Birds, Butterflies, Bullfrogs, and Beyond... Bringing Biology Education to Life with Citizen Science

Questions:
• How can we inspire teachers to integrate citizen science into their teaching?
• How can educators and citizen science project leaders best support and promote participation in citizen science by educators and students?

Targeted Curriculum:
• We recruited lesson submissions and published a book containing 15 lessons, four case studies, and advice about implementation in a variety of contexts.
• We aim to provide a jumping off point, with specific examples of how citizen science can help teachers engage students in an array of scientific practices while learning key science content and skills.

Lessons in the book:

**Whale Song Project**
- Classify whale songs in the Whale FM database to assist scientists in understanding behavioral responses of whales to sonar and other loud sounds in the ocean.

**It’s Been a Hard Day’s Flight: Determining the Flight Distances of Monarch Butterflies**
- Learn about the migratory patterns of monarch butterflies and explore tagging recovery data from the Monarch Watch citizen science project.

**Terrestrial Invertebrates**
- Collect and analyze biological inventory data.

**Signs of Spring: Earthworm Inquiry**
- Brainstorm signs of spring and explore one organism that provides an annual sign of spring’s impending arrival—the earthworm!

**Animated Maps for Animated Discussions**
- Use critical thinking skills to draw conclusions from animated maps portraying bird population dynamics throughout the year, and consider the role of modeling in scientific research and environmental conservation.

**Bird Migration Patterns in My Area**
- Consider indicators of climate change, interpret various representations of bird citizen science data, and reflect on how citizen scientists can assist in building better understanding of bird migration as a local indicator of climate change.

**Habitat Matters: YardMap Your Schoolyard**
- Learn about the importance of small-scale habitat management and discover the characteristics of green spaces that create productive habitat for birds.

**Winter Twig Investigation**
- View a twig as a living system. Observe twigs on deciduous trees or shrubs throughout the winter, collect data indicating when the buds burst into leaf or flower, and submit the data to Project Budburst.

**Flight of the Pollinators: Plant Phenology from a Pollinators Perspective**
- Learn how to observe, quantify, and record how plants change across seasons.

**Ozone Bio-monitoring Garden Study**
- Consider the effects of ground-level ozone pollution on plants and how that relates to animals. Using an online training module, practice estimating the amount of damage to plant leaves.

**Turtle Trackers**
- Learn about turtle species by researching common native turtles, constructing a class field guide of these species, and engaging in one of the regional citizen science projects across the United States that involve aquatic and terrestrial turtles.

**Who’s Out There? A Calling Amphibian Story**
- Learn how to identify frogs and toads by call and apply this knowledge during a frog call hike to inventory calling amphibians and analyze call pair-terms within the context of atmospheric and habitat conditions.

**Wetland Discovery**
- Learn about temporary bodies of water and go on a field trip to map this type of wetland habitat and describe the plants and animals living there.

**Using Inland Coastal Citizen science opportunities to study marine food webs**
- Engage in virtual and field-based scientific discovery related to aquatic food webs, learning that all organisms are interconnected and discovering the impact of upstream activities on marine organisms.

**Tree squirrels; narrators of nature in you neighborhood**
- Observe and record wildlife behavior while conducting experiments and analyzing data to determine how squirrels perceive the safety of various for-aging locations.

How Do These Lessons Address Science Topics And Standards?

Lessons Mapped to Key Science Topics

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<th>Habitats</th>
<th>Life Cycles</th>
<th>Migration</th>
<th>Biodiversity</th>
<th>Wetlands</th>
<th>Human Impacts</th>
<th>Food Webs</th>
<th>Animal Behavior</th>
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Lessons Mapped to Scientific Practices

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<tr>
<th>Asking questions and defining problems</th>
<th>Developing and using models</th>
<th>Planning and carrying out investigations</th>
<th>Analyzing and interpreting data</th>
<th>Using mathematics and computational thinking</th>
<th>Constructing explanations and designing solutions</th>
<th>Engaging in argument from evidence</th>
<th>Obtaining, evaluating, and communicating information</th>
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What better way to learn science?