

2010 Monarchs in the Classroom Newsletter

Education, Research, and Conservation



Monarch On WWF 10 Most Threatened List

Each year, the World Wildlife Fund lists the 10 most threatened species. Unfortunately, the monarch has made the list this year, along with the polar bear, mountain gorilla, and giant panda. WWF cites the illegal logging taking place in their overwintering sites in Mexico as part of the reason monarchs are on the list. The organization cites global climate change and habitat loss as key threats to the long-term survival to several species on the list.

To view the entire 2010 list, visit <http://www.worldwildlife.org/species/10towatch2010.html>

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The theme of this year’s newsletter is citizen science. Birds, weather, worms, streams and rivers, and of course monarchs, all have programs dedicated to learning more about them.

Citizen science programs involve volunteers, people from all walks of life, in scientific research. Sometimes these citizen volunteers design their own research projects, and sometimes they contribute to existing programs. They might study climatic phenomena, like rainfall or temperature, or they might monitor the abundance of beneficial plants and animals, like monarchs or loons; or not so beneficial plants and animals, like invasive buckthorn or earthworms. Whatever it is being monitored, citizen science programs provide benefits for the volunteers and to society. To learn more about the field of citizen science, consider visiting a website devoted to just this topic: www.citizenscience.org.

From a scientific perspective, citizen science makes organisms (or natural phenomena like weather) with large geographic ranges a bit easier to study. Having an army of volunteers makes scientists’ jobs more manageable and it allows them to collect larger amounts of data in more places. Having datasets from a wide range of places also allows scientists to track behavior or population changes in an entire population or in a larger portion of the population. One scientist couldn’t collect this amount of data on his or her own.

The fortunate thing about citizen science is that the citizen volunteers also benefit! Volunteers that participate must have some interest in what they’re studying; if they weren’t interested, they wouldn’t participate. Volunteers learn more about what they’re interested in. They are also able to contribute to real scientific research; truly dedicated volunteers often become authors of peer-reviewed journal articles.

In many cases, the environment benefits, too. Volunteers learn what makes their monitoring sites more ecologically sound, often changing management practices or stopping development that would decrease the ecological value of the site. They also teach others what they’re learning—their students, children, neighbors, friends, or just passers-by.

In our digital age, with computers capable of crunching massive amounts of data, there is a perfect juxtaposition of questions that need lots of volunteers, methods to answer these questions, and mountains of data that volunteers provide. We have access to exciting analytical tools, helping to ensure that the data volunteers collect are put to good use.

Read on, learn a lot, and consider contributing to our understanding of the world on which we all depend by joining a citizen science project!

Advanced Science Inquiry Course for Past MITC & SEE Graduates

We have an exciting new course offering just for past graduates of our summer Schoolyard and Insect Ecology courses! This new course builds directly upon the content developed in our past courses by providing the time and support necessary for you to focus on your professional science inquiry teaching goals.



Course Information

- Open to teachers who have previously taken one of our Schoolyard or Insect Ecology courses.
- Location: U of M St. Paul Campus
- Dates: July 12-16 (M-F) and July 19-21 (M-W). In addition, there are three meetings during the school year, dates TBD, where participants will come together to discuss teaching rewards and challenges related to inquiry.
- Three free U of M graduate credits, catered lunches, supportive curriculum, \$300 stipend, and more.
- Course applications are due by March 12th.

Teachers in our 2010 course will have the opportunity to gain first-hand experience in one of several exciting citizen science programs. Choose from citizen science programs such as the Monarch Larva Monitoring Project, the Great Lakes Worm Watch, Citizen Stream Monitoring Program, MN Odonata Survey Project, and more. These programs provide a rigorous and established protocol that will create the scaffold for you and your research team to build your own research project.

After practicing a prescribed protocol, we'll work in teams to conduct a scientific study that is interesting and relevant to your teaching. The focus will be on addressing the key challenges of making science fun and rewarding for you and your students, while at the same time addressing key inquiry and science standards. Throughout the process, you'll have ample opportunity to work with colleagues, expert teachers, and scientists. The pace and content of this course will allow everyone to cultivate science confidence and expertise. We hope that teams of teachers from the same school will be able to attend the course together to establish a support network throughout the school year.

Space is limited; if you're interested in applying, contact Lis (young142@umn.edu) to receive an application. Applications received by March 12th will receive full consideration. Applications received after this date will be considered on a space available basis.

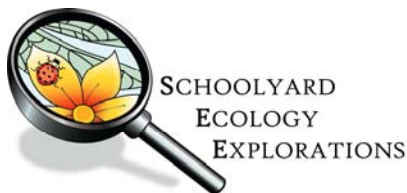


Questions? Contact Lis (young142@umn.edu) for more information about the course, and to receive an application. We hope to see you in the field this summer!

Donate to Support Schoolyard Learning and Wildlife Habitat

We have a great new opportunity for anyone interested in science learning and conservation!

Please consider supporting our schoolyard garden program. You'll help to cultivate a generation of students who will care about nature. Schoolyard gardens are especially important in urban areas, since the only 'nature' available in many urban schoolyards is grass. Since grass is not suitable habitat for most wildlife, including pollinators like monarchs, you'll also be aiding in the creation of habitat. Important pollinators, as well as other invertebrates, birds, and even some mammals, will use the schoolyard gardens that your donations help to create!



Minnesota. Unfortunately, the NEST Foundation is no longer able to support this program. We are looking for people like you, who care about pollinators and value outdoor education, to pick up where the NEST Foundation left off.

We are grateful for any support that you can provide. If requested, gifts of \$1000 or more will be recognized by naming a garden after the donor or in honor of someone designated by the donor. Please contact Lis (young142@umn.edu) for more information on naming a garden grant.

Donations are made through the University of Minnesota Foundation website. If you would like to make a donation, please visit our website (www.monarchlab.org) and click on the "Donate to Support Schoolyard Learning & Wildlife Habitat" link.

Thanks to the generous support of the NEST Foundation, over 40 schoolyard gardens have already been installed throughout



Groveland Park Elementary, located in St. Paul, Minnesota, is one of 53 schools who have received a garden grant. Your generous donation can help turn a bland landscape into a beautiful schoolyard garden, attracting pollinators *and* students!

Schoolyard Garden Grants!

2010 marks our fifth year distributing schoolyard garden grants. These grants have facilitated the creation of ecologically diverse plant and insect communities that are ripe for all kinds of student inquiry. Secondary, elementary, art, and science specialist teachers have been awarded garden grants. These sites enhance student motivation and make it easy to incorporate outdoor learning into your curriculum. There are two grant options:

1.) Request A is a 'garden by numbers' approach for teachers who don't have a lot of gardening experience, or who won't have a lot of help. The plan is easy to follow and the plants are hardy and drought resistant.

2.) Request B allows teachers to design their own garden, enhance an existing garden, or better use an existing garden through the purchase of equipment or curricula. This flexible proposal has room to let your green thumb take charge!

We hope you'll consider applying for up to \$1500 to enhance your schoolyard and student learning!

Grant applications will be available online in September at www.monarchlab.org, with a due date of December 1, 2010. Please email Lis (young142@umn.edu) if you are interested in



Citizen Science Opportunities

Many of our readers are probably aware of our own citizen science project, the Monarch Larva Monitoring Project, (www.mlmp.org) but there are also many other citizen science projects. Some of them focus on monarchs, while others do not. Here is a small sample of some of the opportunities available.

All of the projects listed can be adapted for use in the classroom. Monarch Health can be done while raising monarchs for science projects or for teaching life cycles. Great Lakes Worm Watch could be included in schoolyard or outdoor learning (There's something about the mustard extraction of earthworms that you have to see to believe!) or as part of a project to be entered in science fairs. Cornell's programs could be particularly useful in the winter, when extracting earthworms from the frozen ground or releasing monarchs would prove quite difficult. Bird watching can be a great way to get your students outside even on chilly December days.

When you include a citizen science program in your curriculum, you'll teach your students about the natural world, and give them practical science skills. Plus, the data help all of us understand more about the natural world. Everyone benefits!

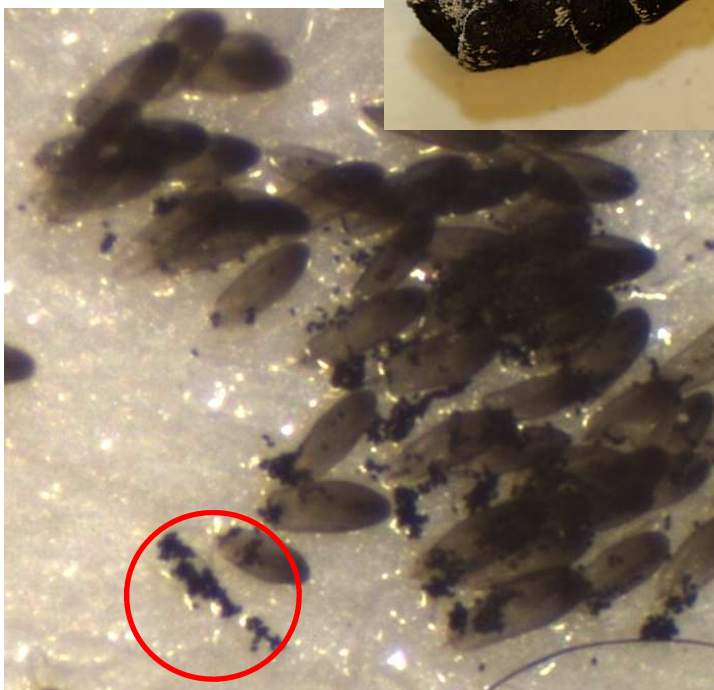
Monarch Health

Monarch Health is directed by a former U of M graduate student, Dr. Sonia Altizer, at the University of Georgia. The goal of the project is to determine the distribution of the protozoan parasite *Ophryocystis elektroscirrha* (Oe) and the extent to which it harms monarch butterflies. Knowing the prevalence of this parasite can help scientists learn more about how the monarch's migration affects parasite transmission, and what happens to infections in non-migration populations such as those in southern Florida.

Oe Biology

Oe can only replicate inside its larval host, so it creates a dormant spore able to tolerate external conditions. The spores, present on the surface of adult monarchs, land on the surface of eggs as the female deposits them. The caterpillar eats its egg casing, consuming the spores in the process. Inside its host, the parasite can reproduce while the caterpillar and pupa develops. The parasite develops into new spores able to survive on the adult's abdomen about three days before the adult monarch emerges from its pupa.

Moderate and heavy Oe infections affect flight endurance and also results in smaller butterflies, both in terms of weight and wingspan. Black spots of spores can be seen underneath the surface of pupae with heavy infections. Very heavily infected



The scale sample above is infected with Oe. The large black ovals are monarch scales, but the smaller clumps of black dots (circled) are spores.

monarchs have difficulty emerging from their pupal cases. Failure to emerge results in deformed wings; since they are unable to fly to find food, the adults eventually die.

How to Participate

Anyone can participate in this program; volunteers collect wild monarch adults or larvae. Using a free kit provided by Monarch Health, volunteers gently touch a sticker to the adult's abdomen to collect a sample of scales along with any spores that might be present. These sticker samples are then sent to the Altizer lab where they are analyzed for the presence of Oe.

For more information about Monarch Health and to request the materials to participate, visit www.monarchparasites.org

Citizen Science Opportunities (continued)

Great Lakes Worm Watch

Based out of the University of Minnesota, Duluth, and led by Dr. Cindy Hale, the goal of Great Lakes Worm Watch is to determine the location and abundance of non-native earthworms in the region. Minnesota is the only state with a published report of earthworm distributions, and data are missing; more than half of the counties have no earthworm records at all. There is definitely a need for an army of citizen scientists!

Earthworm Threat

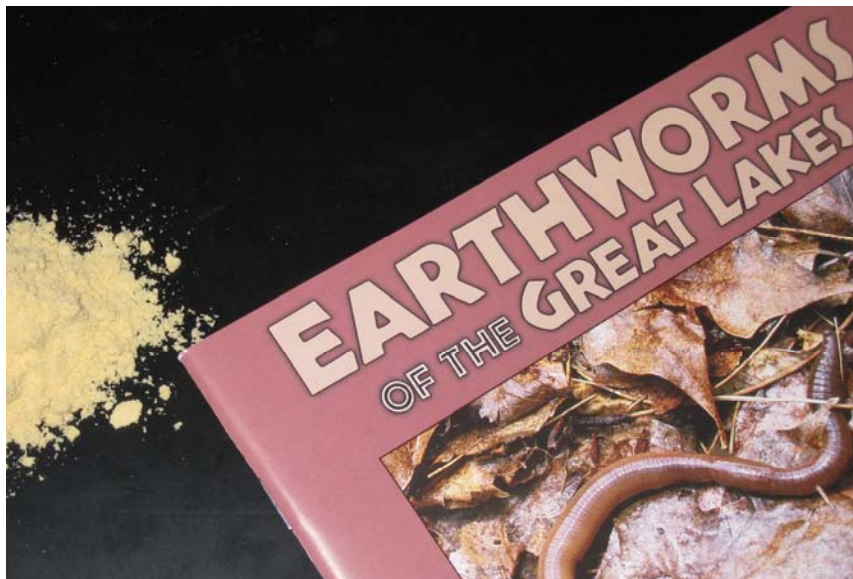
How do you know what a non-native earthworm looks like? It's actually quite easy; if you see an earthworm in Minnesota, it is non-native. There is no evidence of native terrestrial earthworms ever living in Minnesota. And, even if Minnesota had had native earthworms, they would have died after the last glaciation, which took place 11,000 years ago.

Even though non-native earthworms are found throughout the region, there's still something you can do. Without human involvement, earthworms move slowly, less than half a mile over 100 years!

Preventing the spread of earthworms can be achieved by containing unused fishing bait and through the proper use of 'red-wiggler' composting worms. These worms are not known to survive Minnesota winters, so freezing compost for one week or longer should eradicate both the worms and their eggs.

How to Participate

Worm sampling is the primary way for volunteers to participate in documenting earthworm occurrences. There are three different sampling methods listed on the project's website, but the most exciting method is the mustard extraction. By adding powdered mustard to a gallon of water and pouring it over a few square feet, any worms in the area come to the surface because the mustard irritates their skin. This is fascinating to watch, both for kids and adults! Worms are then collected, preserved, and sent to Great Lakes Worm Watch.



Ground mustard and an earthworm guide are two important resources to participate in Great Lakes Worm Watch. Mustard can be purchased in bulk from food co-ops or whole foods stores, and this earthworm guide can be purchased directly from GLWW.

For more information about earthworms and how to participate, visit www.nrri.umn.edu/worms

Cornell Lab of Ornithology

One of the well-known players in the citizen science world, the Cornell Lab of Ornithology, has 11 different projects for volunteers to choose from. Anyone with an interest in birds or bird watching can participate, and the projects have different time commitments. Some only require a few days a year, like the Great Backyard Bird Count, while others, like eBird – a real time online bird checklist that allows you to contribute bird sightings to scientists – can be done year-round!

CamClickr asks volunteers to identify and sort photographs of birds. This can be done anywhere; Internet access is the only requirement, and volunteer efforts contribute to a useful, organized archive of images for scientists to study. To date, more than 7 million photographs have been taken, so there is no shortage of bird photos to identify.

Project FeederWatch is perfect for volunteers who have bird feeders in their backyards. Participants count the number and species of birds who visit their feeders from November through April. The data go to scientists, giving them a better idea of the distribution and abundance of birds in the winter.



If you watch birds that visit your feeders, you should record the quantity and species and submit it to Project FeederWatch.

To learn more about each of the 11 projects at the Cornell Lab of Ornithology, and to participate, visit <http://www.birds.cornell.edu/netcommunity/citsci/projects>

Navigating the Skies with Antennae

One of the biggest questions in monarch biology, how these amazing insects navigate to their overwintering sites, has puzzled scientists for decades. New research* from the University of Massachusetts, led by Dr. Steven Reppert, has provided new insights on how monarchs are able to navigate using their antennae.

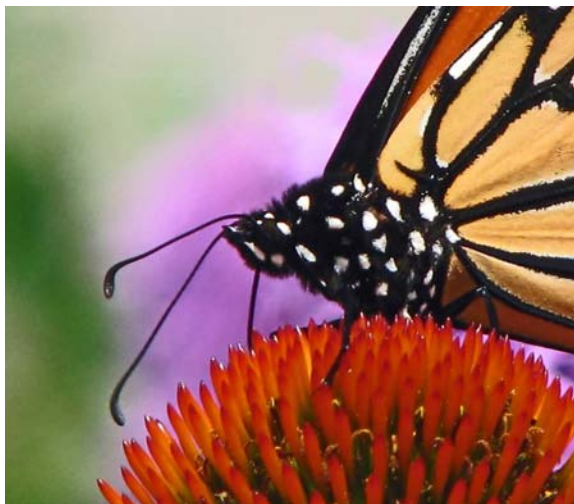
Previous monarch research led scientists to believe that monarchs are able to navigate by using the sun's position in the sky. This is no easy task, since the sun moves from east to west over the course of a day. Despite the moving target, monarchs are still able to migrate south using the sun. The 'sun compass' they possess along with their circadian rhythm allows them to compensate for the sun's movement during the day and maintain a southern flight path.

Most organisms have some sort of circadian rhythm, including humans and plants. This rhythm renews every 24 hours, and is responsible for sleeping and eating patterns. There is some debate about how strongly circadian rhythms affect these patterns. Light-dark cycles may also play a role, especially in locations like the Arctic Circle, where the amount of daylight varies greatly during the year. One study of reindeer living above 78 degrees N latitude revealed the animals exhibit circadian rhythms in the spring and fall, but not in summer or winter, when days are the longest and shortest, respectively. Conversely, another study in northern Alaska involving porcupines and ground squirrels reports these organisms maintained circadian rhythms through 82 days of nights and sunshine. At any rate, the circadian rhythm plays a role in monarch navigation.

This circadian "clock" is located in the monarch's brain, and scientists assumed it was the monarch's only means of navigation. But, in the world of science, one should never assume. The new study from Dr. Reppert's lab has shown that there is another time compensated sun compass in the monarchs' antennae. The way Dr. Reppert's lab discovered this is an amazing example of scientific ingenuity. They dipped some monarchs' antennae in black enamel paint and others with a transparent enamel paint and watched their flight pattern in flight chambers. Monarchs with the clear coating flew south, as expected. However, the monarchs with the black paint flew in random directions, although they did exhibit directional flight, indicating the antennae also house important navigation cells. Monarchs who had their antennae surgically removed exhibited random patterns, and did not exhibit any directional flight; instead they kept changing

direction. Scientists now believe the antennae *and* the brain play important roles in monarch navigation.

Researchers still don't know how the monarchs find the same overwintering sites each year, but we now have a better understanding of how they're able to navigate south toward the sites. We also know cells in the antennae are able to sense light, in addition to sensing smells, sounds, and barometric pressure, and navigating the skies. At this rate, monarch antennae will have more functions than a Swiss Army knife!



*Merlin, C., R. Gegear, S. Reppert. 2009 Antennal Circadian Clocks Coordinate Sun Compass Orientation in Migratory Monarch Butterflies. *Science*. 325:1700-1704.



Scientists now believe it's the antennae, and not the monarch's brain, that play the most important role in navigating to the overwintering sites of Mexico.

Antennae Photo: <http://www.flickr.com/photos/rwjensen/2703658944/>

Is Crowding Ok?

Monarch larvae are usually assumed to occur in fairly low densities in the wild, although many Monarch Larva Monitoring Project (MLMP) volunteers report finding multiple eggs or larvae on a single plant. In a 2009 study* that utilized both laboratory studies and data from the MLMP, researchers from Emory University, the University of Georgia, and the University of Minnesota assessed the effects of monarch larval density on their response to infection by an important protozoan parasite, *Ophryocystis elektroscirrha* (often known as Oe). In the lab, larvae were inoculated with parasite spores and reared at low (1 larva per shoe-box sized rearing container), moderate (5 larvae per container), and high (10 larvae per container) densities. Larvae were more likely to be infected with Oe when they were reared at higher densities. Also, infected monarchs raised at high densities were smaller, developed more slowly, and didn't live as long as infected monarchs raised at low densities. Interestingly, monarchs reared at medium densities were larger and developed more quickly, whether they were parasitized or not. This effect could result from greater larval feeding rates at moderate densities, combined with physiological stress at the highest densities.

MLMP data showed that larval densities often do reach high levels, especially in year-round resident populations such as those that occur in Florida, and during the early spring and late fall phases of the breeding season. Thus, treatment levels in this experiment are likely to be ecologically-relevant.

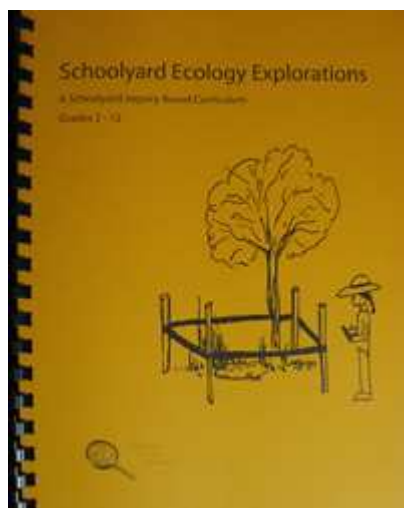


Based on the findings of this study, rearing monarchs in high densities should be avoided. Photo by Charles Gatchell.

Based on this study, we recommend avoiding crowding larvae during rearing, trying to limit the number of larvae in our regular "shoe-box" containers to five. We're also adding a step to the data collection in the MLMP density measurements for volunteers who want to take an extra step, allowing us to collect more detailed data on the number of monarchs that occur on single milkweeds.

*Lindsey, E., M. Mudresh, V. Dhulipala, K. Oberhauser, S. Altizer. 2009. Crowding and Disease: Effects of host density on response to infection in a butterfly-parasite interaction. *Ecological Entomology* 34:551-561.

New Product: Schoolyard Ecology Explorations Curriculum Guide!



An all-new curriculum guide for 2010 focusing on schoolyard and outdoor education, the Schoolyard Ecology Explorations curriculum guide is a must-have for teachers who work with students outside and/or have schoolyard gardens!

If you already have our Monarchs & More curriculum guide, then you'll be familiar with the layout of the SEE curriculum lessons. However, we've included all new lessons and this guide works for all grade levels.

Sections include:

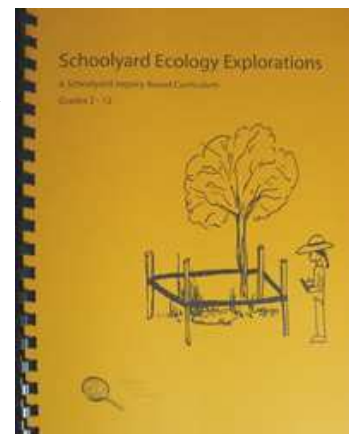
- Experiments in the Schoolyard
- Recording Natural Cycles
- Observing Organisms
- Investigating Ecology
- Discovering Biodiversity
- Seeking Sustainability

The guide is 239 pages long with teacher and student handouts. You can order the curriculum guide on our website for only \$18. See details on page 8.

MITC Catalog: Order Online at www.monarchlab.org/store/

Schoolyard Ecology Explorations Curriculum Guide

The lessons in this science inquiry-based curriculum are designed to increase the student’s connection to nature through observation and experimentation. Many of the lessons can be implemented on any school grounds, including urban schoolyards where access to nature may be limited. Furthermore, many lessons can be adapted to suit grades K-12. The guide is divided into six sections: Experiments in the Schoolyard, Recording Natural Cycles, Observing Organisms, Investigating Ecology, Discovering Biodiversity, and Seeking Sustainability. Each lesson includes key concepts, an objective, and background information; 239 pages with teacher and student handouts. \$18



Fourth Edition Curriculum Guides

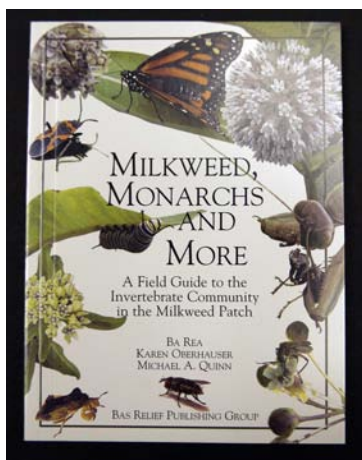
The 4th edition Monarchs and More curriculum contain added content about doing inquiry in your classroom, as well as more lessons on engaging students in a variety of outdoor activities. Separate guides for Grades K-2, 3-6, and Middle School each include age-specific lessons divided into 6 sections: Butterfly Life Cycles, Butterfly Systematics, Ecology, Conservation, Conducting Experiments, and Monarch Migration.

Each guide includes extensive background information, with sections on monarch biology, practical tips for rearing and observing insects, and conducting inquiry-based lessons in the classroom. Lessons include both teacher and student pages. There is an appendix with an extensive bibliography, and black-line drawings that can be copied for student handouts or overhead transparencies. K-2 (233 pages) \$21, 3-6 (342 pages) & Middle School (315 pages) \$24



Monarch! Come Play With Me

Ba Rea has created a sensitive, interactive narrative that focuses on the questions and answers between a monarch and a young girl. As the monarch progresses through metamorphosis from larva to adult, the young girl compares her own needs and activities to those of the monarch. The illustrations are exquisitely simple, scientifically accurate, and truly a delight to behold. From pre-schoolers to adults, ALL ages will be captivated by this beautiful volume. \$11



Milkweed, Monarchs and More Field Guide

by Ba Rea, Karen Oberhauser and Mike Quinn
 Designed to help students, citizen scientists and others explore the milkweed community, this book includes over 300 full-color photos and entries on insects and spiders. Color coded symbols are used throughout the guide to indicate the animals’ roles in the milkweed community. It also includes an overview of the unique features of the milkweed family—including photos and ranges—identifying features for 10 of the 110 species found in North America. \$9

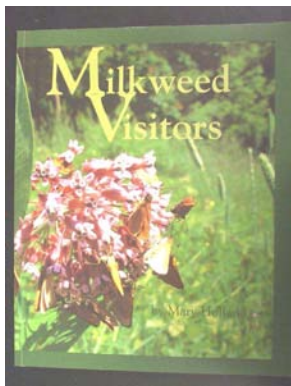
MITC Catalog: Order Online at www.monarchlab.org/store/

Teacher Workshops

Have Monarchs in the Classroom come to your school to give a teacher workshop about science inquiry, monarch biology, or schoolyard ecology! Workshops can be tailored to your needs. Half day up to 5 days, before or after school, or on in-service days. We will provide curriculum guides. Contact us for details: (612) 624-8706 or info@monarchlab.org. \$100 per hour

Classroom Visit

Have monarch scientists visit your classroom to talk to students about research, monarch biology, and/or conservation. Contact us for details: (612) 624-8706 or info@monarchlab.org. \$80 per hour



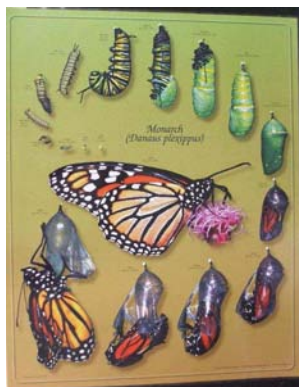
Milkweed Visitors by Mary Holland

Selected as a "Best Book of 2006" by the Association for Advancement of Science!

This beautifully colored 8" by 10" paperback will be a priceless addition to your classroom. Mary Holland has captured the critters who inhabit the milkweed community in clear, large, beautiful photographs, and explains their roles in this fascinating, magical location. You and your students will be inspired to look more closely at these amazing creatures. \$11

Monarch Life Cycle Poster

Produced by the Midwest Monarch Project, this 17 x 22 inch laminated poster includes photographs of monarch stages from egg to adult as well as a timeline of the life cycle. Laminated. \$10



Community Connections Poster

Highlights components of a monarch's habitat. 24 x 36 inches. Laminated. \$10

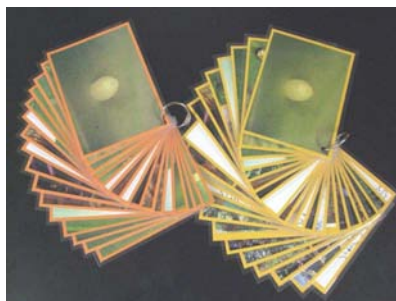
My Monarch Investigation Journal

Produced by Ba Rea, this 32-page journal is designed to be a permanent, personal record of each student's investigation of the life cycle of the monarch butterfly. The book includes illustrations and photographs covering caterpillar anatomy, habitat and community, life cycle, and migration. \$5 each or \$4 each for 20 or more



Life Cycle Cards

A set of 16 laminated cards highlighting the metamorphosis of the monarch butterfly. Each color image is backed by a brief summary of the unique characteristics used for easy identification of the monarch in all stages of its life cycle. \$8



Annual Life Cycle Cards

Our laminated 20-card set covers the individual life cycle, shows side-by-side comparison photos of male/female wings and abdomens, and includes maps of the fall and spring migration and photos of predation, activities, and clustering monarchs in Mexico. Available in English or Spanish. \$10

2009 Insect Fair: Celebrating Student Scientists

Student athletes have the Little League World Series. Student musicians have piano recitals. And for student scientists, there is the Monarchs in the Classroom Insect Fair!

The 13th Annual Insect Fair was held on Saturday, December 12th, at the University of Minnesota. There were over 500 people in attendance, with 35 teachers bringing 300 students from Minnesota and Wisconsin. Parents and families also attended, having the opportunity to see all of the student projects on display.

Most students created poster boards displaying the methodology and results of their invertebrate experiments. They were interviewed in groups by U of M scientists, and answered questions both from the scientist and their peers. Other student groups worked with staff from the Bell Museum, creating larger-than-life insect displays.

After the “nerve-racking” interview, as some students put it, the rest of the day consisted of breakout sessions where students learned about carbonation by making root beer, played Bug Bingo, made technical drawings, and learned about products people get from insects! Of course, the day would not be complete without lunch. Pizza was the hottest item of the day.

The event concluded with an active discussion about what students learned from projects they saw during the day. The opportunity gave the entire group a chance to reflect on the information presented by all of the student scientists.

2010 Insect Fair

Coffman Memorial Union will again be hosting the 2010 Insect Fair, scheduled for Saturday, December 11. The Fair is open to any teacher that would like to bring students, so even if you haven’t taken one of our workshops, you should still consider participating! The online registration process will open in September. If you have any questions about the Fair, contact Grant at info@monarchlab.org. We hope to see you at the Fair!

Featured Projects

The following three projects represent a small sample of the projects on display. There were over 100 projects represented, and they were all unique!

See you Later Pollinator – St. Hubert School

The purpose of this project was to find out how the number of flower clusters, called umbels, on a milkweed plant affects the number of pods per flower cluster and the percent of flowers forming pods. With most milkweed species, one pollinated flower results in one seed pod. But, what if every single flower on a plant gets pollinated? Will that result in a large number of seed pods, or will the plant focus its resources on a limited number of seed pods? After four weeks of monitoring plants with different numbers of umbels, the data suggest that increasing the number of umbels results in more seed pods per cluster. Maybe next year, we’ll find out if there is a limit to the number of umbels and the number of seed pods!



U of M graduate student Bridget Henning was one of 16 volunteer interviewers at the Insect Fair. Without our volunteers, the Fair would be chaos!



U of M Ecology Professor Don Alstad takes time after the interview to give a few pointers to a scientist in training.

2009 Insect Fair: Celebrating Student Scientists (continued)



Monarch Life Cycle – Carondelet Catholic School (Above)

This group of students constructed 3-D models of the different stages of a monarch butterfly: egg, larva, pupa, and adult. Using Styrofoam shapes, felt, pipe cleaners, and other materials, the students created the different stages and also labeled the parts, learning about the monarch life cycle in the process.

CSI Insects – Woodland Middle School (Right)

This group of students created a display with the help of Bell Museum staff that investigates the insects related to the field of forensic entomology. Students researched which insects are attracted to, feed off of, and/or live on the body. In most cases, the same insect species reaches a body first, so they discovered that insects can help forensic scientists determine the time of death. When it comes to forensic entomology on the TV show “CSI,” there is some truth to it!

Below are the award recipients for Outstanding Display, Outstanding Project, and Outstanding Question. Congratulations!

Award	Project Title	School
Display	Crunching Munching Caterpillars	St. Hubert School
Display	A Flutter in Time	Medford Elementary School
Display	Male vs. Female	Medford Elementary School
Display	Tools of the Trade for Lampyridae: Cold Light and Dark Adapted Eyes	St. Peter's School
Display	How Smart is Your Hisser?	Rossman Elementary
Display	How do Insects Change?	Battle Creek Elementary
Display	Goldenrod Ball Gall Escape Tunnel: Do Insects Have a Preference?	Calvin Christian School
Project	Exponential Aphids	St. Hubert School
Project	Got Milkweed?	St. Hubert School
Project	Monarch Marathon	St. Hubert School
Project	See You Later Pollinator	St. Hubert School
Project	Warrior Worms: The effect of earthworms on northern MN forests	Cloquet Middle School
Project	Control of Varroa Mites in Honeybee Hives	Willow Creek Middle School
Project	Schoolyard Invertebrate Survey	Dowling Urban Environmental School
Project	A 'maze' ing Ants	Woodbury Elementary School
Project	Crazy Cockroach	Weaver Lake Elementary
Project	The Bat Guano Loving Cockroach	Horace Mann Elementary
Question	Oak, Birch, or Aspen; Oh My!	Epiphany Catholic School
Question	Rockin' Roach	Rossman Elementary
Question	The Biggest Guzzler	Rossman Elementary
Question	Do Lady Beetles Eat More in the Dark?	New City School
Question	Moving Millipedes	Weaver Lake Elementary
Question	Do Insects Have Jobs?	Battle Creek Elementary
Question	How Does Wind Affect Monarch Larvae Behavior	Amery Middle School

Macroinvertebrate Stream Monitoring

Every year, we include a “winner” of an ecology lesson in our newsletter. This year, you and your students can learn all about macroinvertebrate stream monitoring!

Objective

Students will sample and identify stream bottom macroinvertebrates in a nearby stream to assess the pollution level of the stream. The methodology and data collected in this study will provide opportunities for independent student inquiry projects.

Background

Scientists use many techniques to assess stream water quality. Macroinvertebrate sampling is one method and has many advantages. Because macroinvertebrates vary in their pollution tolerance, the species present indicate the level of pollution in the stream. Thus, you and your students will determine the health of a local stream ecosystem. Identification keys for stream bottom macroinvertebrates are easily found on the web. The Leaf Pack Network is the inspiration for this lesson:

<http://www.stroudcenter.org/lpn/LPNmanual/index.htm>. You can adapt this activity to the time available and the age level of your students.

Leaves naturally fall into streams and collect in “packs” as they are caught in the rocks and other objects in the stream. In this lesson you will create leaf packs by packing leaves into a mesh bag and anchoring them into the stream. Stream bottom macroinvertebrates will colonize the leaves over a period of weeks, after which you can bring the leaf-packed bags into the classroom to identify and study the macroinvertebrates.

Materials

- Mesh bags, such as onion or orange bags
- Leaves from stream bank plant species
- Fishing line
- Ice cube trays
- Plastic shoe boxes
- Petri dishes
- Magnifying glasses or stereoscopes
- ID key from the Leaf Pack Network website (see above)

Procedure

You can take students to the stream to carry out the protocol below or you can collect the macroinvertebrates yourself and bring them back to the classroom for the students to identify. If you take students to the stream it is extremely important to prepare students for water safety. We recommend extra adults to aid in supervising students at the stream.

Locate a stream to monitor. It is best to utilize a stream near the school to increase student interest. Make sure you can access the bank of the stream easily. At the stream, locate a riffle area, where you can see short but plentiful waves on the surface of the flowing water. This indicates rock structure below and is the ideal habitat for macroinvertebrates.

Complete the habitat worksheet and make a map of the stream site. Use the student worksheet on the next page to record the stream site habitat, questions 1 – 7.

Prepare the leaf bags. Take dry leaves from the stream banks and pack them into the mesh bag. Record the name of the plant species packed into the bag. Tie off the ends of the bag by making a knot with the ends of the mesh bag. If you are placing multiple bags in the stream make tags to help identify them later.

Secure the bags in the stream. Lace a long length of fishing line through the leaf bag. Anchor the line to a large rock or other stable object in the stream. Position the bag so that the maximum amount of water passes by the bag. The bag should be stable and should not bounce in the waves. Record the location of the bag on your site sketch.

Leave the bags in the stream for 3-4 weeks. Check them periodically to make sure that they remain submerged.

Retrieve the leaf bags. With as little disruption as possible, quickly lift the leaf bag out of the stream and place it in a plastic shoe box. Add in some stream water to cover half the height of the bag. Bring back to the classroom.

Identify and sort macroinvertebrates. Using plastic spoons and eyedroppers, gently move the delicate and quick organisms into Petri dishes. Using stereoscopes, magnifying lenses, and a key, identify and sort the macroinvertebrates. Sort them into the major groups listed on the inventory and place them into sections of the ice cube tray to keep track of the numbers in each group. Record the numbers in the table.

Determine the pollution in the stream. Compare the total number of organisms found in each of the pollution tolerance level columns. Conduct a class discussion about the health of the local stream. Have students speculate on what the results indicate about the nearby ecosystem. What can students do to protect and improve the health of the stream?

Future studies. Students can create their own stream studies by changing one of the variables in this study. For example, students could look at the effect of the leaf species packed into the bags on the types and numbers of macroinvertebrates. Another idea is to create two bags that are the same and place them in different locations, maybe one downstream from a storm water pipe and the other upstream. Let students decide and watch their excitement for science blossom!

Stream Site Habitat Worksheet & Macroinvertebrate Survey

Scientist Name: _____

1) Name of stream:

2) Describe the bottom of the stream. Estimate the total bottom makeup.

Bedrock ____% + Rocks ____% + Gravel ____% + Sand ____ + Silt ____% = 100%

3) What is the estimated average depth and width of the stream? (Circle relevant units)

Depth ____ inches cm Width ____ feet meters

4) Describe the stream flow (circle one): High Normal Low

5) Describe the vegetation along the banks of your stream:

6) Note any evidence of pollution or other human disturbance:

7) Make a quick sketch of your stream site. Include landmarks such as trees, a bridge, large rocks and any other reminders that will help you relocate your position again. Draw a wave pattern to mark the location of the riffle in the stream. Mark the location of your bag with a dark 'X.'

8) List the species of leaves packed into your bag:

9) Macroinvertebrate inventory:

Pollution Sensitive	Number	Somewhat Pollution Sensitive	Number	Pollution Tolerant	Number
Caddisfly larvae		Beetle Larvae		Aquatic Worms	
Mayfly Nymph		Clams		Blackfly Larvae	
Gilled Snails		Cranefly Larvae		Leeches	
Riffle Beetle		Damselfly Nymph		Midge Larvae	
Stonefly Nymph		Dragonfly Nymph		Lunged Snails	
Water Penny		Scuds		Planaria	
Other:		Other:		Other:	
Total:		Total:		Total:	

10) Look over the results of your macroinvertebrate inventory. Write a summary that you could present to a local community group about the pollution level in this stream. What recommendations would you make to improve and protect the health of the stream?

Two New Organizations Focused on Monarch Conservation

The immediate news on monarch populations is not good; the size of the wintering colonies in Mexico in 2009-2010 is the lowest it has been since scientists first began measuring them in 1993. This year, monarchs occupied 1.92 hectares of land; the mean over all years has been 7.39 hectares, with a previous low of 2.19 hectares in 2004-2005. However, many people are working to conserve and restore monarch habitat in the US, Canada, and Mexico.



In 2009, the Monarch Butterfly Sanctuary Foundation and the Michoacan Reforestation Fund merged to form the new *Monarch Butterfly Fund* (MBF, www.monarchbutterflyfund.org). The MBF board includes monarch, forest, and conservation experts from the US, Canada, and Mexico, and fosters continued survival of monarchs and their migration through a multifaceted conservation strategy. This strategy includes *collaboration* with a number of other non-profit organizations who are active in the Monarch Butterfly Biosphere Reserve; *forest restoration* in the monarchs' Mexican overwintering sites; *habitat assessment and species monitoring* to evaluate the

overall health of monarch habitats; *scientific research* that has direct relevance to monarch conservation; *education and outreach activities* to encourage greater understanding, appreciation, and support of the challenge of monarch conservation; and *sustainable development* projects that support the livelihood of residents of the Monarch Butterfly Biosphere Reserve. We hope you'll visit the new website, and donate what you can to monarch conservation!

Also in 2009, the *Monarch Joint Venture* (MJV) was formed to coordinate monarch conservation efforts in the United States. The MJV is modeled after successful bird conservation Joint Ventures, and builds on the foundation of the North American Monarch Conservation Plan. Karen Oberhauser is its president, and a full-time coordinator, Priya Shahani, works on the University of Minnesota's St. Paul campus. Initial activities include monitoring and research, education and outreach, and habitat conservation. The MJV's work is based on the knowledge that monarchs, with their cadre of public and scientific supporters, can represent many other species and habitats. Thus, a key goal is to promote monarchs as a flagship species whose conservation will sustain habitats for pollinators and other plants and animals.

MonarchLIVE: A Distance Learning Adventure

The goal of MonarchLIVE is to teach about the biology, life cycle, and ecology of the monarch, and to create awareness of the interdependence of the US, Canada, and Mexico in the health and conservation of monarchs.

Last spring, the MonarchLab went on a new adventure, along with the US Forest Service and Prince William County Public Schools, to bring a live webcast show to classrooms around the world, literally! Not many of us here at the MonarchLab have ever been in front of a camera, much less hosted a show! We had a great experience, thanks to the students and experts on the team. Our show was just one of five in the series and our job was to teach about the biology of monarchs in the summer. Elementary students and adults spoke about the monarch lifecycle, threats to the summer monarch population, and what is being done to conserve habitats for monarchs. If you would like to see the show, visit http://monarch.pwnet.org/mom/pop_webcast.php

We would especially like to thank the students, teachers, and administration of Battle Creek Environmental Magnet School and the Friends of Lilydale Park in St. Paul who went to great lengths to prepare for the show.



Lis gives some advice to one of the students involved with MonarchLIVE during rehearsal. With a camera recording live, it would be easy to get nervous, but all of the students did a great job!

The US Forest Service and Prince William crew are starting a new show highlighting the importance of pollinators. For more information, and to sign up for this new adventure, go to: <http://pollinatorlive.pwnet.org>

Driven to Discover: Enabling Authentic Inquiry Through Citizen Science

The University of Minnesota’s MonarchLab blends science research, K-12 science education programs, and citizen science, with boundaries between all of these programs often blurring. These boundaries have just gotten a little more fuzzy, as we embark on a new program that uses citizen science as a vehicle for engaging youth in authentic science research. In citizen science projects, people from all walks of life collect ecological monitoring data that researchers can use to answer scientific questions. These projects serve a crucial role in helping scientists examine large-scale patterns in the natural world. Yet citizen scientists rarely initiate their own scientific investigations, and thus miss out on one of the most important (and exciting) parts of science research.



Wild monarchs like this one will be used in this new project to engage students in authentic science research.

In our new *Driven to Discover* Project, we’re recruiting adult mentors—teachers, Master Gardeners, Master Naturalists, parents, Girl Scout leaders, and others—to lead research clubs, studying monarchs (through the Monarch Larva Monitoring Project) or birds (through the Cornell Lab of Ornithology’s Bird Sleuth program). These clubs will begin by following the protocols of these citizen science projects, and then use their observations to develop their own research questions. Working with U of M scientists, they’ll formulate hypotheses and collect data that will allow them to test these hypotheses and answer their questions. We’ll let you know what they learn as they contribute to our knowledge about birds and butterflies!

Earth Day Celebrates 40 Years in 2010

The 40th anniversary of Earth Day takes place on April 22nd, but how did it start?

Earth Day began as an idea for a nationwide teach-in day that U.S. Wisconsin Senator Gaylord Nelson announced in September 1969. Nelson wanted to call the event ‘National Environment Teach-In’ but press coverage called it Earth Day, so the name stuck. But why April 22nd? Julian Koenig, one of Nelson’s organizing committee members, had a birthday on April 22nd. ‘Koenig’s birthday’ rhymed with ‘Earth Day,’ so the idea came to him easily, according to Nelson. In addition, the date brought good weather, landed after Easter and spring break, but before finals, allowing for optimum college campus participation.

In 1970, 20 million Americans took part in the grassroots campaign in support of the environment. Today, Earth Day is celebrated in 175 countries, with an estimated 500 million people participating. Earth Day is now coordinated by the Earth Day Network, a nonprofit organization.

How can you participate in Earth Day’s 40th anniversary? It could be something as simple as a trash clean up near your school; enhancing a habitat by planting a garden or improving an existing one; or creating a school campaign about



The unofficial Earth Day flag, by John McConnell.
Photo source: http://en.wikipedia.org/wiki/File:Earth_flag_PD.jpg

recycling, reducing waste and water usage, and saving energy. If you don’t have time to coordinate your own project, you could participate in an existing one. The Earth Day Network website has a list of opportunities in your area.

For more information about Earth Day opportunities in your area, and for more information about environmental issues, log on to www.earthday.net and select ‘Earth Day Events’ under the ‘Programs’ heading.



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See page 3 for details

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