Curriculum

* Walk through of the app
* Units
  + Recommended objectives
  + Vocabulary
  + Content (includes print & simbraille graphics)
  + Follow-up activity suggestions

## Follow-Up Activity Suggestions

* Learning about how African Penguins who are in an oil spill are cleaned
* Practicing coordinates using a life-size coordinate grid

## Features of the App

* Works with VoiceOver
* Read aloud for text and image descriptions
* Built in zoom
* Built in scratch pad
* Check if answer is correct
* A score report can be emailed after the student completes a unit

## Structure of the Units

* Meet the Animal (includes animal sound)
* Getting Started (Sheet 1)
  + 2 open ended questions
* Warm-Up (Sheets 1 & 2)
  + 10 Introduction/Review (MC)
  + Teach concepts for locating and interpreting information

## Structure of the Units, Continued

* Select Difficulty – Self rating (MC)
* Application Set A (Sheet 3) and Application Set B (Sheet 4)
  + 4 questions: locate information (MC)
  + 1 Math question (MC)
  + 1 Prediction question (open-ended)
* Check in – Self rating (MC)
* What I Learned (open-ended)
* Conclusion

## Menu

* Units not started have a photo.
* Units in progress have a “Men Working” sign.
* Units completed have a check mark.

## Getting Started for Tasmanian Devil (Bar Graph)

* A bar graph titled “Weights of Four Marsupials in Pounds” is shown.
* The x-axis is labeled Marsupial Species and shows 4 animals.
* The y-axis is labeled Weight of Adult Male in Pounds. The scale goes from 0-225 in increments of 25. Every other value is labeled (e.g., 50, 100).

## Getting Started Questions

### Getting Started 1

* Describe this bar graph and tell what each part is. If you are unsure, please try your best. It’s ok if you don’t know the answer. Record your answer.

### Getting Started 2

* What is one thing you know about the Tasmanian Devil from this bar graph? If you are unsure, please try your best. It’s ok if you don’t know the answer. Record your answer.

## Introduction (Video)

* An iPad screen labeled “Meet the African Penguin is shown.
* On the left is text describing the African penguin.
* On the right is a photo of an African penguin facing the camera.

## Getting Started (Video)

* Two iPad screens are shown.
* The screen on the left is titled “Get Ready for Some Questions”.
  + On the left is text.
  + On the right is a map titled “African Penguin Colonies.”
* The screen on the right is titled “Getting Started 1”.
  + A question is shown at the top of the screen..
  + The map “African Penguin Colonies” is below the question.
  + A record button is visible at the bottom of the screen.

## Thoughts on Getting Started from a TVI

“The only thing he didn't respond to well was the Getting Started where he had to look at the whole graph and then tell what he knew. He is not one to respond to a prompt and be able to spit it out. It took maybe 15 minutes for him to think about what he was going to say. He could find things in the graph, but to come up with an answer for the open ended question was something hard for him. This is a skill he should learn.”

## Thoughts on Getting Started

“Hearing myself talking about the graph out loud made me focus and think about what I am doing.” (7th grade, female, braille)

“It was hard to come up with things to say at the beginning. I got more confidence for each unit.” (9th grade, female, braille, ELL)

“it sort of prepared me for the questions. It made you think about obvious parts of the graphic that I would have probably have missed without the questions.” (7th grade, female, braille)

## Another Map Warm Up Problem

* An iPad screen is shown titled “Warm Up 1”.
* On the left the text of a problem is shown.
* On the right is the map titled “African Penguin Colonies.”

## Warm Up Problem (Video)

* An iPad screen titled “Problem 5” is shown.
* On the left is the text of the problem.
* On the right is a map titled “Namibia’s and South Africa’s Garden Route Tour.”
* Question is worded differently in the video. We modified question text following the pilot study.

## Another Example of Warm Up Problems (Video)

* Two iPad screens are shown. The one on the Left is titled “Warm Up 6” and one on the right is titled “Warm Up 7”.
* On both screens on the left the problem is shown.
* On both screens on the right the line graph titled “The Size of the Cane Toad Habitat by Decade” is shown.

## Thoughts About Warm Up Problems

“I really like the explicit instruction in the warm up and errorless teaching and then he gets to branch on his own.” (TVI)

“The warm ups…helped me get ready for the questions. and get familiar with the graphs.” (6th grade, female, braille)

## Select Difficulty Screen

* In our study most students selected the choice their TVI would have selected.
* A screen titled “Select Difficulty is shown.
* The question reads “Now that you’ve tried some maps, how well do you understand this topic?”
* Three choices are provided:
  + Very well, I know this material already.
  + Pretty well; I’ve worked on maps, but I could use some practice.
  + Not very well; I need more practice.
* On the right a photo of an African penguin is shown.

## Math Question and Prediction Question (Video)

* Two iPad screens are shown. The one on the left is titled “Problem A5” and the one on the right is titled “Problem A6”.
* On the “Problem A5” screen:
  + The left side of the screen shows the problem.
  + The right side of the screen show a Venn diagram titled “Number of Student Visitors”.
* One the “Problem A6” screen:
  + The top of the screen shows the problem.
  + Below the problem is the Venn diagram titled “Number of Student Visitors”.
  + At the bottom of the screen is the record button.

## Check In and What I Learned

* The iPad screen on the left is titled “Check In”.
  + There is a question at the top of the screen that reads “Now that you’ve completed the unit, how do you feel about your ability to use maps in your school work?
  + The choices are:
    - Super, I can work with almost any map.
    - Ok, but I need more practice.
    - Not good, maps are confusing.
* The iPad screen on the right is titled “What I Learned”.
  + At the top of the screen, the question reads “What strategies work best for you so that you can get information from maps? Record your answer.”
  + A drawing of boy with his chin resting on his hand is shown.
  + The record button is at the bottom of the screen.

## Score Report

* Two iPad screens are shown.
* The screen on the left is titled “Score Report.” It contains text describing how many problems the user got correct on Problems A1-A5 and B1-B5.
* The screen on the right is titled “public 2Public User Tasmanian Devil.” Data for the student is shown. It is not “student friendly”. The words “correct” and “incorrect” appear next to problem numbers.

## When You’re Teaching Students Graphics Literacy Skills, There is Lots to Think About!

* Systematic approach
* Using surrounding information
* Preview
* Verify information
* Vocabulary development

## Effective Strategies: Systematic Approach

“At the beginning of the study I'd have to remind her to take her time and examine before you answer. I'd ask her ‘What do you think you can do differently?’ if she got it wrong. I saw her spend more time slowing down and looking over the graphic. I hope she realizes that she needs to take time.” (TVI)

“I learned to scan left to right and look at every detail. I learned that you have to follow the lines to find things. It taught me to pay attention to everything on the paper.” (5th grade, male, braille)

## Effective Strategies: Using Surrounding Information

“I sometimes had a hard time differentiating the textures. The key really helped me practice telling them apart.“ (7th grade, female, braille)

[Now] I know you have to pay attention. You have to pay attention to how [graph or map] is laid out and what the question is asking you. You have to know if there are data points and if you have to go to the left and look slowly to find [the value].” (7th grade, male, braille)

## Effective Strategies: Preview

“Especially in coordinate planes, we have to make graphs. It is helpful to know about the x and y axis and which quadrants are positive and negative. General idea of previewing is good to help me in my classes. I preview now.” (8th grade, male, braille)

## Effective Strategies: Verify the Information

“Hearing myself talking about the graph out loud made me focus and think about what I am doing.” (7th grade, male, braille)

“Start at the key and familiarize yourself with the symbols and then do a light scan to orient myself and then after that I can go back in and look for specific things.” (7th grade, male, braille)

## Effective Strategies: Vocabulary Development

“[Now I] feel more successful in the math class because I can do math more fluently. I can work with graphs more fluently. I think if I had gone in math class before with a bar graph [I wouldn’t know what to do.] and now I really can see the difference.” (5th grade, male, braille)

“I didn’t know about box plots but now I know about the quartiles and stuff.” (7th grade, male, print)

## In the Words of a TVI

“I believe the app and graphics are an interesting, motivating way for a student to learn to read graphics. The vocabulary and concepts needed for each graph are included so that the student is ready for what they may encounter in math, science, or any of the other content subjects. I feel that this is an important skill for students to learn, and this is the best program I have seen to concentrate on introducing the necessary skills for reading tactile graphics and giving adequate practice in using the skills.”

## Summary

* AnimalWatch Vi Building Graphics Literacy assists students at the 6th-7th grade math level to build their ability to locate and interpret information in graphics
  + Accessible iPad app is available through the App Store by searching on AnimalWatch Vi Graphics or going to the link directly from an iPad <https://apps.apple.com/us/app/animalwatch-vi-graphics/id1500956962>
* Teacher curriculum is available as an accessible PDF at no cost
  + Graphics are available for purchase ($350) from the Lighthouse <https://adaptations.org/products/br600>

## Research Articles

Rosenblum, L. P., Zebehazy, K. Z., Gage, N. A., & Beal, C. R. (in press). Experiences building graphics literacy Skills: Interviews with teachers and students, *Journal of Visual Impairment & Blindness*.

Rosenblum, L. P., Zebehazy, K. Z., Gage, N. A., & Beal, C. R. (in press). Pre-Algebra students’ performance locating and interpreting data in graphs and maps, *Journal of Visual Impairment & Blindness*.

Rosenblum, L. P., Cheng, L., Zebehazy, K, T., Wall Emerson, R., & Beal, C. R. (2020). Teachers’ descriptions of mathematics graphics for students with visual impairments: A preliminary investigation, *Journal of Visual Impairment & Blindness*, 114(3), 331-236.

Rosenblum, L. P., Cheng, L., & Beal, C. R. (2018). Teachers of students with visual impairments share experiences and advice for supporting students in understanding graphics. *Journal of Visual Impairment & Blindness*, 112(5), 475-487.

## Project INSPIRE

* 5 year federal project awarded to Dr. Tina Herzberg
* <https://www.uscupstate.edu/project-inspire> and on Facebook
* Six-week online courses for TVIs, braille transcribers, adult service providers, and university disability resource center personnel
* STEM Braille Boot Camps that provide multiple opportunities to learn and practice STEM braille codes for students in 6th grade through college
* Fun virtual STEM Braille Bowl Competitions to challenge braille users in grades 6th-12th throughout the U.S. to demonstrate their skills and knowledge in the STEM braille codes beginning in 2022

## Project INSPIRE Courses

* All courses are free and self-paced
* Courses are offered 2 times to collect participant data and then made available on Paths to Literacy for anyone to access
* [Spring 2021 Flyer](https://www.dropbox.com/s/id8xzu4krwysrf6/Project%20INSPIRE_Spring%202021%20Course%20Advertisement.pdf?dl=0) of course offerings (register by Feb. 8, begin Feb. 15)
* Two courses available now on Paths to Literacy at [https://www.pathstoliteracy.org/resources/project-inspire-free-self-paced-courses-increase-stem-potential-individuals-who-read](https://www.pathstoliteracy.org/resources/project-inspire-free-self-paced-courses-increase-stem-potential-individuals-who-read%20)
  + Nemeth Code within UEB Contexts and Strategies for Supporting the Pre-K-1st Grade Student in Building Math Skills
  + An Introduction to Nemeth Code Symbols Used in Grades 2 to 5 and Strategies for Supporting Elementary Students in Building Math Skills