Kids as Urban Scientists: Data Collection App and Web Display for Youth Mapping the Biodiversity of Urban Areas

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The Importance of Urban Biodiversity

Prior to the 2012 London Olympics, city planners added extensive wildflower meadows and something interesting happened: The number of pollinating insects and other local species (e.g., the biodiversity of the area) increased dramatically (Conniff, 2014). In response to statistics indicating that the portion of our planet characterized as urban is on track to triple from 2000-2030, scientists and community members in the United Kingdom and some American cities are taking action to study (e.g., Lerman, Nislow, Nowak, DeStefano, Kind, Jones-Farrand, 2014) and introduce often simple strategies for increasing urban biodiversity. Recent studies demonstrate that modest actions, such as adding community gardens or being conscious of habitat corridors for safe travel by wildlife, can increase native species (Conniff, 2014).

Target Audience: Urban Elementary Students and Their Teachers

This project has built from existing scientists' technology tools and research to design and evaluate an intervention that puts the mapping of the urban biodiversity in the hands of youth ages 9-12. In 2014, the Obama administration in the United States created the Promise Zone designation to coordinate initiatives and attract resources to areas within American cities where individuals have consistently faced the challenges of deep and persistent poverty (The White House, 2014). For example, in our target population of students during a recent school year, 80.8% of our students were eligible for free or reduced-price meals because of very low family income (Pew Trusts, 2015, p. 39). Our work focuses on low-income youth because of the opportunity to impact persistent trends for young students. Gorski (2013) and others (e.g., Songer, Kelcey and Gotwals, 2009) suggest inquiry learning and research-based principles for interventions that "have proven effective at bolstering the learning and engagement of low-income students and families" including "Principle 10: The inalienable right to equitable educational opportunity includes the right to high expectations, higher order pedagogies, and engaging curricula" (Gorski, 2013; p. 117).

An additional challenge is the lack of quality technology resources in science for elementary students. A shortage of resources is particularly problematic in light of extensive research that confirms that young students are capable and such knowledge development should begin well before secondary school (Metz, 2000; NRC, 2012). "In short, young children have a broad repertoire of cognitive capabilities directly related to many aspects of scientific practice, and it is problematic to view these as simply a product of cognitive development. Current research indicates that ... cognitive capabilities directly related to scientific practice usually do not fully develop in and of themselves apart from instruction, even in older children or adults. These capacities need to be nurtured, sustained, and elaborated in supportive learning environments that provide effective scaffolding and targeted as important through assessment practices." (NRC, 2007;44-45).

What We Learn Adds New Solutions for our City

Our learning technology resources consist of a mobile app, web-based resources and curricular activities designed to guide youth ages 9-12 in gathering and analyzing data and creating solutions about the biodiversity of their neighborhood. Central components of the mobile app and the curricular intervention include:

a. *Students are invited to gather and organize data on schoolyard biodiversity by professional animal trackers in Africa.* Figure 1 provides the letter from professional animal trackers inviting Philadelphia students to collect and analyze data in their schoolyard similar to the work conducted in Africa.

Example: Tracker Letter

Dear Trackers,

Welcome to Mkalli team! I'm Mkalli and I'm from Tanzania, a country on the coast of Africa. The Mkalli team's logo is a fish because I love catching and eating fish from the three lakes in Tanzania.

In Tanzania, we have many insects. I recently observed this animal and was trying to identify if its an insect. I know that all insects have **6 legs** and **3 body parts.**

Figure 1: Professional African Animal Tracker and Tracker invitation letter

b. *Youth, with guidance by scientists and their teachers, perform work that has many of the characteristics of actual biodiversity scientists' work*. The investigation-based unit guides students in being responsible for field-based data collection, data analysis, and communicating and sharing of their findings with others towards broader understandings. Using the mobile app, student groups are assigned to go outside to a particular area of their neighborhood and track and record evidence of plants and animals in their zone. This data collection also includes taking a photos and the collection of a small animal that they believe might be an insect, and making and recording careful observations of the animals and plants in their region within a set two-week time period. When they return, their data is uploaded so that all students' information can be combined in a city-wide database. Figure 2 illustrates sample mobile app screens for youth data collection and display.

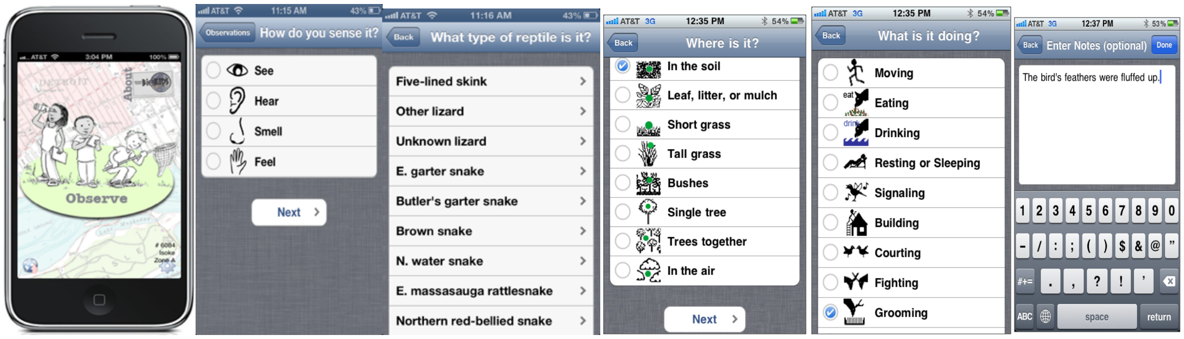

Figure 2A: Sample screens from the data collection mobile app.

c. The students' knowledge has value for urban planning, and the information will become a local resource for their area of their city. Students are asked to think critically about the data they have collected in order to analyze their data and propose a solution that draws from their evidence-based conclusions. Through these activities, students not only participate in actual science activities, but they recognize the value of presenting and discussing valid solutions for what can be done to improve their city. These activities require the students to demonstrate a suite of 21st century skills including communicating, critical thinking, problem solving, and interpersonal skills. Figure 3 provides an overview of the investigations and lessons that culminate in the generation and presentation of a solution to increase local urban biodiversity.

Curriculum Story

Blue = Science & Engineering Practices   Orange = Disciplinary Core Ideas   Green = Crosscutting Concepts

Lesson Overview	3D Learning Goal	Career Awareness
Lesson 1: Solving the Mini-Beast Mystery (90 min) **Badge 1: Mini-Beast Tracker**	**Students construct a claim based on evidence about whether their Mini-Beast is an insect.**	Students will focus on critical thinking to identify scientific skills needed to be a tracker.
Lesson 2: Tracker Observations (90 min) **Badge 2: Urban Tracker**	**Students make observations of plants and animals in their schoolyard.**	Students add their observations to the Philly Scientists database.
Lesson 3: Tracking Animals and Plants in your Schoolyard (90 min) **Badges 3: Field Researcher**	**Students collect animal and plant data within a zone of their schoolyard/ neighborhood.**	Students use technology as a data organization and collection tool.
Lesson 4: Tracking the Biodiversity in your Schoolyard (90 min)	**Students create a claim backed with evidence about which zone has the lowest biodiversity.**	Students engage in critical thinking by making a claim supported with evidence.
Lesson 5: Energy in a Food Web (90 min)	**Students create a claim backed with evidence using their own data to illustrate a food chain.**	Students use problem solving skills to explain energy flow in a foodweb.
Lesson 6: Improving Biodiversity in my Neighborhood (90 min) **Badge 4: Solution Generator**	**Students create a solution (claim) backed with evidence to increase neighborhood biodiversity.**	Students conduct research to find a solution that increases neighborhood biodiversity.
Lesson 7: Tracker Planning (90 min)	**Students create a display of their biodiversity solution in written text, tables, diagrams, and/or charts (patterns).**	Students create a display of their solution.

Figure 3: Curriculum Story outlining the four week lessons and next generation science learning goals.

Assessment & Recognition Through Digital Badging

Digital badges refer to the practice of awarding and certifying accomplishments and recognition for skills, interests or cognitive demonstrations, such as those demonstrated in immersive tasks such as in online games. In a handful of very recent studies, digital badging has been associated with a variety of benefits for student learners including the credentialing of soft skills (Devedzic et al, 2015) and the individualization of learning and learning pathways (O'Byrne, Schenke, Willis, & Hickey, 2015; Davis & Singh, 2015). The ICT demo will conclude with a chance for audience members to view and discuss research results and interact with our digital badges, both those designed to reward youth accomplishments and skills and those designed to acknowledge teacher knowledge and skill development.

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