

The background of the slide is decorated with various science-related icons in a light, colorful style. These include a flask, a beaker, a radiation symbol, a magnifying glass, a test tube, a syringe, a ruler, a hexagon, a molecular structure, a pill, and a triangle. The icons are scattered around the central text, adding a scientific theme to the design.

Free Tools to Integrate into Labs and Research Process in a Classroom

Yajaira Torres De Jesús, PhD.



My Steps in Life



2022

**Coordinator (Science / MSA)
Teacher / Mentor / Lead Advocate
Lecturer / Resources creator
STEM Club Moderator**

2021

**Postgraduate
Certification in
Audit and Digital
Evidence**

**2020
Obtained the PhD**

2019

**STEM Grants
Advocate Program
Society for Science**

**2003
Started in Colegio
Rosa - Bell**

**BA in Teaching
(Science)**

2014

Started the PhD

2011

**First STEM Integrated
Curriculum in a Private
School from K - 12 / First
STEM Museum**

2010

**STEM Certification
(Boston)**

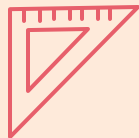




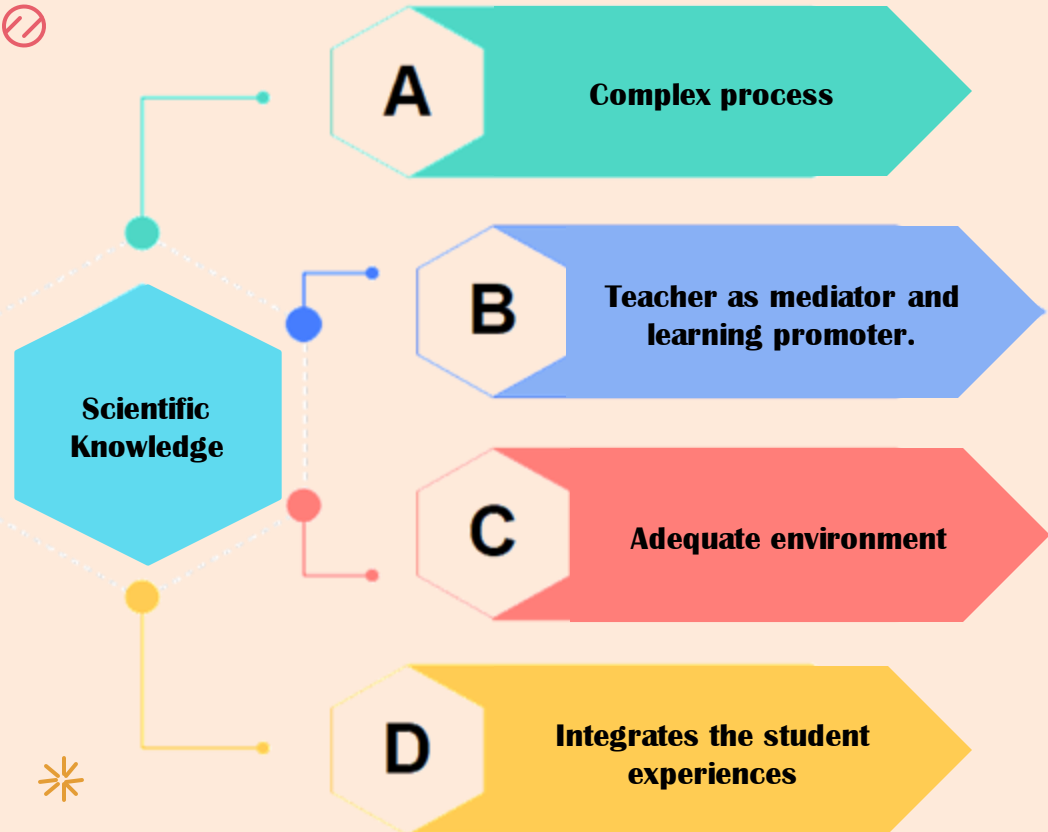
Objective



Share and explain alternative tools that can be integrated into the classroom to carry out the construction of scientific knowledge through laboratory and research experiences.



Did you know...





**Without laboratories, scientists
would be like soldiers without
strategies.
– L. Pasteur**





The solution of a problem is the primary objective of scientific research.

Scientific research constitutes a set of methods, laws and procedures that guide efforts towards solving problems with maximum efficiency.



Intervening Variables



**Thematic content
and type of
experiences**



**Availability of
materials and/or
equipment.**



**Versatility, attitude
and disposition of the
teacher.**





Scientific research is one of the most exciting and rewarding activities (F. Sagner) that can be carried out from multiple platforms and tools. (L. Clark)





Tools Thematic Content



01 Teach Scientific Language

05 Sound Levels

02 Microscope & Magnifier

06 Quality Parameters

03 Microbiology

07 Diagrams & Graphic Org.

04 Measure, Count & Identification
with Images



08 Statistics,
Simulations &
Project's Ideas



Tools to Promote the Scientific Language



<https://www.sciencenewsforstudents.org/how-to-use#navigating-science-news-for-students>

Tools to Promote the Scientific Language



Survey Methods

[Launch Interactive](#)



Topic

[Ecology](#)
- [Populations](#)

[Environmental Science](#)
- [Conservation](#)

[Science Practices](#)
- [Experimental Design](#)

[Resource Type](#)
[Interactive Media](#)
- [Click & Learn](#)

Materials

- [Resource Google Folder \(link\)](#)
- [Student Worksheet \(PDF\) 281 KB](#)

Level

[High School – General](#)
[High School – AP/IB](#)
[College](#)

Used In

1 BioInteractive Playlists

Favorited By

♥ 29 Users

<https://www.biointeractive.org/>



Tools – Microscopes & Magnifier



Android
Cozy Magnifier & Microscope



(Rotger y Sanz, 2021)

iPhones
iMicroscope - Magnifier





Tool - Microbiology



Open CFU

<http://opencfu.sourceforge.net/>

Result: 91₁₀₂ Set as NA

Show objects Line width 2.5

Files: Image2/6 (G.png)

Threshold: Inverted 10 Auto

Radius: 5 Min 50 Max Auto-Max

ROIs and Mask: None

Colour filter: Use colour filter Hue: 0 Mean 180 Tol Saturation: 100 Min 255 Max

Auto outlier filter: Use outlier filter

Per image				
ID	File name	#Objects	#Excluded	Comment
0	A.png	78	26	2013-06-27 [14:49:50]: no com
1	G.png	91	11	2013-06-27 [14:50:49]: no com
2	H.png	9	0	2013-06-27 [14:50:52]: no com
3	Q.jpg.png	301	0	2013-06-27 [14:52:25]: no com
4	B.png	69	0	2013-06-27 [14:52:32]: no com

Per object												
ID	Valid	X	Y	ROI	Area	Radius	R	G	B	Hue	Sat	Neighbour
77	<input checked="" type="checkbox"/>	218	599	1	133	7	198	150	77	36	131	1
19	<input checked="" type="checkbox"/>	227	1061	1	155	7	198	153	79	38	132	1
35	<input checked="" type="checkbox"/>	949	909	1	172	8	193	132	62	32	132	1
12	<input checked="" type="checkbox"/>	636	1186	1	183	8	195	139	67	34	133	1
37	<input checked="" type="checkbox"/>	938	898	1	185	8	196	135	67	32	133	1

OpenCFU

n = 1105

Addition ??

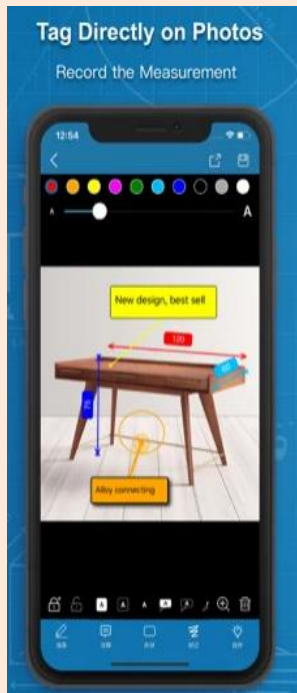
n = 1104



Tool – Measurement on Images



Photos Measure - Image meter
iPhone / iPad



<https://apps.apple.com/us/app/photos-measure-image-meter/id1189158497>

+ Tool – Real Time Measurement from an Image



Smart Measures

Android / iPhone / Mac / iPad



<https://play.google.com/store/apps/details?id=kr.sira.measure&hl=en&gl=US>

Tool – Counting on Images

DotDotGoose by American Museum of Natural History

The screenshot displays the DotDotGoose software interface, which is used for counting birds in images. It is divided into several panels:

- Point Data (Left Panel):** Shows a survey ID (3) and a list of classes: Blue Adult, Canada Goose Adult, Canada Goose Juvenile, Juvenile, and White Adult. A summary table lists the counts for each class across several images.
- Image Data (Middle Panel):** Contains input fields for X and Y coordinates, Custom Fields, Waypoint (145), Photo Quality (1), Mud (1), Grass (1), Shrubs (0), Water Present (0), and On Water (0). There are also buttons for 'Add Field' and 'Delete Field'.
- Survey ID CH_West (Right Panel):** Shows a list of classes: RFBO_Flying, RFBO_Nesting, RFBO_Roosting, RFBO_Unknown, and RTTR. A summary table shows the counts for these classes across images 2YBA3680.JPG and 2YBA3681.JPG.
- Image Data (Far Right Panel):** Contains input fields for X and Y coordinates, Custom Fields, Area (Crater Hill), Colony (West), Island (Kauai), Counter Name (JStenska), Image Quality (Poor), and Notes (Individuals accounted for in images 2YBA3670-72.JPG & 2YBA3676-80.JPG).

The central image shows a large group of birds on a rocky ground, and the right image shows a grassy field with scattered birds. The software interface includes various controls for loading, saving, and exporting data.

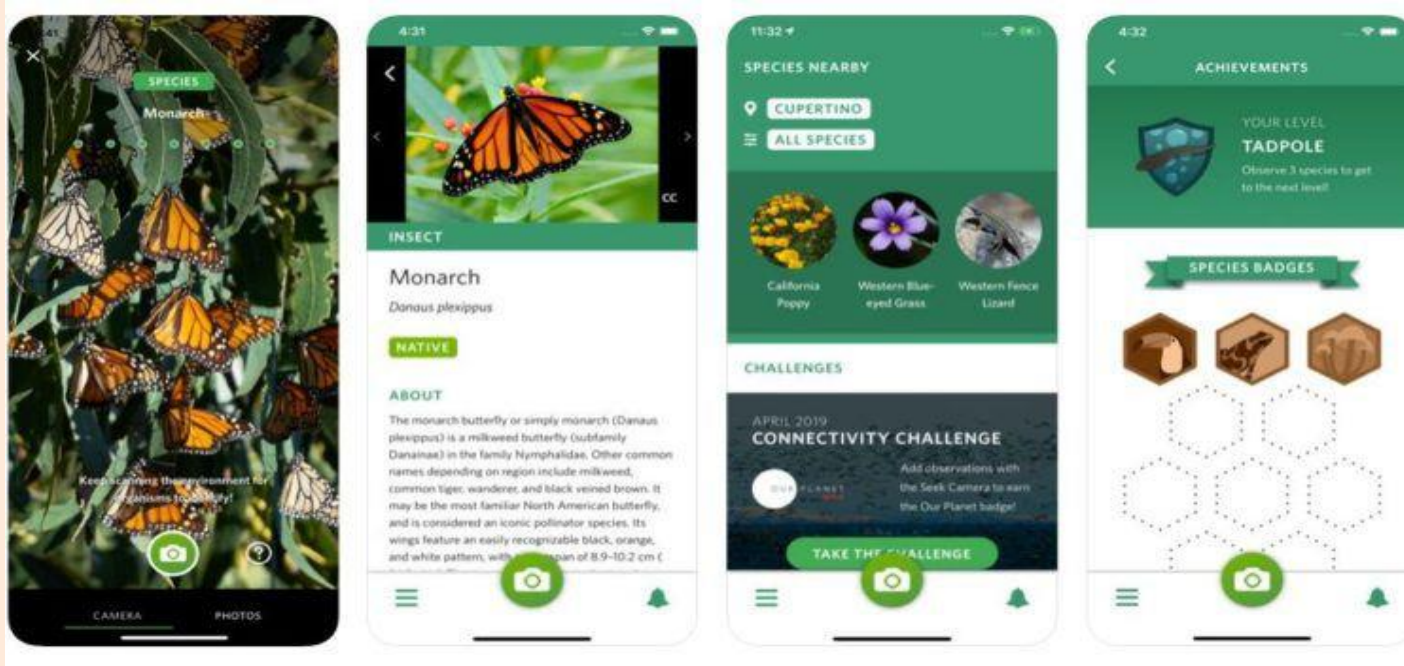
<https://www.amnh.org/research/center-for-biodiversity-conservation/capacity-development/biodiversity-informatics/software-counting-images-open-source>



Tool – Identification on Images



iNaturalist and Seek (Android & iPhone)



https://www.inaturalist.org/pages/seek_app

<https://play.google.com/store/apps/details?id=org.inaturalist.android&hl=en&gl=US>

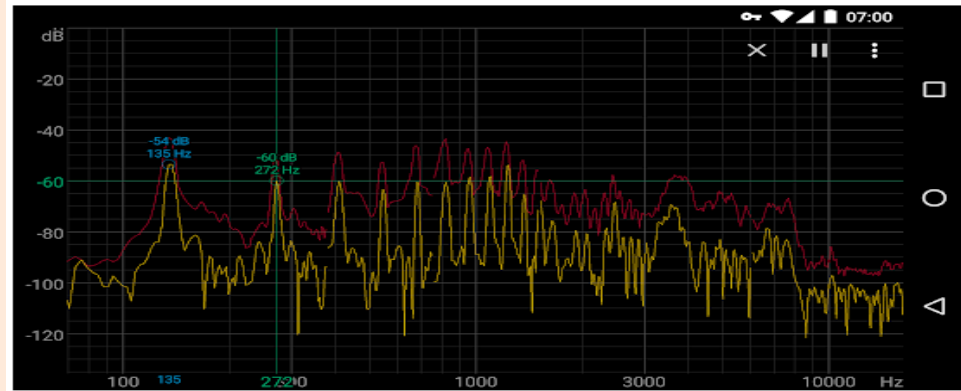
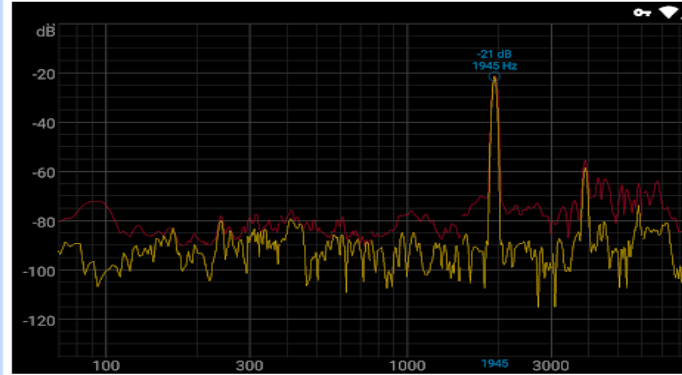
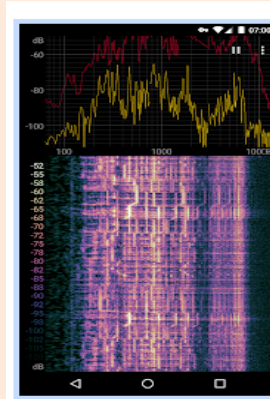
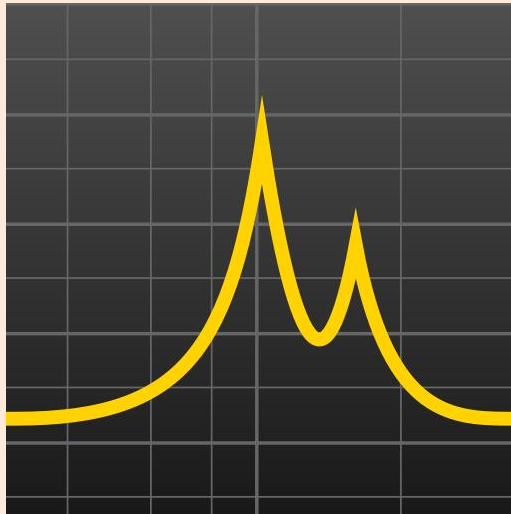


Tool – Sound Levels



Spectroid

Android / iPhone / Mac / iPad



<https://play.google.com/store/apps/details?id=org.intoorbit.spectrum&hl=en&gl=US>



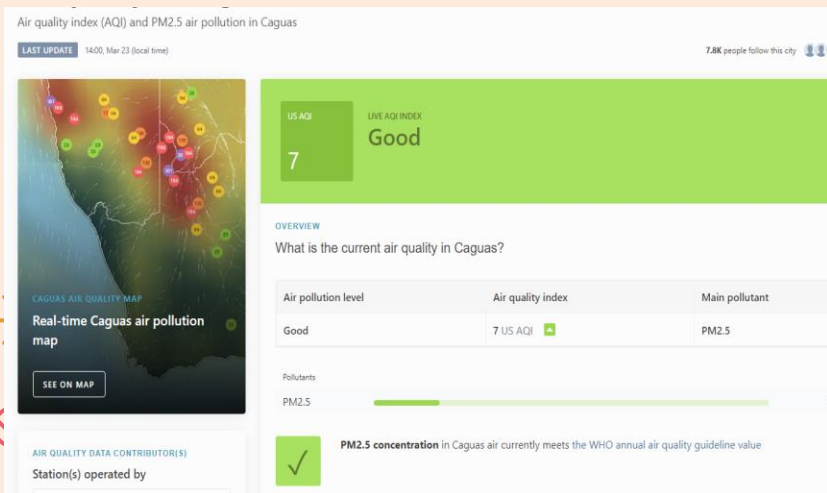


Tool – Quality Parameter - Air



IQ Air

Android / iPhone / Mac / Computer / iPad

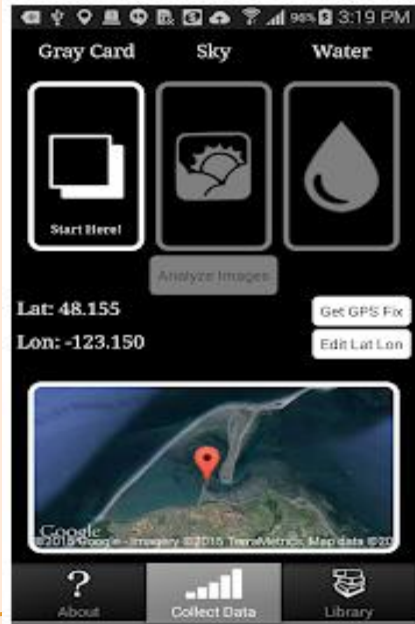


<https://www.iqair.com/>





Tool – Quality Parameter - Water



HydroColor – Water Quality App Android / iPhone / iPad



<https://play.google.com/store/apps/details?id=com.h2optics.hydrocolor&hl=en&gl=US>





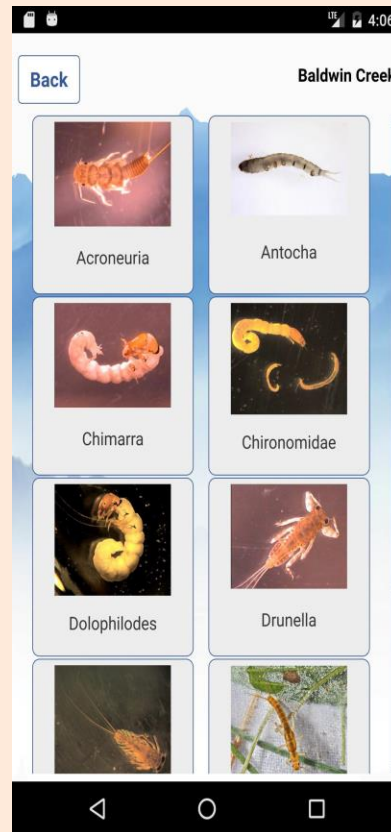
Tools – Quality Parameter - Water



Vermont EPSCoR Macroinvertebrate Field Guide

A cross platform of the
original EPSCoR iOS
application; buildable for
GNU/Linux, MacOS,
Windows, iOS and
Android.

<https://github.com/Vermont-EPSCoR/Macroinvertebrates>





Tools - Quality Parameter - Water

PR Macroinvertebrate Photographic Guide (PDF Document)



Índice BMWPPR

- El valor de tolerancia se asigna una sola vez por familia, independientemente de la cantidad de individuos que sean recolectados.
- El valor del índice para cada sitio se obtiene sumando los valores de tolerancia (T) de cada familia ($BMWP = \sum T_i$).
- Este valor permite determinar la calidad de agua de acuerdo a las categorías enlistadas en el Cuadro 1.

Cuadro 1. Clasificación de la calidad del agua de acuerdo al puntaje total para el BMWPPR.

BMWP-PR	CALIDAD DE AGUA
≥ 97	Agua de calidad excelente.
77-96	Agua de calidad buena, no contaminada o no alterada de manera sensible.
57-76	Agua de calidad regular, eutrófica, contaminación moderada.
37-56	Agua de calidad mala, contaminada.
18-36	Agua de calidad mala, muy contaminada.
≤ 17	Agua de calidad muy mala, extremadamente contaminada.

Índice IBFPR

- Este índice combina los valores de tolerancia con la abundancia de cada familia y el número total de individuos en una muestra.
- El valor del índice se obtiene de la sumatoria de multiplicar los valores de tolerancia de cada familia (T) por la abundancia de organismos (n) y dividiendo esto por el número total de individuos (N) recolectados ($IBF = \frac{\sum (n_i \cdot T_i)}{N}$).
- El valor obtenido es asociado a una categoría de calidad de agua enlistada en el Cuadro 2.

Cuadro 2. Clasificación de la calidad del agua de acuerdo al puntaje total para el IBFPR.

IBF-PR	CALIDAD DE AGUA	INTERPRETACIÓN DEL GRADO DE CONTAMINACIÓN	CATEGORÍA
0.00 - 4.24	Excelente	Contaminación orgánica poco posible.	1
4.26 - 5.11	Muy Buena	Contaminación orgánica leve.	2
5.12 - 5.98	Buena	Alguna contaminación orgánica.	3
5.99 - 6.85	Regular	Contaminación orgánica sustancial.	4
6.86 - 7.72	Regular Pobre	Contaminación orgánica muy sustancial.	5
7.73 - 8.59	Pobre	Contaminación orgánica severa.	6
8.60 - 9.46	Muy Pobre	Contaminación orgánica muy severa.	7

Autores: P.E. Gutiérrez-Fonseca¹ (gutifp@gmail.com), A.M. Alonso-Rodríguez² (aurapr15@gmail.com), A. Ramírez² (aramirez@ramirezab.net), Universidad de Puerto Rico, ¹Fundación Puertorriqueña de Conservación.

Fotografía: K. Rosas, L. Reyes, P.E. Gutiérrez-Fonseca. Universidad de Puerto Rico.

https://www.researchgate.net/publication/295854904_Guia_fotografica_de_familias_de_macroinvertebrados_acuaticos_de_Puerto_Rico





Tools – Diagrams & Graphic Organizers



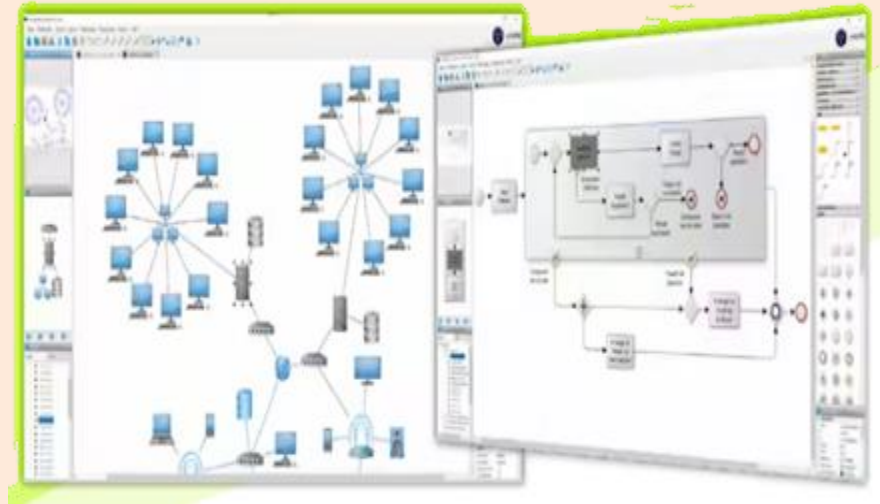
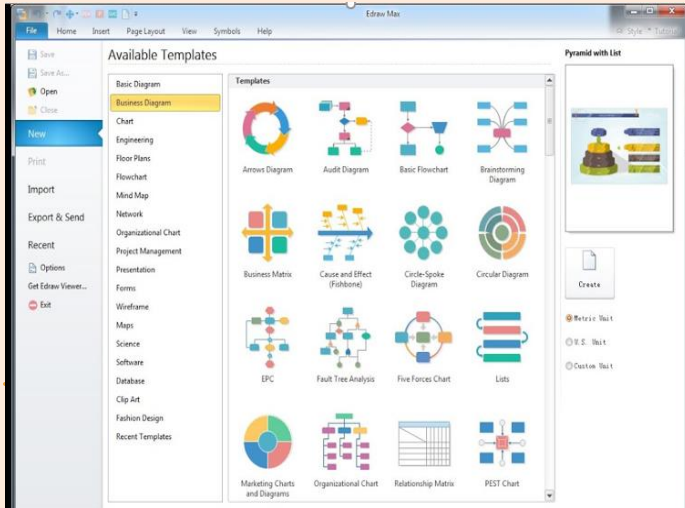
EDrawMax
(Computers / Tablets / iPads)

yEd
(Computers / Tablets / iPads)



https://www.edrawsoft.com/ad/edraw-max-soft-t.html?gclid=EAIaIQobChMIncOY-PHc9gIVDGKCh3swQ0zEAAYASAAEgINP_D_BwE

<https://www.yworks.com/products/yed>





Tools – Statistics, Simulations & Project Ideas



NCSS Statistical Analysis (Window / No MAC)



<https://www.ncss.com/download/ncss/free-trial/>

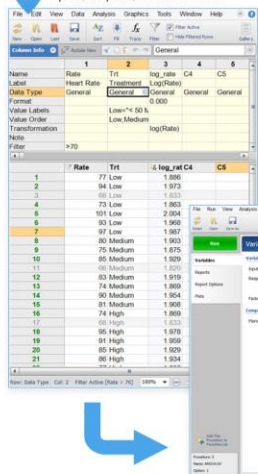
PASS 2022 Sample Size (Window / No MAC)

<https://www.ncss.com/download/pass/free-trial/>

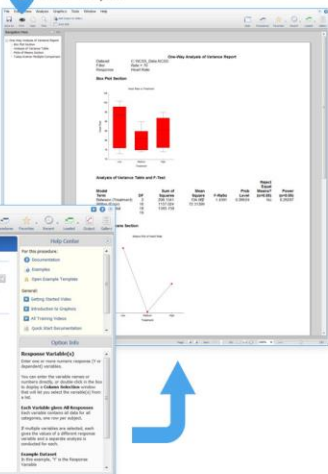
Analysis using NCSS

With a few easy steps you can obtain meaningful numeric results and clean, clear graphics.

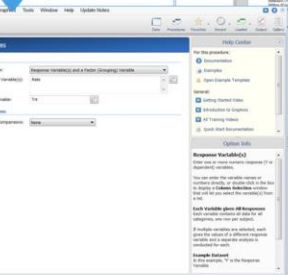
1 Open, Import, or Enter Data



3 View Output



2 Open a Procedure



Choosing a Procedure

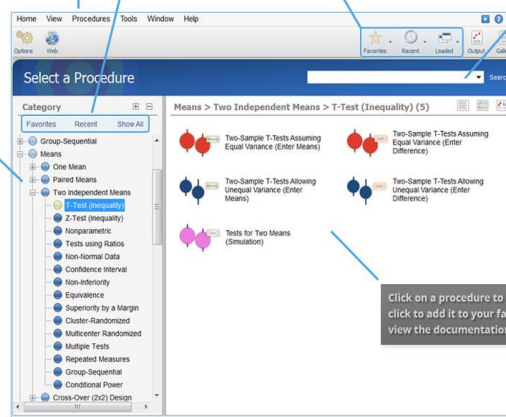
Procedures can be selected from any of the primary windows by selecting them from the menus

You can view all procedures, your favorites, or recently used procedures with a simple click from the menus

Favorites, recently used, and currently loaded procedures may be accessed from all major windows

You can enter a topic or key word into the search bar to find related procedures

Click on a category to see all the available procedures corresponding to that category from the menus



Click on a procedure to open it, or right click to add it to your favorites list, or to view the documentation



Tools – Statistics, Simulations & Project Ideas



CODAP (Common Online Data Analysis Platform) (Window / No MAC)

<https://codap.concord.org/for-educators/>



CODAP



Four Seals UNSAVED Version 2.0 (0444)

Tables Graph Map Slider Calc Text Plugins Undo Redo Tiles Options Help

Tracks (4 cases)				Measurements (858 cases)									
index	anim_id	species		index	day	date	month	latitude	longitude	distance	speed	depth	temperature
1	546	Elephant Seal		1	0	5/23/20...	May	36.99	-122.45			-62	8.1
2	541	Elephant Seal		2	1	5/24/20...	May	37.07	-123.21	33.9	1.41	-413	6.
3	536	Elephant Seal		3	2	5/25/20...	May	37.46	-124.39	56.49	2.35	-337	6.1
4	528	Elephant Seal		4	3	5/26/20...	May	37.87	-125.32	46.92	1.96	-703	4.1

Getting Started

Tracking data from elephant seals 546, 541, 536, and 528 are displayed in the Table, Map, and Graph. Use these tools to start exploring how these seals are behaving in different parts of the ocean.

The Table

- Take a look at how the table is organized, including the column headings on the left and right sides of the table. What happens when you click on the "-" or "+" symbols in the middle?
- On the left side of the table, click on elephant seal #528. Notice that the points from this seal's track are now highlighted in the Map and Graph. What happens if you click on a row on the right side of the table?

The Map

- To see which points belong to which elephant seal's track, drag the animal_id column heading to the center of the Map.
- Choose another column from the right side of the table (e.g., speed, depth, or temperature) and drag it to the center of the Map. What happens?

EDC OCEANS of DATA INSTITUTE

Roller Coasters UNSAVED Version 2.0 (0498)

Tables Graph Map Slider Calc Text Plugins Undo Redo Tiles Options Help Guide

Age_Groups (3 cases)			Roller Coasters (157 cases)			
index	Age_Group	up	index	Coaster	Park	City
1	Toddler		1	Zippin Pippin	Libertyl...	Mer
2	Zwecent		2	Jack Rabbit	Kennyw...	Wes
3	3newest		3	Thunderhawk	Dorney...	Alle
			4	Giant Dipper	Santa C...	San
			5	Thunderbolt	Kennyw...	Wes
			6	Wildcat	Lake Co...	Bris
			7	Coaster Thrill R.	Puyallu...	Puy
			8	Cyclone	Lakeside	Den
			9	Comet	Hershey...	Her
			10	Comet	Walda...	Erie
			11	High Speed Thr...	Knobeels	Elys
			12	Bobsleds	Seabree...	Roc
			13	Starliner	Miracle...	Pan
			14	Swamp Fox	Family...	Myr
			15	Blue Streak	Cedar P...	San
			16	Cannon Ball	Lake W...	Roe
			17	River King Min...	Six Flag...	Eur
			18	Big Bend	Six Flag...	Aril
			19	Great America...	Six Flag...	Aus

Sample of US Roller Coasters Across Years

Roller Coaster Data - Sample of US Roller Coasters Across Years

Roller Coasters

53 of 64 Woodens (81.1%) are N

Percent

Wooden Steel

Max_Height (ft)

Year_Opened

Inversions

N Y

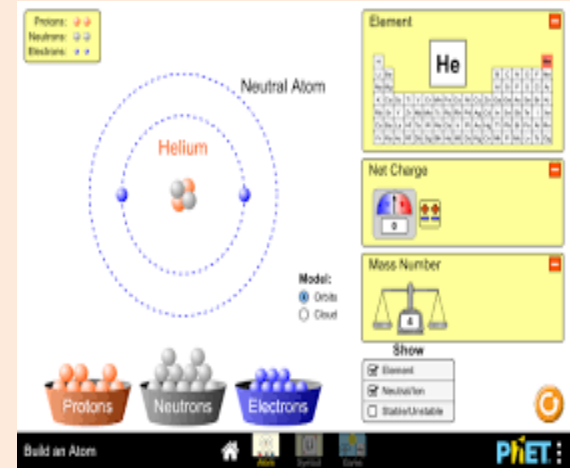
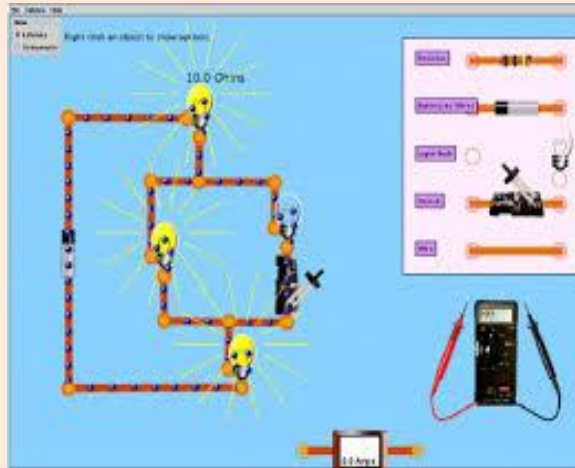
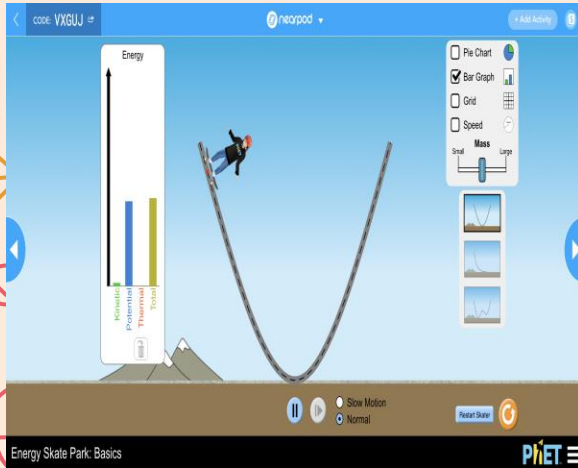


Tools – Statistics, Simulations & Project Ideas



PhET
(Computers / Tablets / iPads / Phones)

<https://phet.colorado.edu/>





Tools – Statistics, Simulations & Project Ideas



Old Cell Phones Project Ideas

<https://www.makeuseof.com/fantastic-diy-projects-made-with-old-phones/>





THE ONLY WAY TO
DISCOVER
THE LIMITS OF THE
POSSIBLE
IS TO GO BEYOND THEM INTO THE
IMPOSSIBLE.

Arthur C. Clarke

SUCCESS.com



Thanks!



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