Combined *STEAM* Art/Science Practices to *Engage* Students into Ecological Science

Brandon Ballengée, Ph.D.
Fundació Catalana per a la Recerca i la Innovació , 28 IX 17

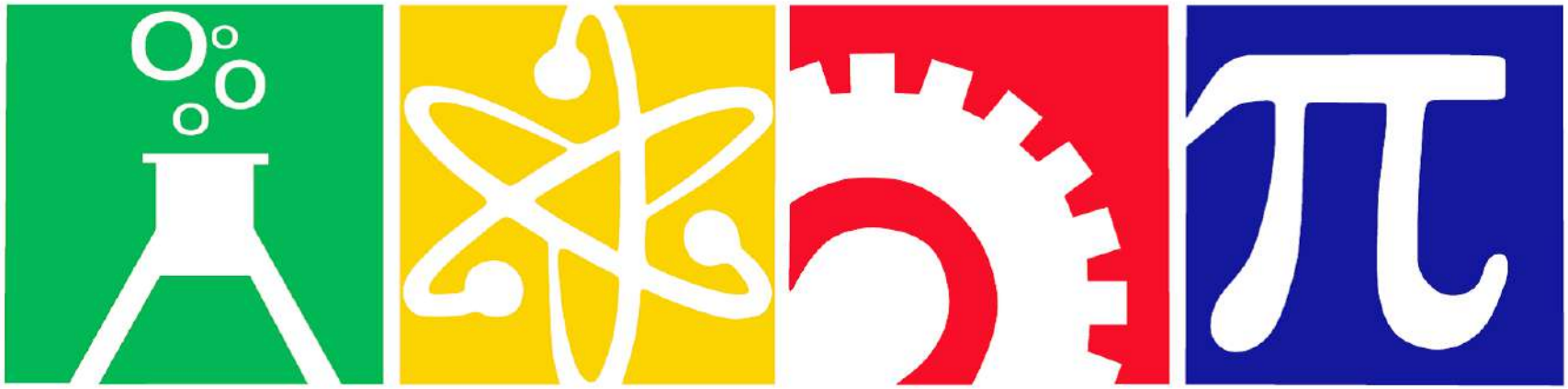
FCRi
Fundació Catalana per a la Recerca i la Innovació

U.S. Consulate General Barcelona

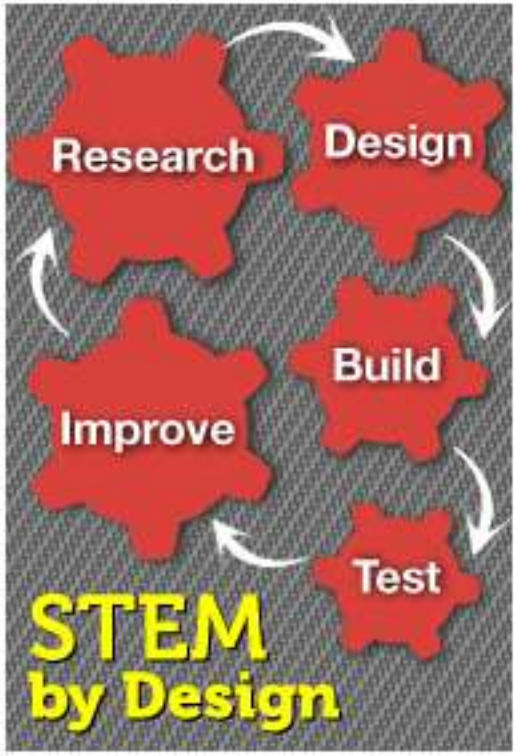
Outline of talk:

- **Introduction to STEM**
- **STEM to STEAM**
- **Recent changes to Science and Art**
- **Past projects: Engaging students about Ecology**
- **Example for you to try!**

What is STEM?



STEM Science, Technology, Engineering, Mathematics



STEM education = integration of science, technology, engineering, and mathematics to *solve real world problems*.

These solutions require *innovation*, creativity, analysis, teamwork, and communication

+ *creative* engineering design process.

National Research Council. (2011). *Successful K-12 STEM education: Identifying effective approaches in science, technology, engineering, and mathematics*. National Academies Press.

What are the goals of STEM?

- To facilitate students " to think deeply and to think well so that they have the chance to become the innovators, educators, researchers, and leaders who can solve the most pressing challenges facing our nation and our world, both today and tomorrow" (U.S. Department of Education, 2017)

- To prepare students for an "increasingly science- and technology-driven world…to expand the STEM-capable workforce and to increase scientific literacy among the general public"

- Expand the STEM-capable workforce and broaden the participation of women and minorities in that workforce.

National Research Council. (2011). *Successful K-12 STEM education: Identifying effective approaches in science, technology, engineering, and mathematics*. National Academies Press.

S.T.E.M to S.T.E.A.M?

- **Emphasizes the value of creativity and arts-based learning in the sciences**

- **Relies on breaking down the distinction between disciplines traditionally seen as "creative" like the arts or music, and STEM disciplines traditionally seen as more rigid or logical-mathematical.**

- **The multifaceted issues and complex problems served by scientific thinkers today require 21st century professionals who go beyond disciplinary content, and are also creative thinkers who work between disciplines**

Henriksen, D. (2014). Full STEAM ahead: Creativity in excellent STEM teaching practices. *The STEAM journal*, *1*(2), 15.

STEAM advocates such as Dr. Nettrice Gaskins affirms the value of STEM but insist that the arts (including humanities) foster creativity, global awareness, design, and literacy; and provide an avenue for learning that adds to STEM.

- **The Key is creativity**
- **Creativity is the catalyst for learning**
- **Democratized interpersonal creative learning for all students regardless of race, sex, orientation or socio-economic status**

STEM
EDUCATION

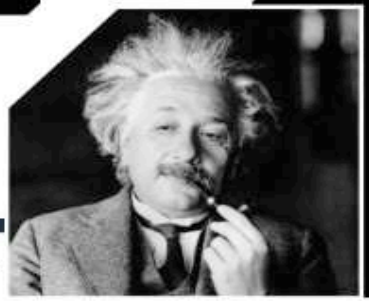
FULL STEAM AHEAD

THE NEW FRONTIER IN STEM STUDIES

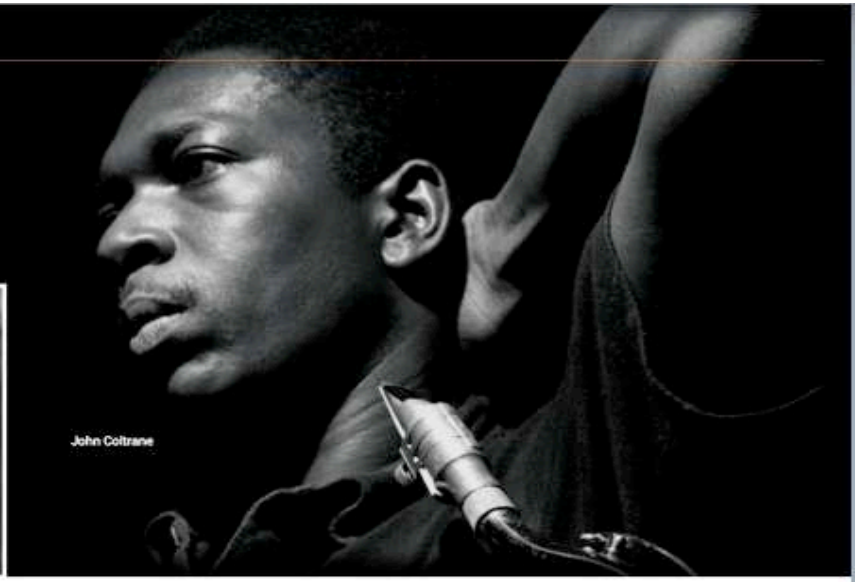
EVER LISTENED TO JAZZ AND THOUGHT OF QUANTUM PHYSICS? EVER STUCK ON A PROBLEM IN THE GALAXIES OF SCIENTIFIC ANALYSIS AND PONDERED HOW TO PLAY MOZART ON THE VIOLIN?

By Kate Alexander

JOHN COLTRANE did. So did ALBERT EINSTEIN.



Albert Einstein



John Coltrane

Today, as you consider career and college choices, you may be interested in a STEM career, but still feel the pull towards creativity and the arts. Or, you may be contemplating a creative field, such as theatre, dance or music, and think there is no room for you in a math-oriented or tech field, such as music engineering.

A growing trend in career preparation, however, is to explore interdisciplinary connections between subjects that have typically been "siloed." In fact, the human mind is not compartmentalized. We don't just know a lot about math. Or cooking. Or Shakespeare. Recognizing this, colleges and institutions are beginning to encouraging students and educators to consider arts within the context of science and technology. The result? STEM's "hot" new cousin, STEAM. It's adding the "A" to STEM to create STEAM.

In this issue of NextStepSTEM, we decided to investigate why STEM is turning more towards STEAM, and what exactly that means for students considering careers in science, technology, engineering, and math.

We spoke to three different experts in the field, Peter Osgood, Director of Admissions from Harvey Mudd College, Dr. Nettrice Gaskins, the Director of STEAM Lab at Boston Arts Academy, and Anne Jolly, a STEM educator and consultant.

STEMMING THE TIDE

The focus on STEM education began several years ago, as the nation came to grips with how crucial these skills are for the growing global economy. U.S. student rankings fell woefully behind other nations in technology and math subjects. We needed to turn the tide.

To improve standards, the President's Council of Advisors on Science and Technology (PCAST) issued a report, "Prepare and Inspire: K-12 Education in Science, Technology, Engineering, and Math (STEM) for America's Future" **http://bit.ly/1HleeOC**. It outlined the underrepresentation of STEM in education, and proposed solutions to instigate success in future careers, innovations, and solutions.

Anne Jolly, a STEM educator, consultant, and author of the 2016 *STEM by Design* **http://bit.ly/1tuztOO** (Routledge Press), explains that today, "businesses are asking us to produce employees with more technologically sophisticated skills, and a more in-depth mastery of science and mathematics."

This will help the economy and nation become more prepared for "the pressing challenges that students are going to be faced with; for example, climate change, food shortages, energy shortages, environmental problems, diseases increasing, clean water [needs], just to name a few," Jolly explains.

So, how do the arts open up new opportunities for students considering a career in STEM? Can integrating the arts help these larger goals?

Dr. Nettrice Gaskins, Director of the STEAM Lab at the Boston Arts Academy **http://bit.ly/2jcrIIT**, believes that the arts hold a key to unlocking all that STEM has to offer the world. On the one hand, she notes that STEM "encourages students to think innovatively, to experiment and to master technical know-how." However, humanities foster another avenue of learning and invention: they teach "creativity, global awareness and literacy." These skills not only enhance innovation and critical thinking in the science and technology fields, but are also needed for both the "current economy and moving forward in the 21st century," Gaskins adds.

In fact, Jolly believes that "arts is such a natural part of STEM that I would say it's not just complementary; it's integral." In other words, the arts inherently work hand-in-hand with science, technology, engineering and math. "You have to apply artistic principles if you're going to improve the appearance, design, or usability of a product."

The process is something that develops from both "sides" - STEM and STEAM. "Design doesn't come from the STEM side solely; it comes from art .. from the artistic or creative expression," Gaskins explains. "That then becomes an idea. Then, it becomes an experiment or something to tinker with. It becomes a design." It is the reason not to silo subjects (i.e. treat art and math as separate), but instead to find "the places of intersection," Gaskins says.

Peter Osgood, Director of Admission at Harvey Mudd College (**www.hmc.edu**), advises us that subjects did not always have the opportunity to "co-exist" and feed off each another. In the past, "we tended to treat each discipline as a discrete unit and almost didn't see all the parts connecting. So math stayed within the math confines, and physics didn't wander away from physics. Chemistry stayed within its confines, etc. And it turns out that that's not a very good model for science." Nor is it a very good model for solving problems - in the world, or for our enjoyment of the world.

Referencing the incredible strides in computer graphics for movies and video games, Jolly comments that, even though science and analytical processes are used to create them, ultimately, innovation is often "mind boggling. And that takes an artistic brain."

Gaskins believes that STEAM increases cross-disciplinary study. Within businesses and corporations that recruit from STEM fields, "they'll tell you how the lines are blurring" and students are expected to be able to work across fields and disciplines. She believes that STEAM came about as a result of seeing how STEM might not fully prepare students to be globally competitive in the 21st century workforce.

IS STEAM NEW?

In speaking with these three experts regarding STEAM in education, it became clear that the arts were far from new to science, technology, engineering and math.

The "A" in STEAM is not just an addition to the science and technology

"The most exceptional thinkers in fields like science or math are also highly creative individuals who are deeply influenced by an interest in, and knowledge of, music, the arts and similar areas" Henriksen, D. (2014)

Are Artists the New Interpreters of Scientific Innovation?

By GISELA WILLIAMS SEPT. 12, 2017

A self-portrait by the artist Hiroshi Sugimoto in the Oculist Witness eyeglasses he designed in 2014. Designed by Hiroshi Sugimoto, Produced by Lizworks and Selima Optique, ©Hiroshi Sugimoto

WHEN WE THINK OF ARTIST residencies today, we think of the MacDowell Colony, in the woods of New Hampshire, and of the Skowhegan School, in Maine. There's the Rome Prize fellowship, at the city's American Academy, and Donald Judd's Chinati Foundation, in Marfa. To be an artist in residence means removing yourself from the noise and obligations of regular life, and instead getting to concentrate on your creative life, often in a beautiful locale.

But once, an artist residency meant something very different: being embedded squarely within regular life, an experience meant both to inspire artists and to infuse what were seen as artless environments with creativity. In 1966, an artist n
and her husban
influential British conceptual artist, started the A
or A.P.G., in London, the goal of which was to en
industrial and government organizations to alle

T's Sept. 24 Design & Luxury Issue

See More »

Changes to Science and Art

The New York Times

Transdisciplinary or Transdisciplinarity?

Nicolescu, B. (2002) *Manifesto of Transdisciplinarity*. Voss, K-C., Tran. New York: SUNY Press.

Focussed on moving beyond disciplines for knowledge production

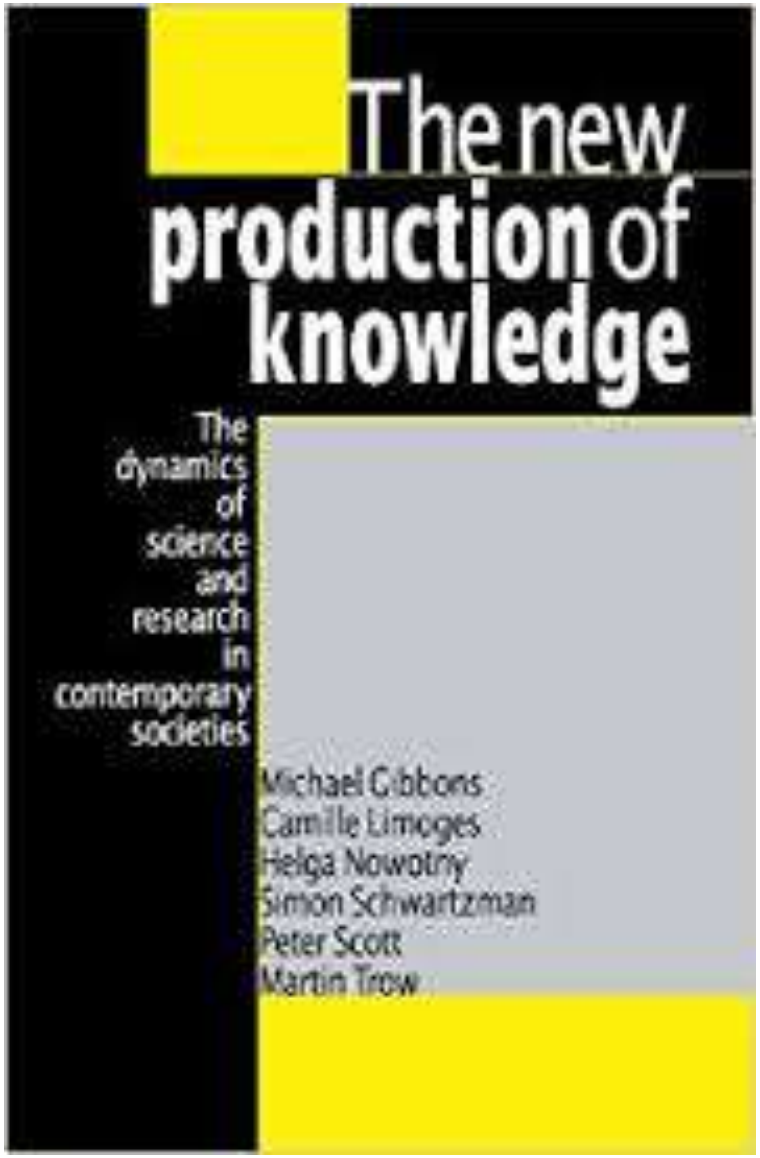
Mittelstraß, J. (2000) *Transdisciplinarity: New Structures in Science*. Presented at the Innovative Structures in Basic Research Conference of the Max Planck Society, 4–7 October

Focussed on real world problem solving

Nicolescu, B. (2002) *Manifesto of Transdisciplinarity*. Voss, K-C., Tran. New York: SUNY Press.

Mittelstraß, J. (2000) *Transdisciplinarity: New Structures in Science*. Presented at the Innovative Structures in Basic Research Conference of the Max Planck Society, 4–7 October

Changes in Science: Mode 2: Knowledge Production



Mode 1: Knowledge produced by scientists and largely remains in scientific community (silo). Operates autonomous from social goals and interests.

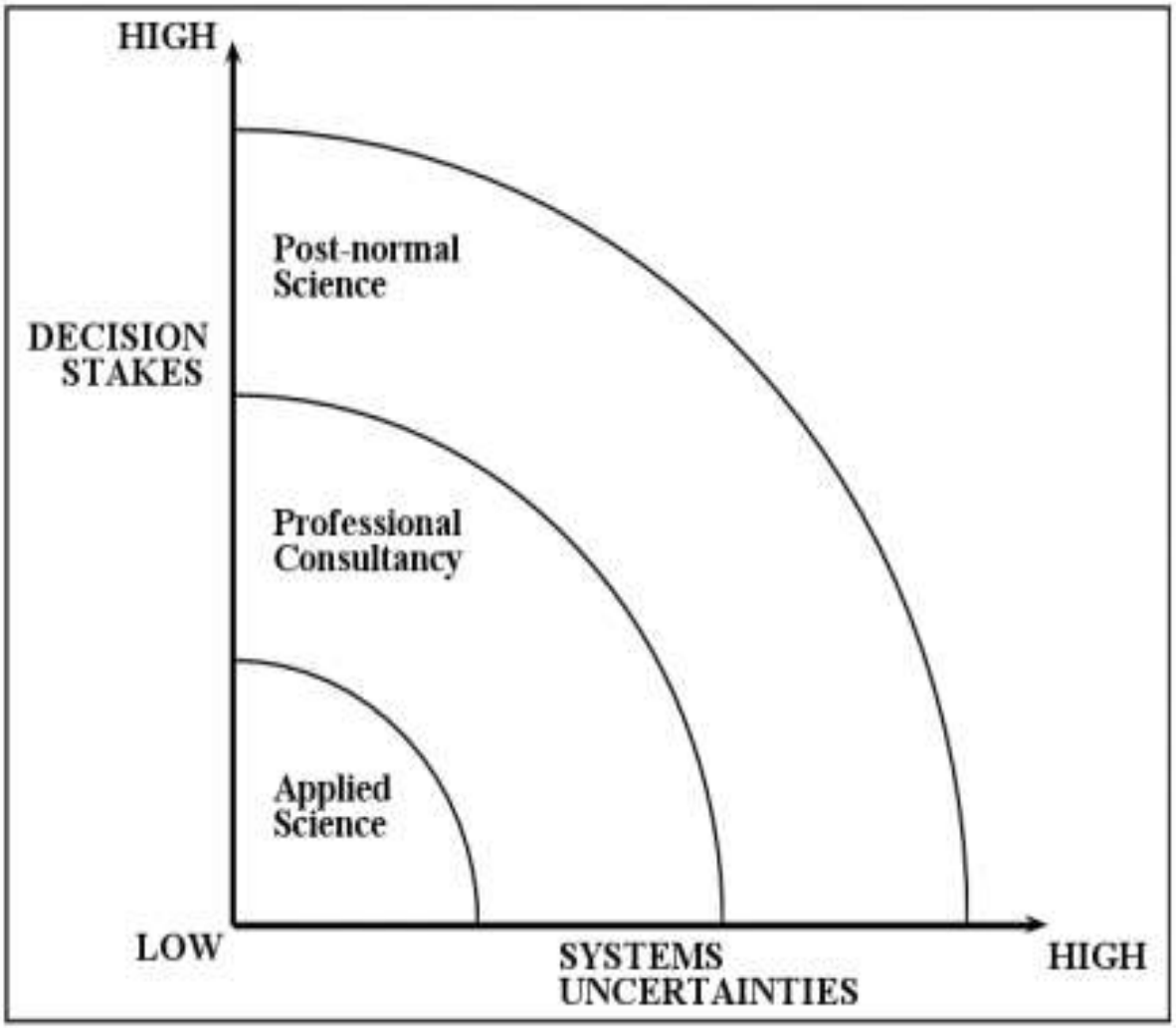
Mode 2: Transdisciplinary (Heterogeneous) knowledge production by individuals from diverse backgrounds- view points.

Reflective and flexible forms of research for complex problem-solving.

Knowledge socially distributed beyond science

Gibbons et al. 1994). *The New Production Of Knowledge: The Dynamics Of Science And Research In Contemporary Societies*. Sage

Changes in Science: 'Post Normal Science'



Funtowicz, S. and Ravetz, J. (1993) "Science for the post-Funtowicz, S. and Ravetz, J. (2003) 'Science for the Post-normal Age'. *Futures* 25, 735–755.

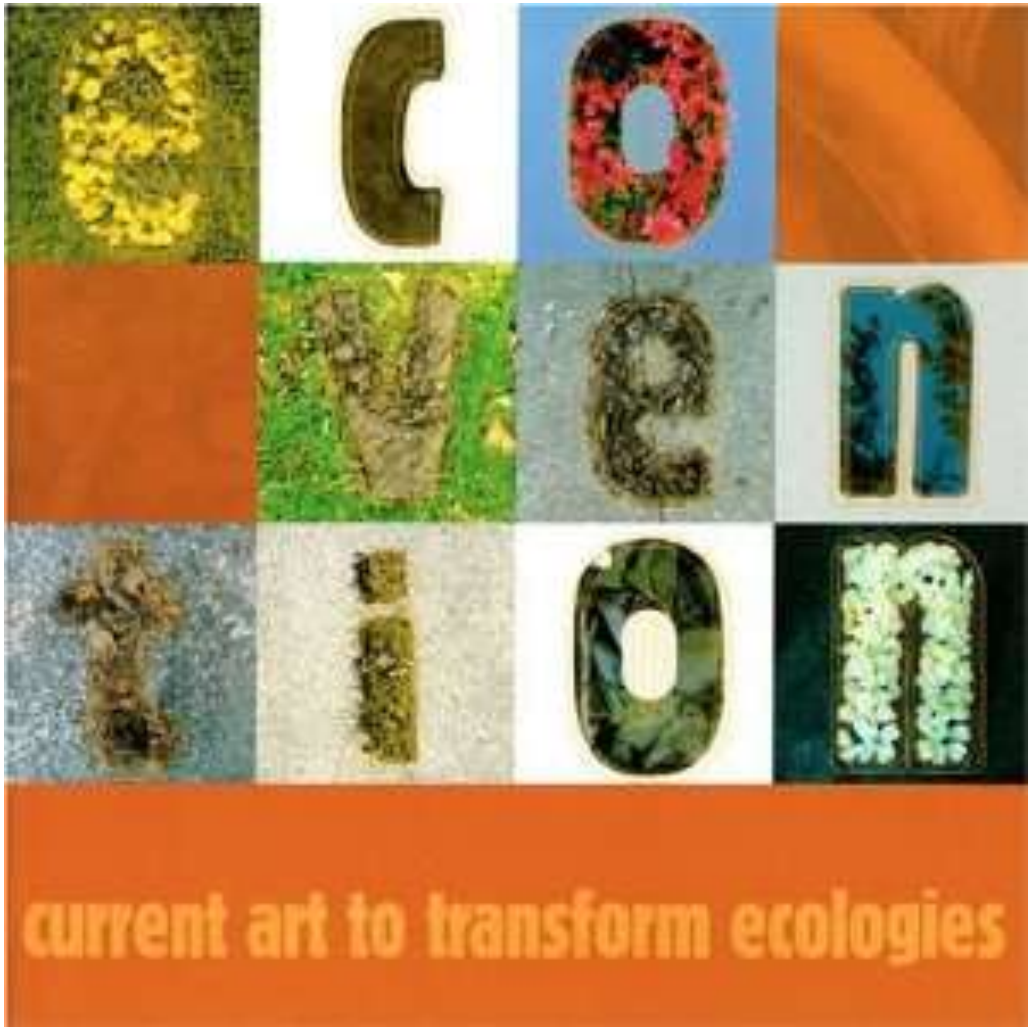
PNS Research is: problem-driven, creative and participatory (even local youth and stakeholders)

Temporal and adaptive to situation as situation constantly changes

Outcomes evaluated by larger society not just piers

Changes in Art

Ecology + Artistic Invention = *EcoVention*



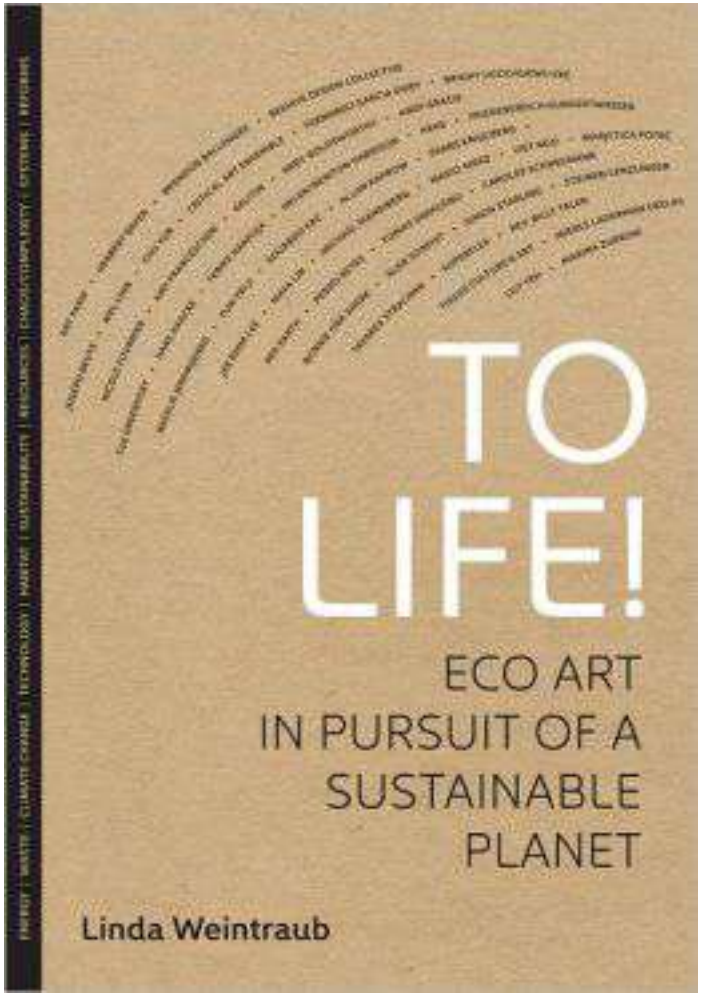
Projects are problem-driven and often participatory (with local youth and stakeholders)

Temporal and often adaptive to situation as situation constantly changes

Outcomes evaluated by society not just piers

Spaid, S. (2002). *Ecovention.* Cincinnati: The Contemporary Arts Center.

Changes in Art



Art + Ecology = *Eco Art*

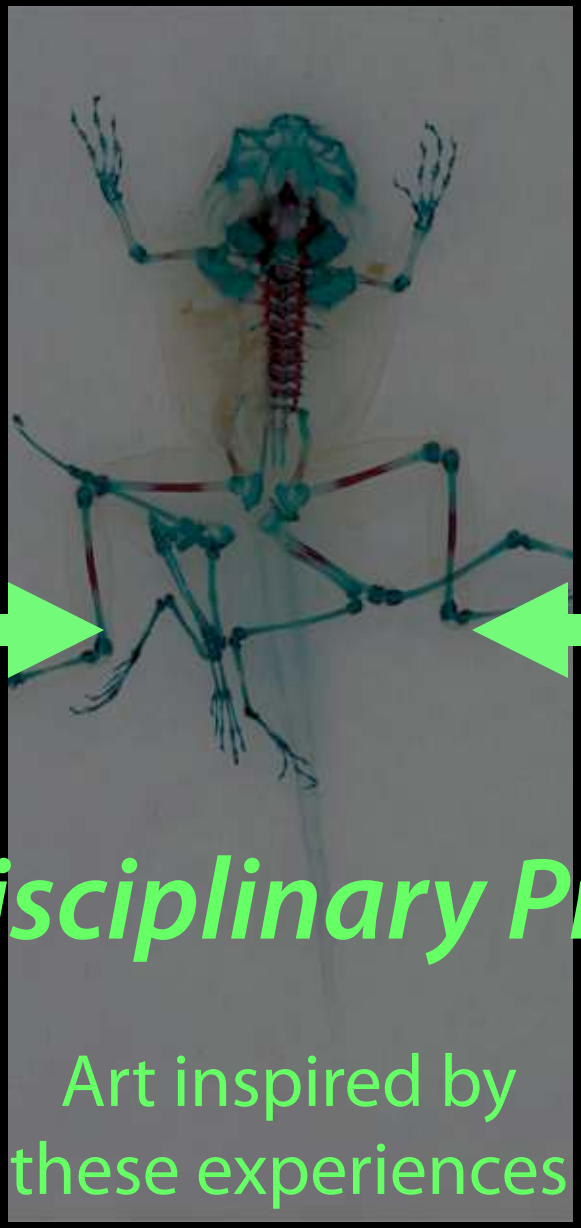
A Survey of
20/21st C. Artist instigated
creative art/ science projects towards
environmental and social
sustainability
+
guides citizens to integrate
environmental awareness,
responsibility, and activism into their
professional and personal lives

Weintraub, L. (2012). *To life!: Eco Art In Pursuit Of A Sustainable Planet*. University of California Press.

Past projects:

Engaging students about Ecology through science and art

Field and Lab
Biological
Research



Participatory
Eco-Ed
Programs

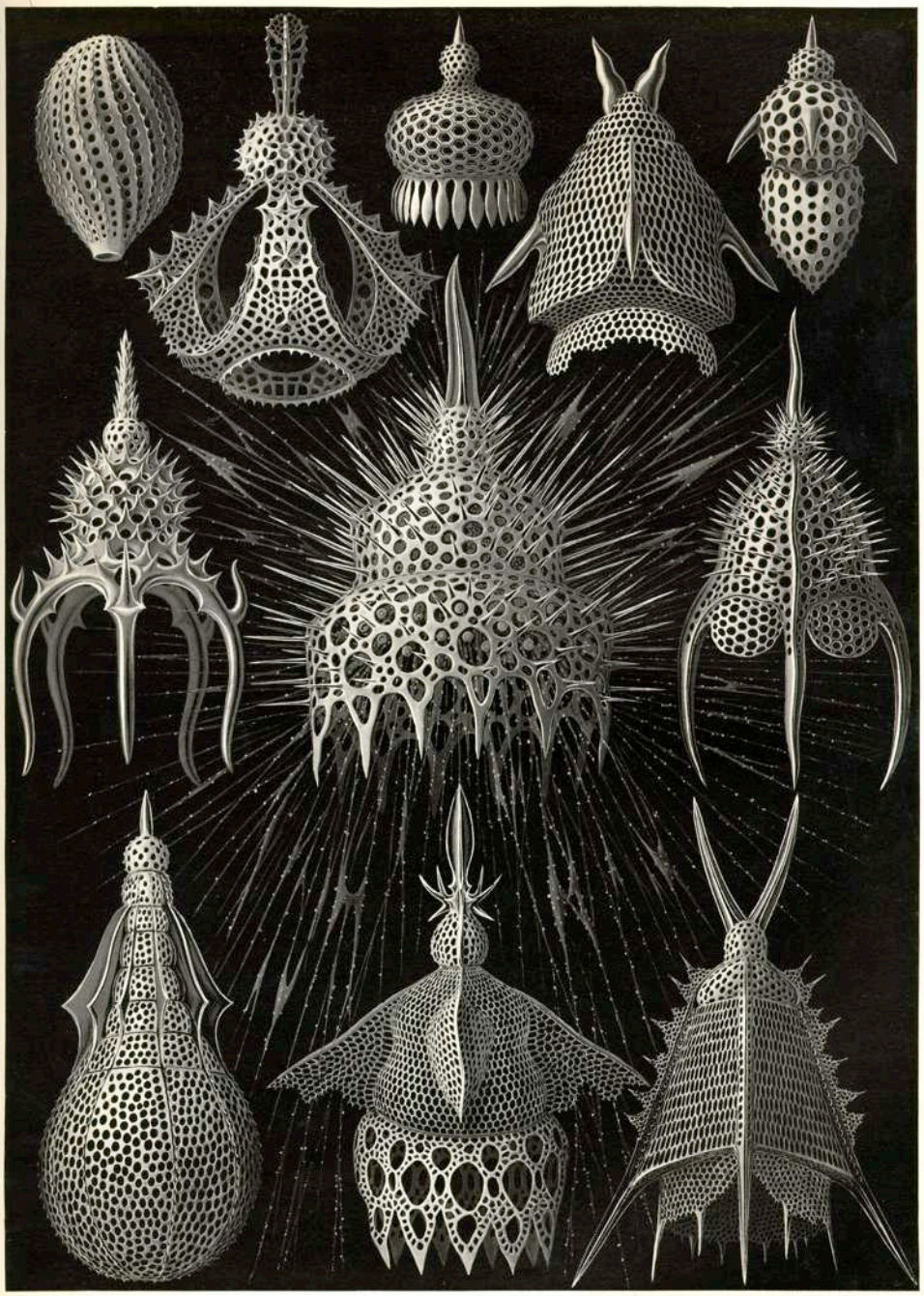
Transdisciplinary Practice

Art inspired by
these experiences

What is ecology?

Artist/ Scientist Ernst Haeckel created the term "ecology" from the ancient Greek word for "home"- "οἶκος" (oikos) in 1866.

The branch of science that is concerned with **the relationships between organisms and their environments** + the study of the detrimental effects of modern civilization on the environment, with a view towards prevention or reversal through **conservation**.



Cyrtoidea. — Flaſchenſtrahlinge.

Ernst Haeckel

Primary focus of scientific research and ecological art: 1996-2015:

Amphibians as 'bio-indicator' species

Of the known 7000+ species, over 1/3 up to 43% are already gone or are declining.

Amphibian deformities have been reported in six continents and appears to be increasing (at least among some populations)

Essonne, France 2012

Asia

The Americas

Africa

Australia

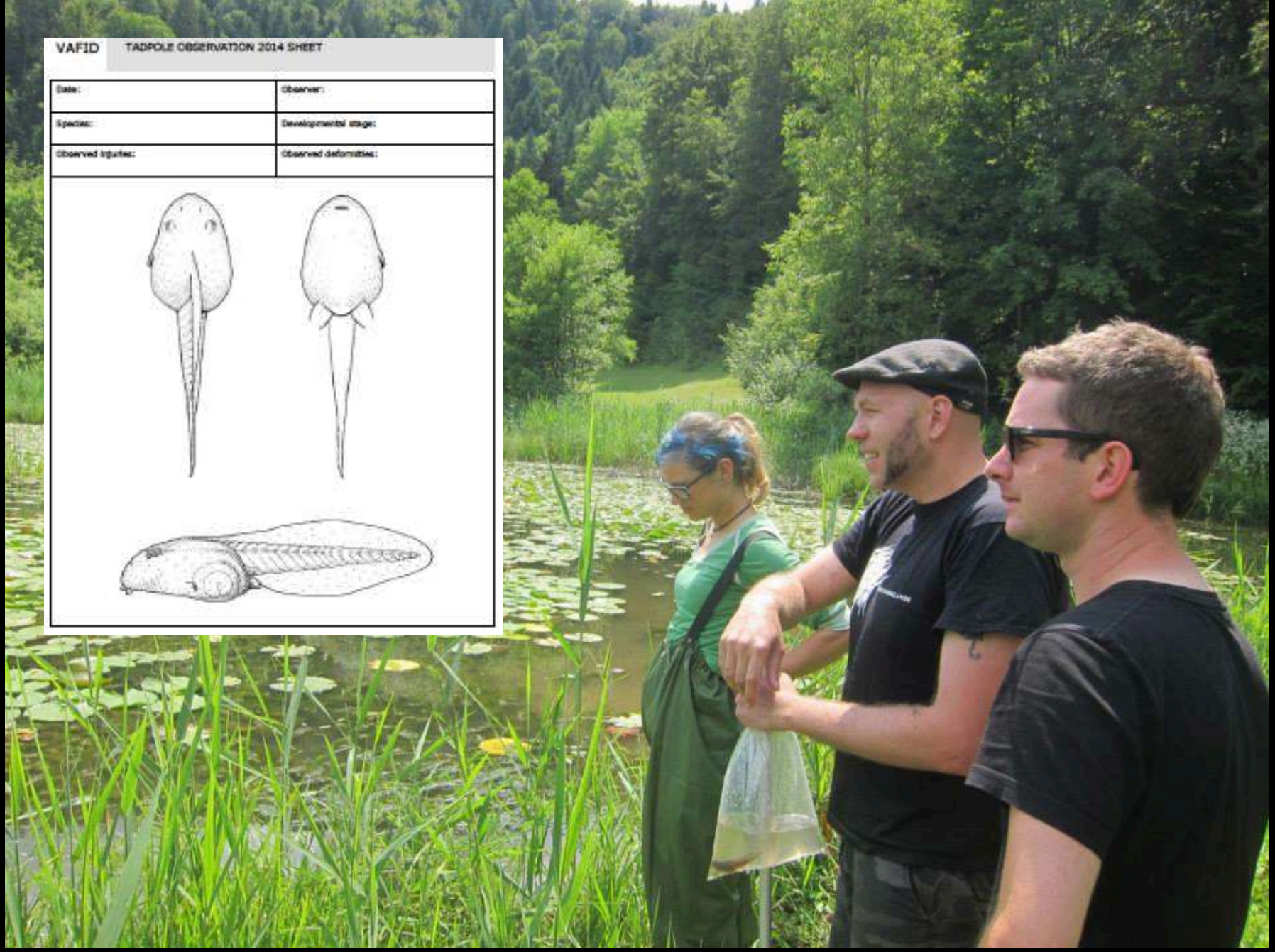
Eco-Actions= **Public participation in preliminary and primary field research/ experiential environmental field-trips**

Yorkshire Sculpture Park, England *Eco-Action* from 2006-08 Malamp UK studies. Photograph 2008 by Jonty Wilde

Piedmont, Italy *Eco-Action* from 2010 Malamp IT studies. Photograph 2010 by Orietta Brombin

Lough Boora, Ireland *Eco-Action* from 2010 Common frog/ *Rana temporaria* studies. Photograph 2010 by Kevin O'Dwyer

Chamarande, France *Eco-Action* from 2012-13 anuran studies. Photograph 2012 by Maeva Blandin



Greater Ljubljana, Slovenia *Eco-Action* from 2013 anuran studies. Photograph 2013 by Marc Dusseiller Dusjagr


PHILAELPH


69 Hz

ZARAGOZA
ECO-ACCIONES / /

Public Bio-Art Laboratories: England 2008

138 visitors to the lab answered questionnaires, of which 91% answered "yes" when asked "Did you learn anything about amphibians by visiting this open laboratory?" (Figure 8). However, the majority of visitors (51%) deemed the YSP Public Bio-Art Lab as "science" when asked "Is this art or science or both?"

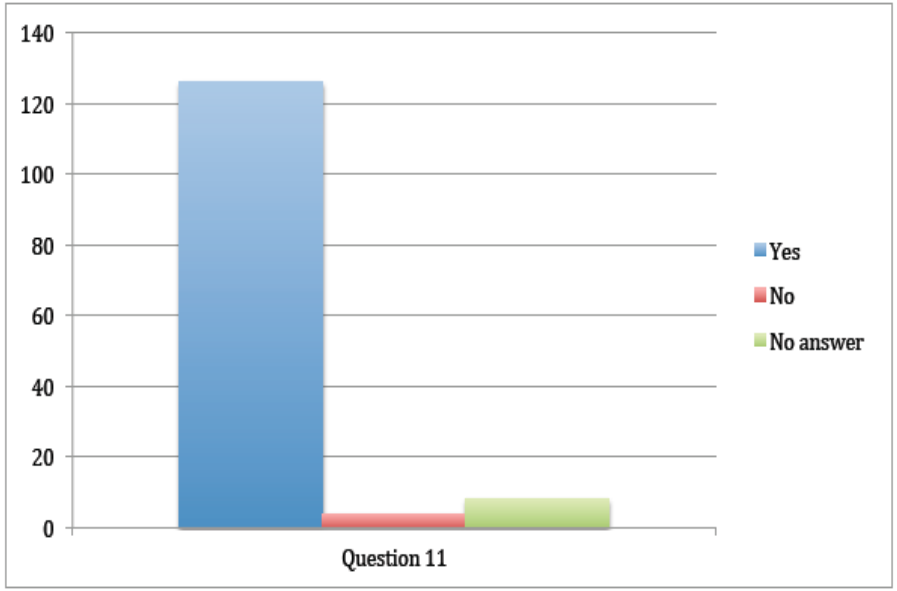


Figure 8: *YSP Public Bio-Art Lab* Questionnaire (June 1- August 1, 2008). Question 11. "Did you learn anything about amphibians by visiting this open laboratory?"

Public Bio-Art Laboratories: Canada 2010

Here only 56 visitors answered questionnaires, of which only 62% answered "yes" when asked "Did you learn anything about amphibians by visiting this open laboratory?" (Figure below). Additionally, most people (73%) viewed the lab as a dually art and science by answering "both" when asked "Is this art or science or both?"

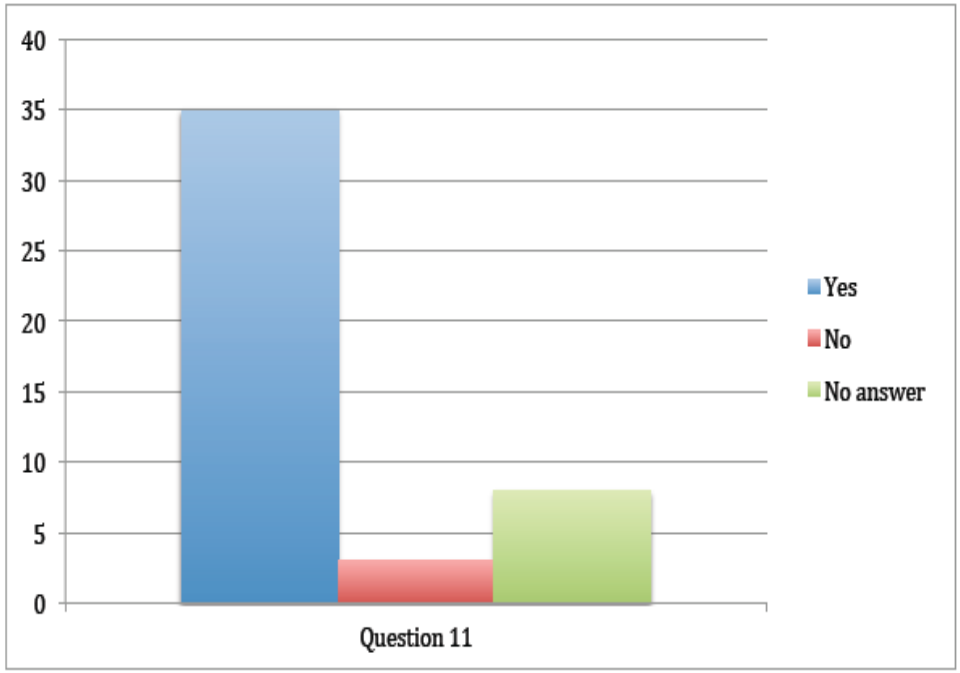


Figure 10: SAT Public Bio-Art Lab Questionnaire (May 15- September 1, 2009). Question 11. "Did you learn anything about amphibians by visiting this open laboratory?"

Amphibian Observation Sheet

Survey Data 1999

Amphibian Observation Sheet

Survey Data 1999

Amphibian Observation Sheet

Survey Data 1999

Amphibian Observation Sheet

Survey Data 1999

8. Invited public observation

Scientific Discoveries: Parasites!

Appears to be increased by agricultural practice

Figure: B. Ballengée & D. Szuroczki, 2009

Scientific Discoveries: Predators!

UK Studies 2005-08

2008 7 13

Appears to be increased by agricultural practice

Figure 4. Deformed hind limbs in wild-caught *B. bufo* tadpoles (top row) compared with hind limb deformities in tadpoles ((bottom row) induced by selective predation by captive dragonfly nymphs. Note protruding bone in the tadpoles second from left end in each row.

From Ballengée & Sessions, 2009. *Journal of Experimental Zoology*

JOURNAL OF EXPERIMENTAL ZOOLOGY (MOL DEV EVOL) 312B (2009)

Explanation for Missing Limbs in Deformed Amphibians

BRANDON BALLENGÉE[1] AND STANLEY K. SESSIONS[2*]
[1]*School of Computing, Communications and Electronics, University of Plymouth, Plymouth, United Kingdom*
[2]*Department of Biology, Hartwick College, Oneonta, New York*

ABSTRACT We present evidence that the most commonly found deformities in wild-caught amphibians, those featuring missing limbs and missing limb segments, may be the result of selective predation. Here we report that predatory dragonfly nymphs can severely injure and even fully amputate developing hind limbs of anuran tadpoles. Developmental responses of the injured/amputated tadpole limbs range from complete regeneration to no regeneration, with intermediate conditions represented by various idiosyncratic limb deformities, depending mainly on the developmental stage of the tadpole at the time of injury/amputation. These findings were reinforced by experimental amputations of anuran tadpole hind limbs that resulted in similar deformities. Our studies suggest that selective predation by dragonfly nymphs and other aquatic predators may play a significant role in the most common kinds of limb deformities found in natural populations of amphibians. *J. Exp. Zool. (Mol. Dev. Evol.) 312B, 2009.*

How to cite this article: Ballengée B, Sessions SK. 2009. Explanation for missing limbs in deformed amphibians. J. Exp. Zool. (Mol. Dev. Evol.) 312B:[page range].

Art

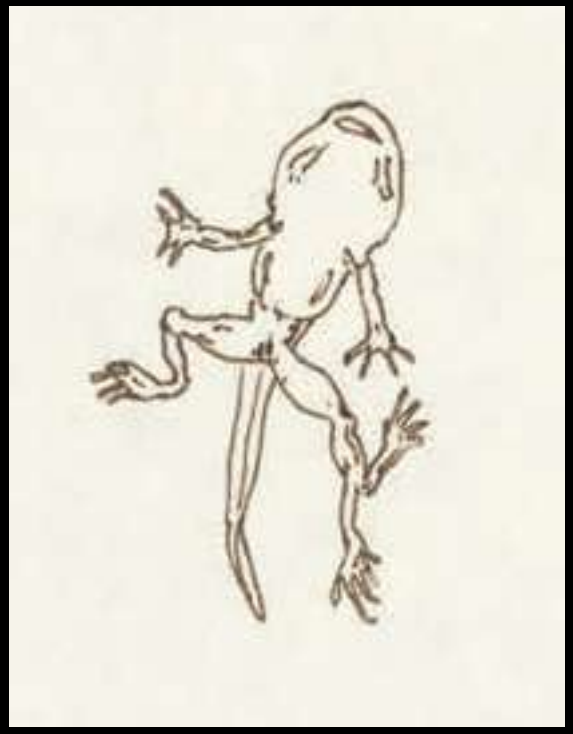
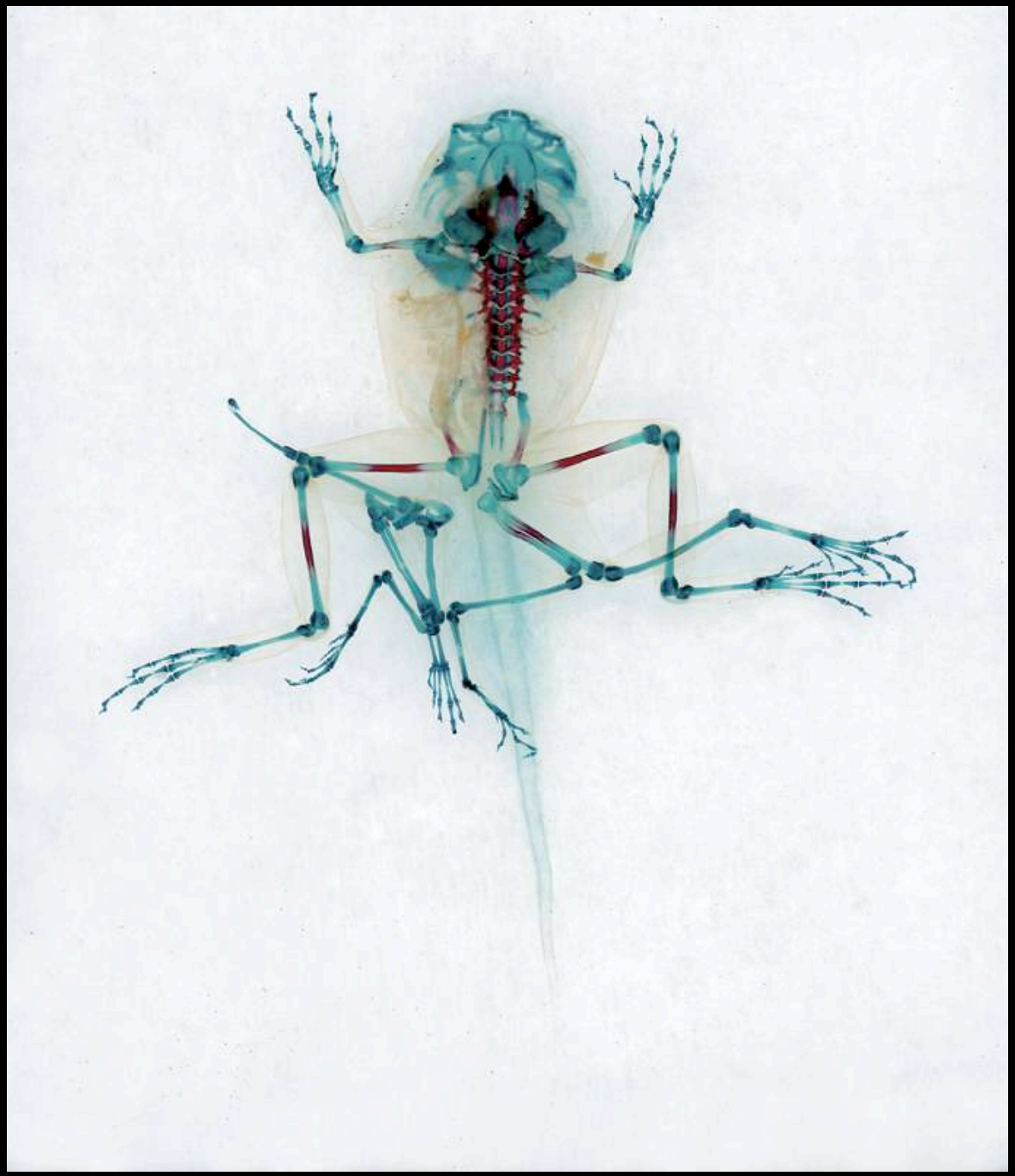
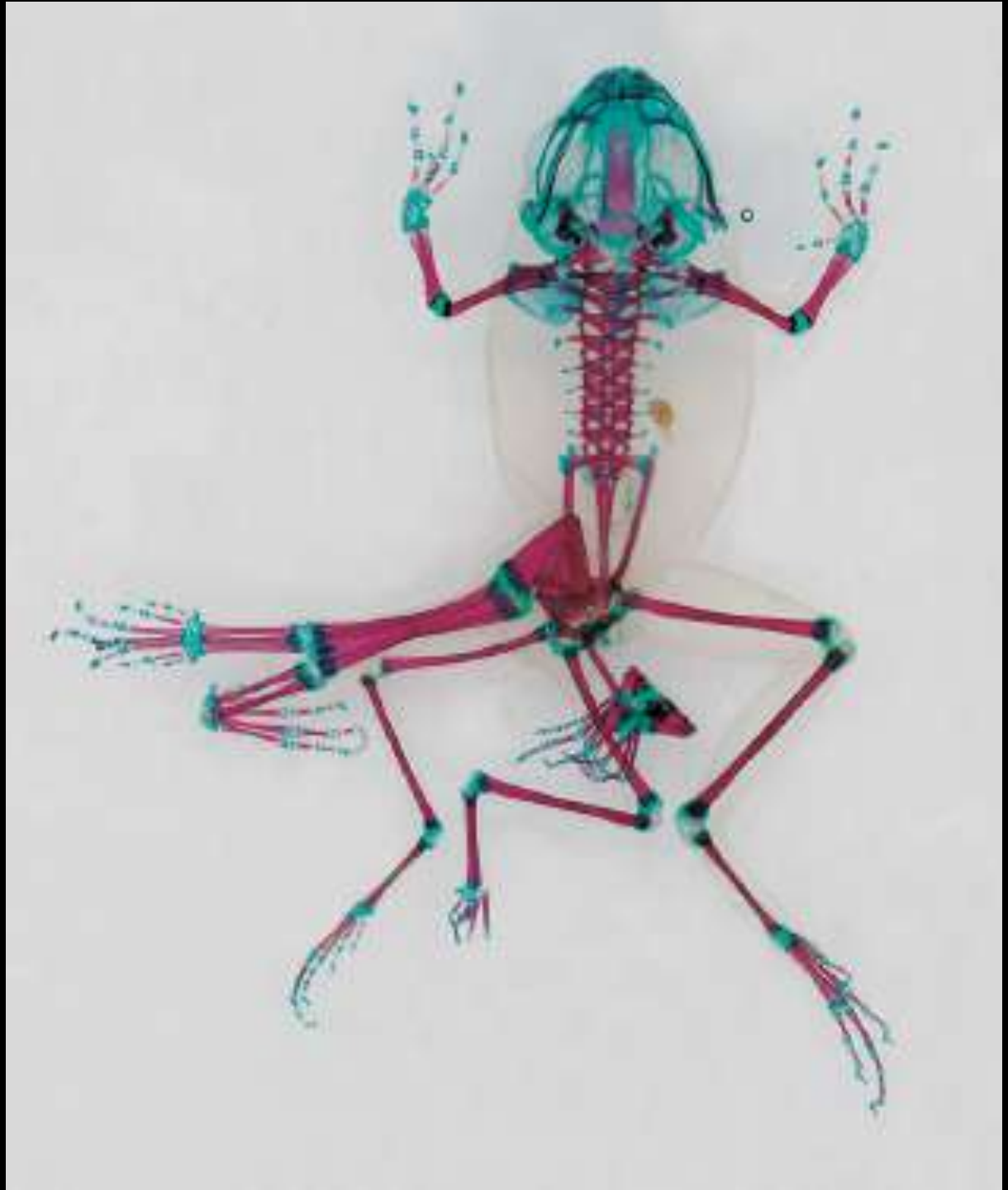


Figure 24. *Planétaire* by Nolwenn Gonenel, 2009. Digital-C photograph on acrylic resin. 57x72 cm.

Figure 25. *Untitled* by Zoé Brunelli, 2009, urethane casts of preserved deformed frog and vellum banner. 1.5 m x 3 m x 1.5 m



DFA 83, Karkinos
In scientific collaboration with Stanley K. Sessions. Titles in collaboration with the poet KuyDelair
2001/07



DFA 18, Triton

DFA 186, Hades
2012

DFA175.Ikaros

Taxonomías, CGMAFOSCA, Nucp de Arte y Pensamiento en Alella, Barcelona, Spain, 2007. Photograph by Elita Jaramillo

IN Water, ZSL Hasselt, Belgium, 2008. Photograph by Kristof Vrancken

Monster Sacré, Nowhere Gallery, Milan, Italy, 2008. Photograph by Luigi Acerra

Recent Exhibitions

Biotechnique, Yerba Buena Art Center, San Francisco, USA, 2007. Photograph by Phillip Ross

Biotechnique, Yerba Buena Art Center, San Francisco, USA, 2007. Photograph by Phillip Ross

Biological Agents, Gallery 400, Chicago, USA, 2008. Photograph by Tomasen Ejnar

2010 Deepwater Horizon oil spill in the Gulf of Mexico

Largest spill in history (Crone & Tolstoy 2010, Rabalais 2014)

John Amos, Skytruth: "Deepwater Horizon Oil Spill - Cumulative Oil Slick Footprint, April 25 - July 16, 2010

Graphic showing the cumulative oil slick footprint for the BP / Deepwater Horizon oil spill in the northeast Gulf of Mexico. Created by overlaying all of the oil slicks mapped by SkyTruth on satellite images taken between April 25 and July 16, 2010.

- **estimated at 206 million gallons of oil released with an immediate 'kill' zone greater than 200 kilometers wide** (GRN, 2011)

- **PB utilized 2 million gallons of chemical dispersants such as Corexit 9500, which made the effluents as much as 52% more toxic than the oil itself, inhibited hydrocarbon-degrading bacteria** (Hamdan & Fulmer, 2011; Rico-Martinez et al, 2013)

- **Thousands of kilometers Gulf floor layered with toxic sludge, shore impacts at greater than 1000 miles of fragile estuary ecosystems and beaches** (CRS Report R42942, Ramseur & Hagerty, 2014). **Increased reports of malformations in marine life** (GRN, 2012)

- **2013 United States Congressional Report estimates that after clean up efforts over 100 million gallons of oil and materials remain in the Gulf** (CRS Report R41531, Ramseur, 2013)

600-1000 species of fishes (77 of which are endemic)

* Sources Chakrabarty et al. 2014

Crude Life: A Citizen Art and Science Investigation of Gulf of Mexico Biodiversity after the Deepwater Horizon Oil Spill (2016-ongoing)

Prosanta Chakrabarty, Ph.D.: Professor of Biology and Scientist (Fish expert) at Louisiana State University (Baton Rouge, Louisiana).

Sean Owen Miller: Artist, designer, and Professor at the University of Florida (Gainesville, Florida).

Rachel Mayeri: Artist, Designer, and Professor of Media Studies, Harvey Mudd College, (Claremont, California)

Lise M Frandsen Autogena: Artist, Filmmaker, and Professor of Cross-Disciplinary Art, Sheffield Hallam University (Sheffield, England).

Suzanne Fredericq, Ph.D.: Professor of Biology and Scientist (Algae expert) at University of Louisiana Lafayette (Lafayette, Louisiana).

And others!!!

THE NATIONAL ACADEMY OF SCIENCES

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KECK FUTURES INITIATIVE

LSU ICHTHYOLOGY

Biodiversity Data Journal 4: e8728
doi: 10.3897/BDJ.4.e8728

General Article

Five Years Later: An Update on the Status of Collections of Endemic Gulf of Mexico Fishes Put at Risk by the 2010 Oil Spill

Prosanta Chakrabarty[‡,§], Glynn A. O'Neill[|], Brannon Hardy[|], Brandon Ballengee[¶]

‡ Louisiana State Unviersity Museum of Natural Science, Baton Rouge, Louisiana, United States of America
§ National Science Foundation, Arlington, Virginia, United States of America
| Louisiana State University, Baton Rouge, United States of America
¶ Louisiana State Unviersity Museum of Natural Science, Baton Rouge, United States of America

The occurrence records of the 77 endemic species of the Gulf of Mexico were tallied using The Global Biodiversity Information Facility and FishNet2 from October-December of 2015

18% MIA (n=14 species)

WANTED

fish species missing since the 2010 Oil Spill

Mexican goby or Blackfin goby

Spreadfin Skate

Unnamed hagfish/
Eptatretus minor

Saltmarsh topminnow

Irksone eel

Fringefin lanternshark

Yucatan flagfish

Mardi Gras wrasse

Yucatan killifish

Yucatan or Golden silverside

Redface moray eel

Black driftfish

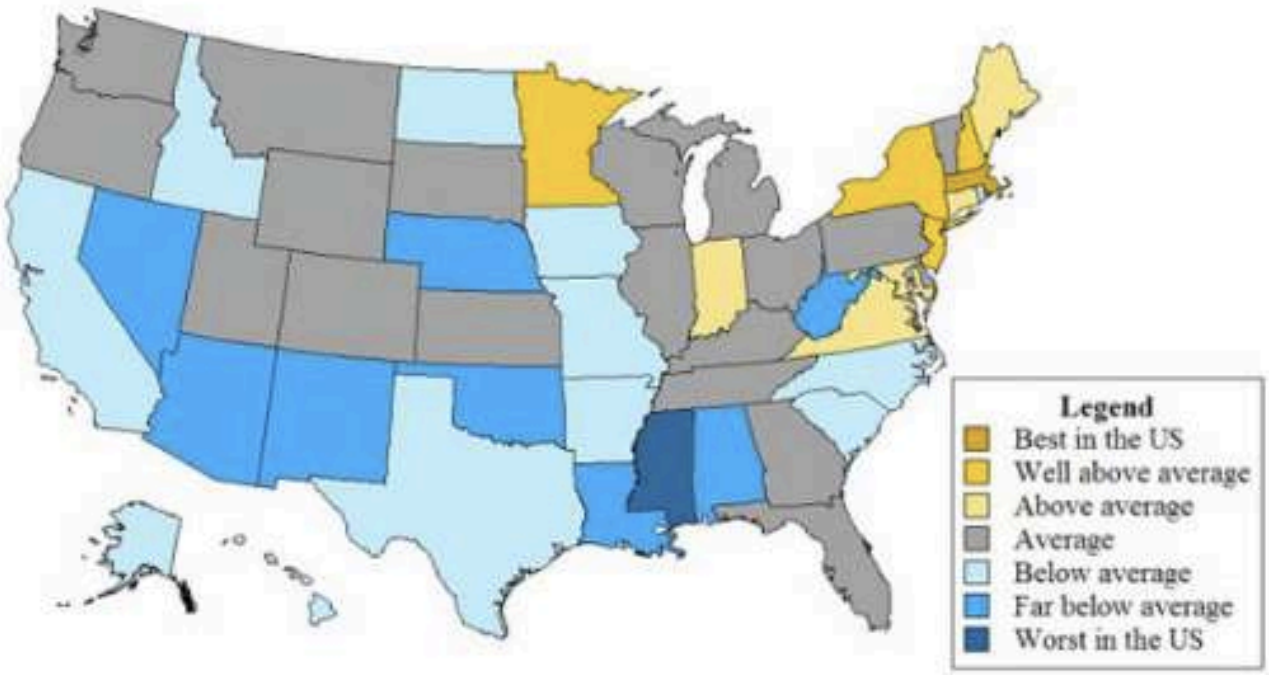
Key Brotula

King snake eel

If you find please contact
Brandon Ballengée and Prosanta Chakrabarty at
the Museum of Natural Science, Louisiana State University
119 Foster Hall
Baton Rouge, LA 70803
email: bballengee@lsu.edu
phone: 646-726-1387

States Ranked Best to Worst on Science Education

By Remy Melina | July 7, 2011 03:06pm ET



SERI data shows that most states are doing a poor job of educating students in physics and calculus.

Credit: Statistical Research Center | The American Institute of Physics


LIFE
LIFE


mpsite
25¢

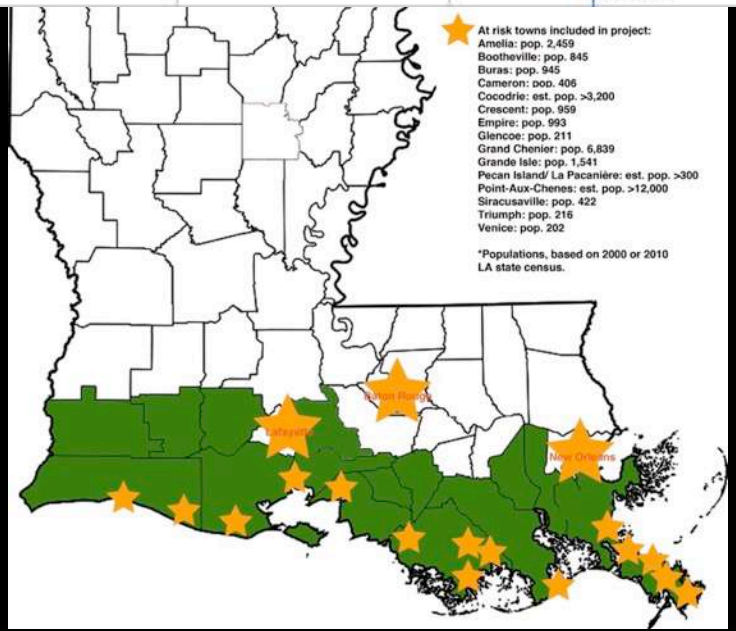

NISSAN


Natural Resources
STATE OF LOUISIANA
UNION JUSTICE
CONFIDENCE
SENATE


Magasin


KREATIVE KIDZ

Date	Location Name	Town	Parish	State	Event	Reach
29-Apr-17	NUNUs Artist Collective	Arnaudville	Saint Landry	LA	Semaine de Francaise Creative Summit	61
30-Apr-17	Pointe-aux-Chenes Marina	Pointe-aux-Chenes	Terrebonne Parish	LA	Blessing of the Fleet	60
6-May-17	Houma Civic Center	Houma	Terrebonne Parish	LA	Rougerou Ball	146
13-May-17	Army Core of Engineers Indian Bayou	Butte La Rose	Saint Martin	LA	Acadiania Master Naturalist Group	24
17-May-17	Studio in the Woods	New Orleans	Orleans Parish	LA	SYMBOLS Event	93
18-May-17	Five Points Brewery	New Orleans	Orleans Parish	LA	CSA Talk Series	50
19-May-17	NUNUs Artist Collective	Arnaudville	Saint Landry	LA	Community Potluck	80
25-May-17	Louisiana State Capital Building	Baton Rouge	East Baton Rouge	LA	Louisiana State Senate Natural Resource Committee	70
3-Jun-17	Bayou Teche Brewery	Arnaudville	Saint Martin	LA	Burning Crawfish Festival	150
8-Jun-17	Grand Isle Marina	Grand Isle	Jefferson	LA	Swollfest Fishing Rodeo	200
9-Jun-17	LUMCON	Cocodrie	Terrebonne Parish	LA	Friday Seminar Series	54
10-Jun-17	Cypremort Point State Park	Cypremort Point	Saint Mary	LA	Free Fishing Weekend	24
13-Jun-17	Paradise Bend Bar and Grill Dock	Pensacola	Escambia County	FLA	Beach Pop-Up	60
14-Jun-17	Pensacola Fishing Marina	Pensacola	Escambia County	FLA	Fishing Peer Pop-Up	40
15-Jun-17	EO Wilson Biophilia Center	Freeport	Walton County	FLA	Special exhibition	120
22-Jun-17	Docville	Arabi	Saint Bernard Parish	LA	Mississippi Delta Institute Teacher Training	73
23-Jun-17	Studio in the Woods	New Orleans	Orleans Parish	LA	Studio in the Woods Summer Youth Camp	27
23-Jun-17	City Park	New Orleans	Orleans Parish	LA	Summer Solstice Party	200
24-Jun-17	Acadiana Park Nature Station	Lafayette	Lafayette	LA	Special presentation	13
26-Jun-17	Pointe-aux-Chenes Marina	Pointe-aux-Chenes	Terrebonne Parish	LA	St. Benedict Academy Summer Camp	64
27-Jun-17	Pointe-aux-Chenes Marina	Pointe-aux-Chenes	Terrebonne Parish	LA	St. Benedict Academy Summer Camp	58
28-Jun-17	Pointe-aux-Chenes Marina	Pointe-aux-Chenes	Terrebonne Parish	LA	St. Benedict Academy Summer Camp	76
30-Jun-17	The Art and Science Museum	Baton Rouge	East Baton Rouge	LA	Special exhibition	36
					Total:	1779



Example for you to try! From Scales to Feathers

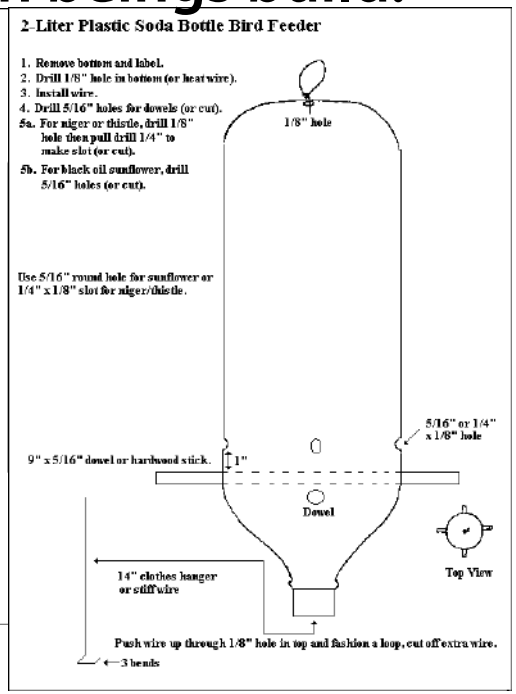
STEAM Approaches towards increasing Environmental Awareness through Urban Species Encounters

Utilizing urban species and pigeons in STEAM teaching ecology and natural history to grade-school students

Urban bird-watching! How can we engage students with pigeons?

1. Change sensory input = binoculars or change of framing
2. Learning to look= Development of search image
3. Specific observations=
What do they see individually? As a group? Describe through drawings or writing (can be done as a game- as species scavenger hunt) collect data

Creative Environmental Stewardship: Human beings build!



A few ideas:

1. Creating individual or larger "team" built bird feeders (can be made from recycled materials- embedding basic stewardship ideas) use engineering, design and art
2. Creating temporary habits or shelters for migratory birds with the entire class- imparting team building skills

How do we demonstrate principles of Darwinian evolution through pigeons?

Where do these birds come from and where are they now?
Darwin Principle: Movement or migration is the key to species adapting to new constantly changing environments

Can we use technology to tract these movements?

1. **Pigeon-cams**
2. **Bird migration satellite data**
3. **Citizen science data (your students can contribute)**

What do the pigeons themselves tell us about genetics?

What varieties can we see? Domestics? Wild-types? Urban?

Inheritance and variations of characteristics (genetics & phenotype plasticity)- collect the data through science and art!

How do we demonstrate principles of *urban ecology* through pigeons? Organisms in complex systems

How do these birds live (survive)? What do they eat? Where do the nest? How do they survive the winter?
***Natural selection in a post natural world*- organisms change!**
Behavioral and physical adaptations to changing environments

“Education is a social process. Education is growth. Education is, not a preparation for life; education is life itself.”

“Experience has its geographical aspect, its artistic and its literary, its scientific and its historical sides. All studies arise from aspects of the one earth and the one life lived upon it.”

-John Dewey
The School and Society

Mucho gracias!

What is Experiential Environmental Education?

The 3 E's to use with STEAM

Experience
a particular instance of personally encountering or undergoing something. the process or fact of personally observing. knowledge or practical wisdom gained from what one has observed, encountered, or undergone

Environment
The whole of surrounding things, conditions or influences. The social and cultural forces that shape the life of a person or a population *In the ecological sense* the air, water, minerals, organisms, and all other external factors surrounding and affecting a given organism at any time.

Education
the act or process of imparting or acquiring general knowledge, developing the powers of reasoning and judgment, and generally of preparing oneself or others intellectually for mature (HAPPY AND HEALTHY) life.

Helpful Books

1. Dewey, J 1938, *Experience and Education*, Collier Books, New York, New York

2. Freire, P 1971, *Pedagogy of the Oppressed*, Continuum Press, New York, New York

3. Hammerman, D R, W M Hammerman, E L Hammerman 1985, *Teaching in the outdoors*, Interstate Publishing, Danville, Illinois

4. Louv, R 2005, *Last Child in the Woods: Saving Our Children from Nature-Deficit Disorder*, Workman Publishing, New York, New York

5. Reed, E 1996, *The Necessity of Experience*, Yale University Press, New Haven, Connecticut, pp. 68-90

6. Rogers, C R 1969, *Freedom to Learn*, Merrill Publishing, Columbus, Ohio

Journal, Book articles & websites (just google Experiental Education or Environmental Ed-lots will come up!)

1. Gibbons, M & D Hopkins 1986, 'How experiential is your experience-based program?' in R. Kraft & M. Sakofs (eds.), *The Theory of Experiential Education*, Association for Experiential Education, Boulder, Colorado, pp. 135-140

2. Leopold A 1991, 'The Role of Wildlife in Liberal Education' in S L. Flader & J. B. Callicott (Eds.), *The River of the Mother of God and other essays by Aldo Leopold*, University of Wisconsin, Madison, Wisconsin, pp. 302-303

3. Light, A 2006, 'Ecological citizenship: The democratic promise of restoration efforts' in R Platt (ed.), *The Humane Metropolis: People and Nature in the 21st Century City*, University of Massachusetts Press, Amherst, Massachusetts , pp.169-180

4. Science Technology Society and Environment Education 2008, 'STSE Education Pedagogy', STSE Website, Retrieved 10 January 2009, from utoronto.ca, http://webspace.oise.utoronto.ca/~benczela//STSEEd.html

5. Solomon, J & G Aikenhead 1994, *STS Education: International Perspectives in Reform*, Teacher's College Press, New York, New York

7. Orr, D 1999. 'What is Education For?', in C Meine & R L Knight, *The Essential Aldo Leopold: Quotations and Commentaries*, University of Wisconsin Press, Madison, Wisconsin, pp. 255-268

8. Resznick, T 1995, 'Where Gaia Meets Mind' in M Gomes (ed), *Ecopsychology: Restoring the Earth, Healing the Mind*, Sierra Club Books, New York, New York, pp 1-20