PDB-101

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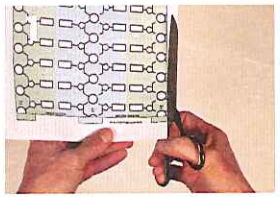
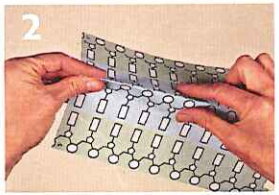
Build a Paper Model of DNA

Fill in the names of the bases on the model shown to the right, or use the detailed model that shows all the atoms in each nucleotide (back side of paper).

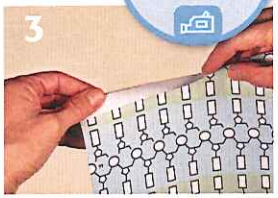
For a video demonstration, visit PDB-101 or bit.ly/19IlwNH



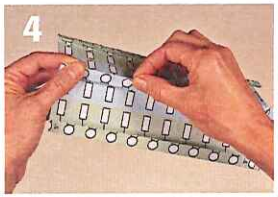
Cut out the model.



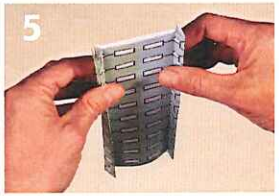
Fold all long creases first. Solid grey lines should be visible on the crease.



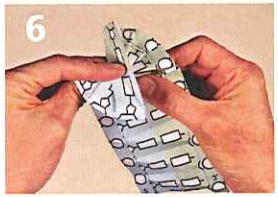
Fold dotted grey lines so they are hidden in the crease.



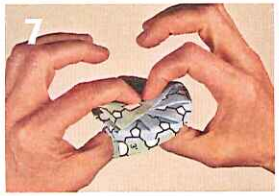
Fold the paper in half so that the backbone (with 3′ written at the top) pops out.



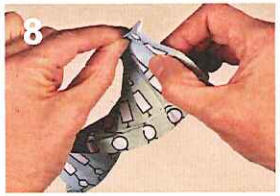
Tuck the other backbone flaps (with 5′ at the top) one over the other, so your model looks like the on in the picture.



Fold the backbones so the model is flat. Fold the horizonal and diagonal lines like a fan (solid lines should be visible on the crease, dotted lines on the inside).



Your model should look like this when all lines have been folded.



Pull the model open, and pop out the backbones on the sides.

Your finished model is a right-handed double helix. Use the tabs to connect several models to make longer strands.

About DNA

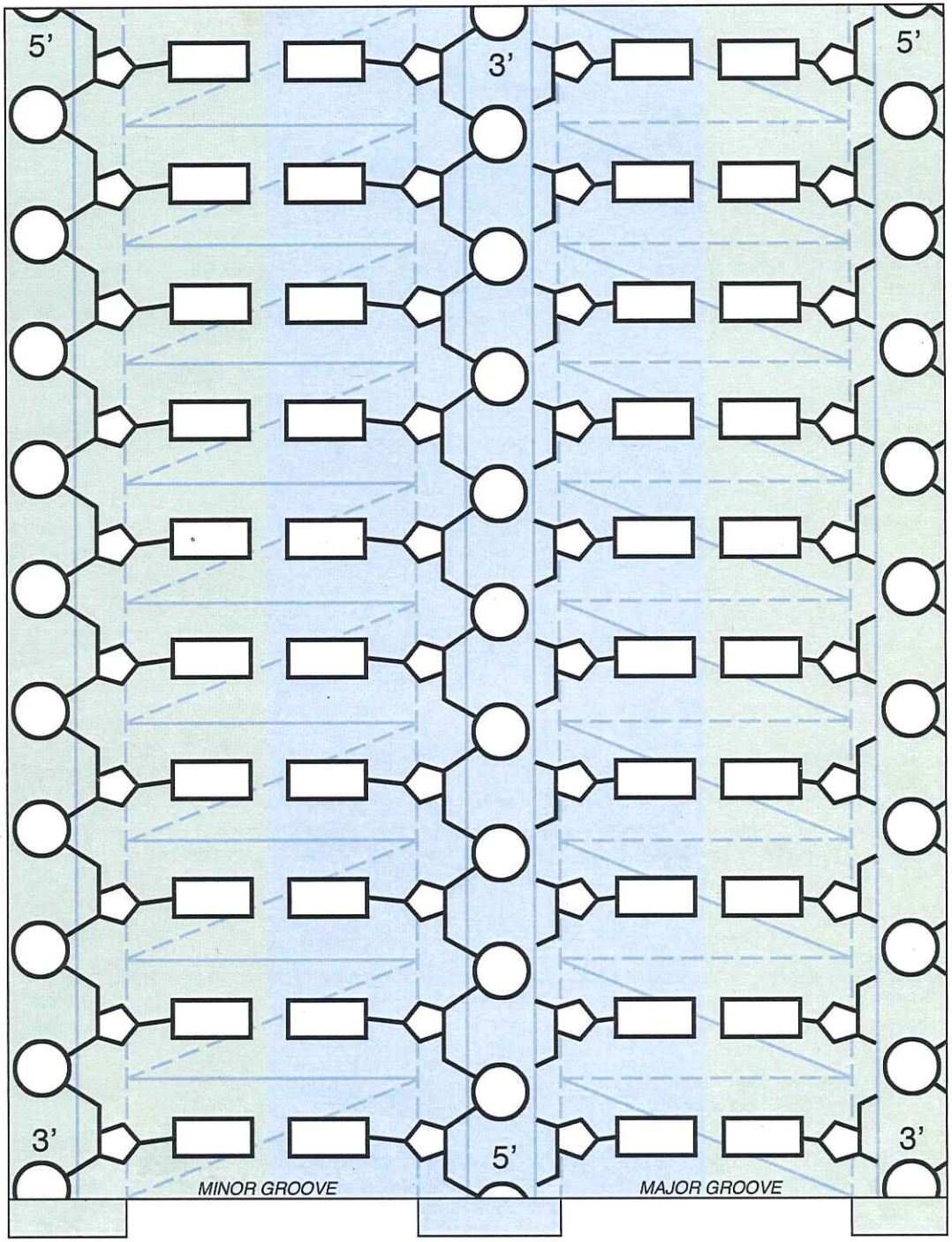
DNA is perfect for the storage and readout of genetic information, which is stored in the way the bases match one another on opposite sides of the double helix. Adenine (A) pairs with thymine (T), and guanine (G) with cytosine (C), with each pair forming a set of complementary hydrogen bonds.

The all-atom model (shown here on the second side) has the sequence C-G-C-T-T-A-A-G-C-G. Notice that this sequence is palindromic: if you take one chain and flip it around, it will form the proper base pairs with another copy of the chain. Add your own base pairs in the model to the right…but be sure to pair them up properly! The edges of the base pairs are exposed in the two grooves of the double helix: the wider major groove and the narrower minor groove. These edges are also used to carry information that is read by proteins that interact with the double helix.

For More

Read the *Molecule of the Month* feature on DNA at http://dx.doi.org/10.2210/rcsb_pdb/mom_2001_11

Download additional copies of this model from the *Educational Resources* section of http://www.rcsb.org/pdb101



iLabs

Northwestern University's Remote Online Labs for High School Science

Schools in Illinois, nationwide, and around the world are discovering the science labs of the future at **www.ilabcentral.org**

Northwestern is bringing high-end lab equipment to all students for free. We're building the technology & sharing our devices so students can analyze real experimental data. Our remote online labs—iLabs—make high school-level science investigations more ***authentic, engaging, and broadly accessible.***

"Every student of mine believes this is technology worth using in a high school class because they realize it is technology they will likely be using in some form in their futures."

Mark Vondracek, Physics Teacher, Evanston Township High School, Evanston, IL

Benefits of Remote Labs

Levels the playing field for all students and provides equal access:

- Accessible to resource-constrained schools or to any school or student wanting to use high-end equipment, no matter where they are
- Rural and urban districts can provide the same high-quality labs as suburban schools

Solves the funding/budget problems that prevent high school labs from being equipped:

- Less cost than traditional labs, and safer
- No need to purchase expensive lab equipment for every school in the district

Improves high school lab experiences for students:

- Increases learning time: students can do more labs per class due to the efficiency of less set-up/clean-up time and labs can be done outside of class—even at home
- Since the school year cannot be extended easily, investment in iLabs allows schools to do more in the same amount of time
- Making science exciting and relevant to students leads to meaningful experiences and real learning
- Supports implementation of Many of the NGSS scientific practices

Visit **www.ilabcentral.org** to view teacher and student testimonial videos and to explore our online labs from Northwestern and other universities around the world!

This work is supported in part by the National Science Foundation under grants IIS-1216389, OCI-0753324, and DUE-0938075, and DMR-1121262 (to the Materials Research Center of Northwestern University), and Hewlett-Packard under the HP Catalyst Initiative, HP Catalyst Leadership Fund, and HP Catalyst Academy Fellows Grant. However, any opinions, findings, conclusions, and/or recommendations are those of the investigators and do not necessarily reflect the views of the funders. We thank the University of Queensland for providing access to their remote lab facilities.

More Than 6000 iLabs Users Around the World to Date

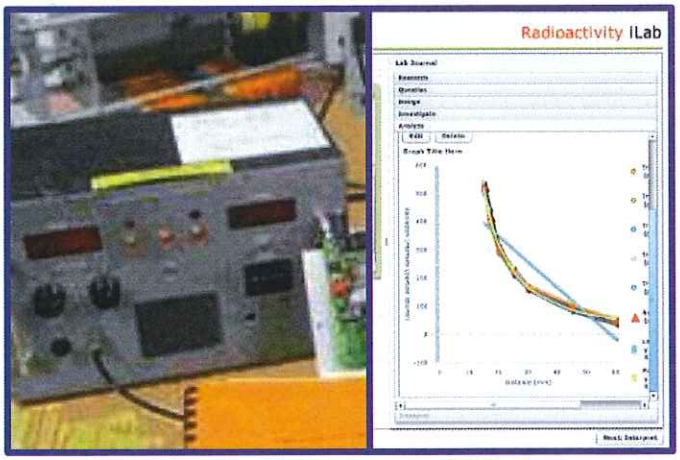
Data From Fall 2009 Pilot

- 20 teachers, 1000 Students
- Schools in Illinois, Wisconsin, Kentucky, Massachusetts, and New York

Assessment Scale	Mean Pretest	Mean Posttest	Gain	Effect Size
total (n=594, question=18)	42%	57%	15%*	0.80
Radiation Energy (9 questions)	38%	59%	21%*	1.03
Data Collection and Analysis Skills (9 questions)	46%	54%	8%*	0.37

All differences significant at $p \leq 0.0001$

Science Teachers Love Remote Labs!



"My students appreciated the ability to perform an experiment that was previously unavailable to them, and the curriculum allowed them to make connections to their everyday world."
–David Chan, Chemistry Teacher, Evanston Township High School, Evanston, IL

"The coupling of technology with real science hooked my students right at the start of the semester..."
***–Ray Stadt**, Science Teacher, Dwight D. Eisenhower High School, Blue Island, IL*

"Not only did I have several days' worth of superb lesson plans but also the learning experience stimulated my students' interest and enthusiasm for many days to follow. As a result, the use of iLabs in the classroom carries my unequivocal support."
***–Mediha Abat**, Science-Math Teacher, Wheeling High School, Wheeling, IL*

CONTACT

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Play To Learn

It's the motto of the EcoNauts but it is more than that. It is what we strive to do. We use scientists from the beginning to guide and advise us when producing our games. We have master teachers develop curriculum and then test that curriculum in classrooms and after school clubs. Our researchers prove that learning takes place. We produce an authenic experience for the students to take into their future, their society!

Please enjoy a momento of your visit here today with a special vial of Lake Mendota water with all its critters, creatures and mystical powers. Help us teach the young to know how important it is to to be an EcoNaut!

AmplifyTablet

Designed to expand the mind

A powerful mobile learning tool

The Amplify Tablet System is uniquely suited for the K-12 classroom. This personalized and intuitive tablet will engage your child in highly interactive, 21st-century learning. Teachers will also gain tools to manage a classroom full of tablets, easily check for understanding on the fly, and plan dynamic, multimedia lessons.

Amplify student learning.

- Students get a high-quality, 10-inch Amplify Tablet designed by Intel® Education that has been specifically developed to meet their needs. The Amplify Tablet has a rugged industrial design, strengthened glass, advanced WiFi radio to boost connectivity, tethered stylus and several other key features to support learning in school, at home or on the move.
- Our tablet's unique instructional software is designed around a student's day, with Notebooks for each class. Students can organize their coursework, create and submit assignments, and participate in online discussions, quizzes and polls posted by the teacher.
- Students can also engage in rich self-directed learning, conducting research and communicating their knowledge using text, presentation, drawing, movie and audio editors available on the tablet.
- Students get the instruction they need when they need it from an easy-to-follow Playlist of class activities, assignments and communications that teachers can personalize just for them. Teachers also have real-time assessment tools to gauge student comprehension and quickly differentiate instruction for small groups or individual students.
- The Amplify Tablet operates on Google's Android 4.2 OS, which has multiple features to enhance accessibility for a diverse range of learners, including text-to-speech and screen magnification.
- We have partnered with Common Sense Media to provide the Amplify Market, the first app store with safe and secure access for students to find engaging, age-appropriate educational tools to extend their learning inside and outside school.

Amplify teacher impact.

- We've created exclusive, easy-to-use Classroom Tools that help a teacher manage a class full of tablets, increase student participation and check for understanding in real-time.
- The Playlist Builder tool allows teachers to develop dynamic digital lessons in a snap with its simple drag-and-drop interface. Teachers can direct content to the whole class, smaller groups or individual students.
- The Amplify Tablet comes with all the standard native Android apps available on a consumer tablet. The tablet also features the Amplify Market, which provides access to a curated set of K-12 apps with ratings, reviews and ideas for how to use each app in the classroom.
- In our high-quality professional development, teachers always learn about the device and features within the context of grade-appropriate, student-centered lessons so that they can easily understand how to integrate the tablet into their classrooms.
- Educators also have ongoing access to a highly knowledgeable help desk staff via phone, email, and online user community.

Amplify technology across your district.

- The Amplify Tablet System allows you to scale your 1:1 initiative and manage thousands of tablets remotely and securely. Districts can easily provision and configure each device down to an individual user basis. Devices can be tracked, locked and wiped with the push of a button. Schools can also enforce their own appropriate use policies and execute local content and app controls.
- The Amplify Tablet's open Android platform supports any digital content in which you've already invested. Our tablet is also compatible with standard student information systems and learning management systems and is compliant with the PARCC/SBAC assessment consortia security and specification requirements.
- With the Amplify Tablet System, districts gain a dedicated Implementation Partner who is a single point of contact and who works hand-in-hand with the district to conduct several assessments (technology, instruction, process) and launch a successful program.

Amplify.

David E. Kanter, Ph.D.
Director of Research
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Please note that Amplify may change the hardware specifications, software, content, and support included in its tablet system in order to provide customers with improved technology and features as they become available.

AmplifyTablet www.amplify.com/tablet

For more information about the Amplify Tablet System, please email access_sales@amplify.com or call (800) 823-1969.

Keith Evan Green

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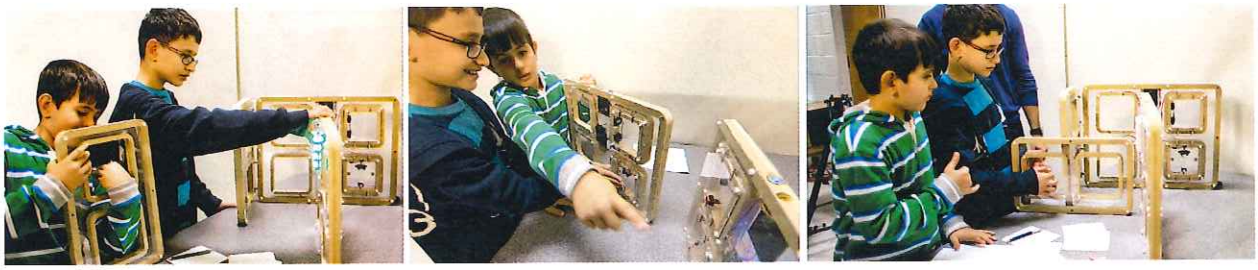
IIS- 1352992

The LIT ROOM is a cyber-physical, literacy support tool at room-scale, embedded in the physical space of a library. This physical-digital environment is transformed by words read by its young visitors so that the everyday space of the library "merges" with the imaginary space of the book: *The book is a room.* And should the LIT ROOM's intelligent reconfigurations not match the imagined spaces of young readers, the young readers "fine-tune" the room through tangible interfaces. Our hypothesis: *that literacy can be cultivated in a space that is at once physical, digital, spatial and evocative of the book being read.* **The LIT KIT** is an outreach component, for home or classroom use, of the room-scaled LIT ROOM – an affordable mechanism designed for educators and parents to bring our larger-scale literacy support tool into classrooms and homes. [**Publications**: IDC '12, IDC '13, DIS '14]



CyberPLAYce bridges the physical and digital worlds, allowing young students to bring their ideas, stories and class subjects to life through the construction of cyber-physical-spatial environments. The CyberPLAYce construction kit is comprised of hand-sized, magnetic modules integrating a variety of electronic components, and rectangular panels, nearly two-feet measured diagonally, that receive the modules and serve as physical building blocks for constructing cyber-physical environments imagined by children. Through play, children become comfortable with the working modules and panels; subsequently, they are provided matching non-electronic module cards allowing them to quickly compose pattern sequences to map ideas, stories and class content. Additionally, students are provided action and story cards to spark their imagination. CyberPLAYce merges play and learning in the physical world while transitioning students from consumers of virtual and digital-centric technologies into technological innovators and cyber-playful storytellers. [**Publications**: CHI '14, DIS '14]

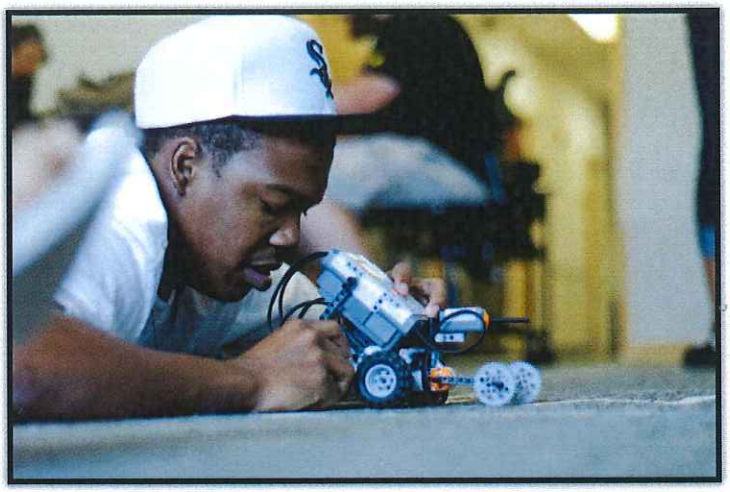
FUSESTUDIO.NET LEVEL UP

FUSE

Creating an Interest-Driven STEAM Exploration Space for Youth

The Program

- Engages teens in STEAM fields through low barrier, hands-on exploratory challenges
- Youth-accessible locations encourage teens to "hang out, mess around, and geek out" after school and on weekends
- FUSEstudio.net connects spaces virtually to create an online community of learners
- Encourages mentor relationships with professional scientists, engineers, and Northwestern University students
- Has the capacity to be scaled up to impact a significant number of youth



Locations

- Evanston Public Library in their Teen Loft
- Evanston Township High School
- Wheeling High School
- Chicago Public Schools
- Chicago Public Library branches
- Neal Math & Science Academy
- Schaumburg School District 54
- North Shore Academy

Learn More

www.fusestudio.net

Maggie Waldron, Program Director:
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A program of the School of Education and Social Policy at Northwestern University

MacArthur Foundation

HIVE CHICAGO
EXPLORE + CREATE + SHARE

Funding for this project was provided by the John D. and Catherine T. MacArthur Foundation and Hive Chicago through the Chicago Community Trust. Hive is a learning network supported by the John D. and Catherine T. MacArthur Foundation.

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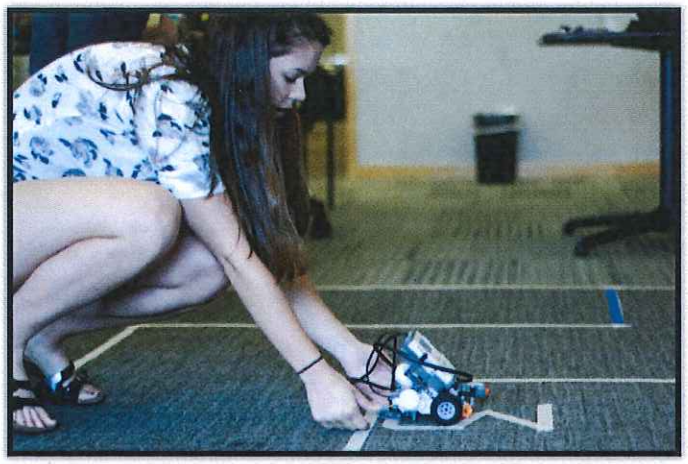
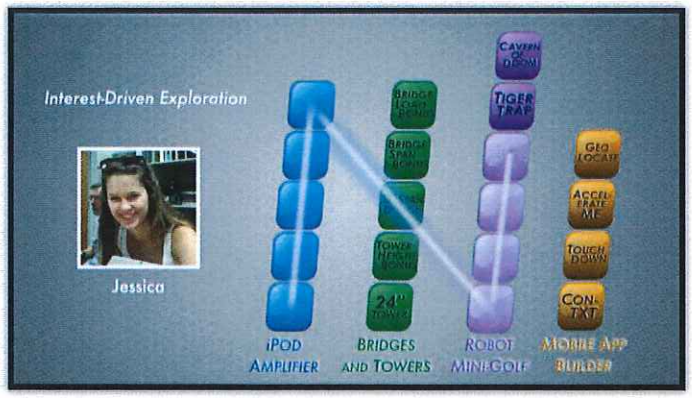
Hanging Out, Messing Around, Geeking Out (HOMAGO)





Challenges and Levels

Each challenge uses a leveling up model from gaming and is carefully designed to engage teens in different STEAM topics and skills sets.

- Robotics
- 3D design & printing
- Electronics
- Android app development
- Biotechnology

Challenges can be tackled individually or in groups. All challenges result in digital media artifacts that are shared online for peer review, remixing, expert judging, and collaboration.

Partners

- Northwestern University (Lead)
- Chicago Architecture Foundation
- Evanston Township High School
- IBM
- Motorola Mobility
- Northwestern-Argonne Solar Energy Research Center
- Siemens
- North Suburban Educational Region for Vocational Education (NSERVE)

A program of the School of Education and Social Policy at Northwestern University

MacArthur Foundation

HIVE CHICAGO
EXPLORE · CREATE · SHARE

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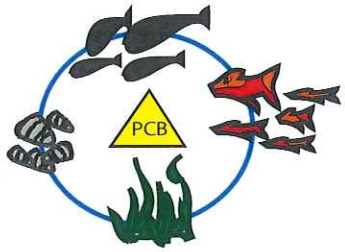
EcoCasting



Northwestern University, Office of STEM Education Partnerships
ecocasting.northwestern.edu

Overview

The Office of STEM Education Partnerships (OSEP) is creating tools and materials to help students learn about the scientific observations, measurement techniques, and computer models used in a National Oceanic and Atmospheric Administration (NOAA) Ecological Forecasting project. A team of environmental engineers, scientists, and computational modelers are developing more precise food web models to better predict PCB toxin levels in Great Lakes fish.

Content and Methods

Northwestern is developing a set of hands-on inquiry activities on ecosystems, food webs, and bioaccumulation for use in environmental science and biology classes in grades 9 -12. These activities will teach students about current scientific research in Great Lakes ecosystems. At the same time, students will learn about innovations in the scientific process, including interdisciplinary collaboration, computer modeling of complex systems, and model validation via empirical data collection.

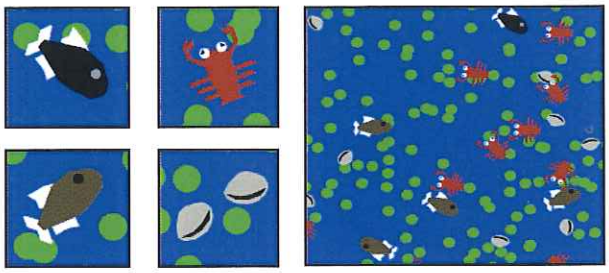
Learning Goals

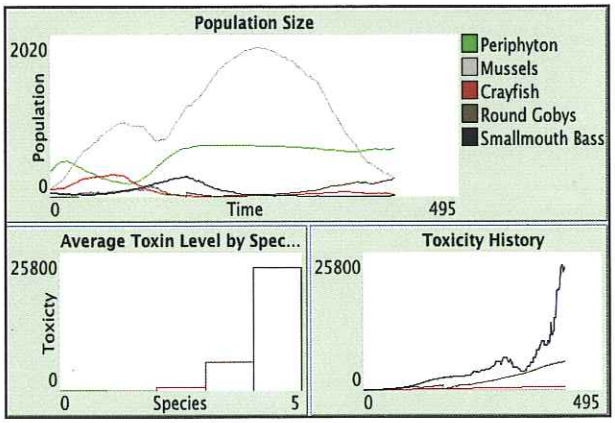
The curriculum is aligned to national standards including new common core standards

- Students use ecological models to investigate food web complexity
- Students investigate PCB toxins and how they move through an ecosystem
- Students investigate invasive species and how they disrupt ecosystems and change bioaccumulation patterns

Cyberlearning Tools

- Students use *Netlogo* models developed for educational use
- Visualization and data analysis enable learners to work directly with complex scientific data and current research
- Learners interact with dynamic representations of scientific processes that contribute to improved conceptual understanding of complex systems and computational modeling
- Using these data and analysis tools, students gain not only content knowledge, but also increased motivation, self-efficacy, and improved attitudes toward technology





Learn More

For more information on the cyberlearning tools, curriculum, or to receive a training on EcoCasting visit:
http://ecocasting.northwestern.edu

Or contact:

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School of Education and Social Policy
Northwestern University

The EcoCasting Project: *Ecological Forecasting: Framework to Evaluate the Effects of Multiple Stresses on Lake Michigan Food Webs and Guide Remediation* is supported in part by the National Oceanic and Atmospheric Administration under grant NMFS-HCPO-2009-2002033 to Kimberly Gray. However, any opinions, findings, conclusions, and/or recommendations are those of the investigators and do not necessarily reflect the views of the Administration.

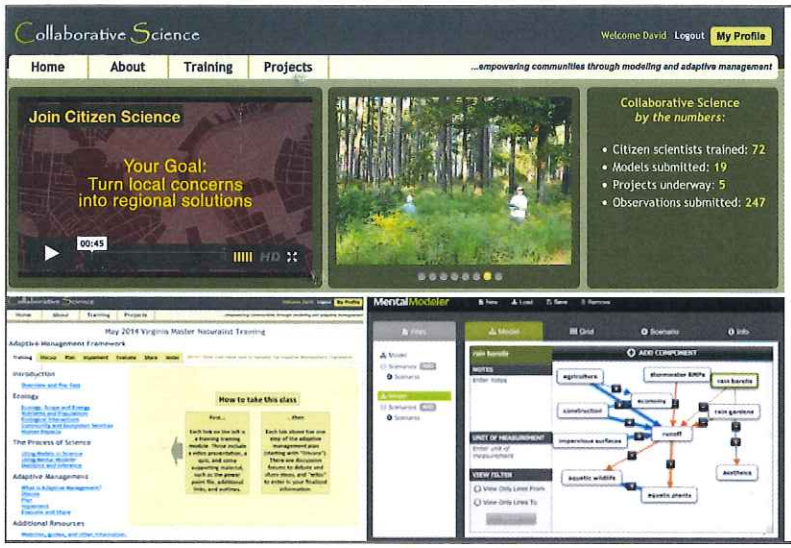
NORTHWESTERN UNIVERSITY

Collaborative Science

Sustaining Ecological Communities Through Citizen Science and Online Collaboration

Rebecca Jordan[1], David Mellor[2], Cindy Hmelo-Silver[3], Alycia Crall[2], Steven Gray[4], Greg Newman[5]

Citizen science provides a unique opportunity to support the research of professional scientists and natural resource managers while engaging the public in important conservation decisions. However, projects with significant research implications often result in little collaboration between scientists and volunteers, thus limiting engagement and learning. Collaborative projects that allow for significant learning gains that are also sufficiently robust to have meaningful research implications are scarce but clearly needed. Online learning may help meet these needs. We developed a website with space for collaborative learning to train volunteers in ecology, using models to facilitate scientific inquiry, and developing adaptive management plans to inform management decisions. The space provides tools to create collaborative citizen science projects. We are using fuzzy-logic cognitive maps in a software tool called Mental Modeler to allow participants to collaboratively create their own conceptual models to generate hypotheses about complex systems.



CollaborativeScience.org

Screenshots show the project homepage (top), the main training page where volunteers see each learning module (bottom left), and a modeling window with an active mental model (bottom right).

Resulting Projects

Two projects are currently underway after pilot classes in the summer of 2013. In the first, volunteers are working with land managers, farmers, the soil and water conservation district, and developers at a unique "conservation development" area to measure the effects of riparian buffers on water pollution from agricultural practices.

The second involves volunteers, scientists, and land managers with the Nature Conservancy to study control measures for the invasive Japanese Stilt Grass in a fire-mediated, pine savannah habitat in Southeastern Virginia, home of the endangered Red Cockaded Woodpecker. The grass is feared to alter the fire dynamics of the system and is a potential threat to the health of the woodpecker's habitat.

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4) University of Massachusetts, Steven.Gray@umb.edu 5) Colorado State, gregory.newman@colostate.edu