

Citizen Science in 2009: A Brief Overview

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Citizen Science has blossomed over the past decade. The involvement of laypeople in monitoring the environment has a long history that has been traced in America to the late 19th Century. Weather watching, hunter and fisher surveys, and Audubon bird counts are early examples of citizens providing information about the natural environment (Droege, 2007). Current citizen science projects involve many of the same topics. Information is collected by members of the public about wildlife, water quality, air quality, invasive species, climate change and astronomy and then analyzed by the academic and government science community. Some databases have become quite substantial and allow for inquiry that would be impossible without volunteer effort.

The prominent organizations involved with citizen science are federal and state governments and universities, usually in multiple partnerships. Almost every Federal agency with a public science mission sponsors citizen science projects that monitor wildlife, water quality, air quality, invasive species, climate change and astronomy. Below is a list of the Federal Departments and their relevant agencies that have publically identified citizen science programs.

- Department of Agriculture
 - US Forest Service
- Department of Commerce
 - National Oceanic and Atmospheric Administration
- Department of Interior
 - Bureau of Land Management
 - US Fish and Wildlife
 - US Geological Survey

- National Biological Informatic Office
 - National Park Service
 - National Aeronautics and Space Administration
 - National Science Foundation ¹
 - Center for Advancement of Informal Science Education (CAISE)

While all of these Federal Departments sponsor citizen science projects, two deserve extra attention. The USGS through its National Biological Informatic Office manages an important resource known as the National Biological Information Infrastructure (NBII). The NBII is “a broad, collaborative program to provide increased access to data and information on the nation's biological resources. The NBII links diverse, high-quality biological databases, information products, and analytical tools maintained by NBII partners and other contributors in government agencies, academic institutions, non-government organizations, and private industry.²” The partners are federal, state and local government agencies, universities, non-profits, international, and private sector. A cursory search of the partnerships for California shows the California Area Information Node (CAIN), a partnership between University of California, Davis and CA Department of Fish and Game. While no specific citizen science projects are listed for California, other information nodes are quite active, e.g., Pacific Basin (Hawaii), Texas, Appalachian Trails and others.

The National Science Foundation (NSF) is the second Federal agency important to citizen science. Since 1984, the NSF has received Congressional appropriations to promote lifelong learning of science, technology, engineering and mathematics (STEM) (Ferrini-Mundy, 2009). This has provided an impetus to both the expansion of citizen science projects and to research on the objectives and qualities of citizen science programs.

¹ The National Science Foundation is an independent agency created by Congress in 1950.

² http://www.nbii.gov/portal/community/Communities/NBII_Home/

The NSF has a major initiative to promote learning in informal science environments (ISEs). They commissioned the National Research Council (NRC) to examine learning in informal environments, i.e. those environments outside the classroom. . The NRC conceptualizes the goals and practices of science learning to consist of six interweaving strands that when taken together can “represent the ideal that all insitutions that create and provide informal environments for people to learn science can strive for in their programs and facilities” (NRC, 2009, p 43). Without going into further detail the six strands are summarized in the following table. Interested readers are directed to the Chapter 3 of the NRC report, Theoretical Perspectives. (pp 27-53)

<p>Strand of informal Science Learning</p> <p>Learners who engage with science in informal environments...</p> <p><u>Strand 1</u>: Experience excitement, interest, and motivation to learn about phenomena in the natural and physical world.</p> <p><u>Strand 2</u>: Come to generate, understand, remember, and use concepts, explanations, arguments, models, and facts related to science.</p> <p><u>Strand 3</u>: Manipulate, test, explore, predict, question, observe, and make sense of the natural and physical world.</p> <p><u>Strand 4</u>: Reflect on science as a way of knowing; on processes, concepts, and institutions of science; and on their own process of learning about phenomena.</p> <p><u>Strand 5</u>: Participate in scientific activities and learning practices with others, using scientific language and tools.</p> <p><u>Strand 6</u>: Think about themselves as science learners and develop an identity as someone who knows about, uses, and sometimes contributes to science.</p>

When these guidelines are applied to citizen science, the NRC states that “Citizen science and volunteer monitoring programs encourage networks of volunteers, including both adults and children, to

engage in scientific practice (Strand 5) through the collection of data for scientific investigations, providing adults with opportunities to gain scientific knowledge (Strand 2), test and explore the physical world (Strand 3), understand science as a way of knowing (Strand 4), and develop positive attitudes toward science (Strand 6). They are often organized and administered through scientific organizations, such as university-based labs and local environmental groups. (p 191-192).

NSF also supports the Center for the Advancement of Informal Science Education (CAISE) which “works to strengthen and connect the informal science education community by catalyzing conversation and collaboration across the entire field—including film and broadcast media, science centers and museums, zoos and aquariums, botanical gardens and nature centers, digital media and gaming, science journalism, and youth, community, and after-school programs.” CAISE is “a partnership among the Association of Science-Technology Centers (ASTC), Oregon State University (OSU), the University of Pittsburgh Center for Learning in Out-of-School Environments (UPCLOSE), and the Visitor Studies Association (VSA). CAISE focuses its work on improving informal science education practice, documenting evidence of impact, and communicating the contributions of informal science education.”³

In addition to citizen science serving as a platform for informal science education, the cost-effectiveness benefit of having numerous volunteers collect and report observations should not be overlooked. To take just one example, the Breeding Bird Survey (BBS) requires 2900 expert bird observers and consumes about 10,000 volunteer hours per year. If personnel were hired to conduct this survey it would take more than 5.5 full-time employees (FTEs) to perform the work at a burdened cost of \$300K per year.. When it is considered that the BBS has been conducted for 40 years with over 10,000 volunteer hours, it would be cost prohibitive to conduct the survey without citizen scientists.

³ <http://caise.insci.org/about-caise>

There is a lively debate about the quality of data gathered by volunteers instead of technicians, but that is not a big concern in well-managed programs. Programs where volunteers are well trained, are motivated to participate, and receive feedback about their efforts seem to have acceptable data quality. While there may be data errors, the volume of observations tend to smooth out the error factor.

Finally, the premier organization for information about citizen science is the Lab of Ornithology at Cornell University. They host workshops devoted to citizen science and serve as a clearing house for all citizen science-based projects through its website www.birds.cornell.edu/citscitoolkit/. Appendix I is a table that provides details on the projects that are currently listed on government and Cornell websites. It lists the organization sponsoring the project, the project name, a brief description, and the projects' website. The list grows daily but it provides a wide-angle view of the types of citizen science projects that are being conducted at the present time.

Appendix II contains some resources for constructing successful citizen science programs. First is a Technical Working Group report on Elements of a Successful Citizen Science Project. A hard copy is provided and a link can be found at:

http://sain.utk.edu/aptrail_documents/Citizen_Science_Report_20070629.pdf.

A second resource is an abridged version of A Director's Guide to Best Practices: Programming – Citizen Science. Its link can be found at www.natctr.org

Bibliography

Droege, S., Just because you paid them doesn't mean their data are better. Citizen Science Toolkit Conference 2007

Ferrini-Mundy, J, Testimony Before the House Copmmittee on Science and Technology Subcommittee on Reserarch and Science Education U.S. House of Representative, Feb 26, 2009

National Research Council, Learning Science in Informal Environments: People, Places and Pursuits, National Academies Press, 2009.

Appendix 1. Table of Citizen Science Projects listed on Government websites and Cornell University Lab of Ornithology.

Dept of Interior, - Forest Service -Fish and Wildlife -Nat'l Park Service	<u>Monarch Butterfly</u> Citizen Science	The Monarch Butterfly website is an interagency effort to educate the public and increase understanding of monarch butterfly biology and conservation	www.fs.fed.us/monarchbutterfly/citizenscience/index.shtml
NASA	<u>For Citizen Scientists — NASA Science</u>	Citizen Scientists have helped to answer serious scientific questions, provide vital data to the astronomical community, and have discovered thousands of objects including nebulas, supernovas, gamma ray bursts	nasascience.nasa.gov/citizen-scientists
State of Kansas Bureau of Water	Soil and Water Testing	CITIZEN SCIENCE: Soil and Water Testing for Enhanced. Natural Resource Stewardship. A Guide for On-Farm Soil and Water Testing.	www.oznet.ksu.edu/kswater/images/citizen_science.htm
Nat'l Park Service Glacier Natl Park	The Crown of the Continent Research Learning Center:	<u>Common Loon Monitoring</u> Involves extensive surveys of Glacier National Park's hundreds of lakes to document presence of Common Loons and observations of breeding and nesting behaviors. <u>High Country</u> Involves extensive back-country surveys to collect data on the number and distribution of three species of concern for Glacier National Park: mountain goats, pikas, and Clark's Nutcrackers. <u>Invasive Weeds</u> Involves mapping surveys of Glacier National Park's 700+ miles of hiking trails to determine the distribution and extent of noxious weeds invading the park.	www.nps.gov/glac/naturescience/ccrlc-citizen-science.htm
Nat'l Park Service State of Washington	Mt. Rainer National Park	conducting field surveys of toads and tadpoles in park lakes, ponds, and wetland areas	rainiervolunteers.blogspot.com
Cornell University	Vegetable Varieties for Gardeners	Gardeners visit this site and report what varieties perform well - and not so well - in their gardens.	vegvariety.cce.cornell.edu/index.php

State of New York Dept of Environmental Conservation	<u>Citizen Science on Hudson River Eels</u>	Dutchess, Putnam and Westchester County high school students and community volunteers are engaging in research on migrating juvenile American eels in several Hudson Valley tributaries	www.dec.ny.gov/press/53979.html
USGS No. Virginia Soil & Water Conservation District	Monitor the effectiveness of riparian plantings	Using a tiny temperature monitoring device, we are evaluating the impact of riparian zone restoration on stream temperature at Lake Fairfax Park in Reston.	www.fairfaxcounty.gov/nvswcd/newsletter/usgs.htm
State of New York Dept of Environmental Conservation	Wildlife Monitoring	Citizens help with Ruffed Grouse survey, Wild Turkey Survey, Bobcat Observation, and Frog and Toad monitoring	www.dec.ny.gov/animals/1155.html
State of Washington Biodiversity Program	Various Monitoring projects	<p>Collect long-term, scientifically significant data on the nearshore habitat and wildlife of seven Seattle area marine reserves and Seahurst Park in Burien.</p> <p>The <u>Coastal Observation and Seabird Survey Team (COASST)</u> involves coastal communities in monitoring local marine resources and ecosystem health</p> <p>The <u>Great Backyard Bird Count</u> is an annual four-day event that engages bird watchers of all levels in counting birds</p> <p>The <u>Port Townsend Marine Science Center</u> offers opportunities in eelgrass monitoring, a survey on the impacts of seaweed harvesting, shellfish safety monitoring, and others</p> <p>The <u>Washington Native Plant Society</u> is encouraging interested participants to help improve scientific documentation of invasive plants in Washington through herbarium collections.</p> <p><u>Joint outreach program</u> developed by the Washington Department of Fish and Wildlife</p>	www.biodiversity.wa.gov/education/citizens.html

		<p>and the University of Washington Gap Analysis Project to promote biodiversity studies through citizens and school-based data collection and research.</p> <p>Plant conservation program focused exclusively on vascular plants designated as rare in Washington State.</p>	
<p>Hawaii and Pacific Basin USGS -National Biological Information and Infrastructure (NBII)</p>	<p>Science and Technology in the Community</p>	<p>Community-based approaches to informing and empowering citizens to impact current conservation efforts in Hawaii. USGS staff has assisted with the training of instructors and students at the K - 12 and university level, offering courses in Geographic Information Systems (GIS), Geography, and the use of Global Positioning System (GPS) technology.</p>	<p>www.nbii.gov/portal/server.pt?open=514&objID=5854&parentname=CommunityPage&parentid=1&mode=2&in_hi_userid=2&cached=true</p>
<p>Alaska Department of Fish and Game, <u>U.S. Fish and Wildlife Service, Chugach National Forest (USDA), The Alaska Zoo, and The Alaska Natural Heritage Program.</u></p>	<p>Wildlife Monitoring</p>	<p>Assist wildlife biologists in collecting important information that will be used to support future research and conservation planning. Current projects are Wood Frog Monitoring, Alaska Bat Monitoring, and Loon and Grebe Watch.</p>	<p>www.wildlife.alaska.gov/index.cfm?adfg=nongame.citizen_science</p>
<p>Nat'l Park Service Nat'l Science Foundation</p>	<p>Cold Weather Data Collection</p>	<p>Alaska Lake Ice and Snow Observatory A K-12 and University partnership measuring snow and ice to understand lake ice growth and conductive heat loss.</p>	<p>www.nps.gov/.../tel/Guides/ss_climate_change_slides_08072008.pdf</p>
<p>NASA</p>	<p>The Citizens and Remote Sensing Observation Network (CARSON)</p>	<p>Designed to show citizen scientists how to explore satellite data to make wide-scale environmental observations on air quality, water quality, and biomes. Neat earth system science tools for grades 3-8</p>	<p>earthobservatory.nasa.gov/Experiments/</p>
<p>Natl Park Service</p>	<p>The Northeast Temperate Network (NETN)</p>	<p>Is responsible for monitoring the health of ecosystems in twelve parks in seven northeastern states and along the Appalachian</p>	<p>science.nature.nps.gov/im/units/NETN/monitor/birds/docs/NETN_ProgramBrief_CitizenScience_2009.pdf</p>

		<p>National Scenic Trail, which stretches over 2000 miles from Maine to Georgia. These parks represent a diversity of landforms and habitats, and are home to a variety of plant and animal species. Completed projects include:</p> <ul style="list-style-type: none"> • Population dynamics of common eiders at Boston Harbor Islands • Abundance and diversity of grassland bird species of conservation concern at Saratoga NHP • How barnacle recruitment in the intertidal zone is impacted by visitor use at Boston Harbor Islands and Acadia NP • How climate change impacts songbird migration • Where to target management to control invasive plant and animal species • Abundance and diversity of forest salamander populations at Marsh-Billings-Rockefeller NHP, Acadia NP, and Roosevelt-Vanderbilt NHS <p>Ongoing projects include:</p> <ul style="list-style-type: none"> • Appalachian Trail exemplary plant communities • Appalachian Trail water quality • Appalachian Trail air quality/visibility • eBird year-round bird monitoring • Estuarine nutrient enrichment • Salt marsh vegetation • Rocky intertidal communities • Phenology 	
<p>State of Wisconsin -Dept of Natural Resources Univ of Wisconsin Extension</p>	<p>Beaver Creek Water Monitoring</p> <p>Freshwater Sponge Monitoring</p>	<p>Citizen-based Stream Monitoring pilot Monitored 23 sites on 16 streams and analyzed data for temperature, transparency, dissolved oxygen (DO), and pH</p> <p>This Citizen-based Monitoring study tries to shed more light on how abundant and widely distributed Wisconsin's sponges are today compared to the 1930s.</p>	<p>watermonitoring.uwex.edu/pdf/level2/reortBCCS C.pdf</p> <p>dnr.wi.gov/org/es/science/citizen/</p>

USGS -Fort Collins Science Center	Invasive Species	A proposal for a national scale citizen science program for invasive species	http://www.fort.usgs.gov/Products/Publications/pub_abstract.asp?PubID=22152
USDA; USGS with supervision of the <u>National Institute of Invasive Species Science</u> and funding by National Science Foundation (NSF);	An invasive species mapping program	Allows citizens, school groups, and professionals to enter invasive species observations into a global database. Provides the training and tools to allow anyone to participate in research on species distributions. For starters, we are focusing on engaging citizen scientists to help map invasive species.	http://weblogs.nal.usda.gov/invasivespecies/archives/2009/04/citisciorg_-_ci.shtml
Natl Park Service- Great Smokey Mountain	Appalachian Highlands Science Learning Center	Environmental monitoring for: Ozone, slime mold, water quality, terrestrial invetebrates, snowpack monitoring, salamander monitoring, and All Taxa Biodiversity Inventory	http://www.handsontheland.org/monitoring/checkup.cfm
Univ. of Illinois at Chicago Peggy Nortebaert Nature Museum	Project Squirrel	Monitors familiar species of wildlife, fox squirrels and grey squirrels, in urban neighborhoods and natural areas	http://projectsquirrel.org/

<p>Tahoma Audubon Society in partnership with the Pierce County Biodiversity Alliance, the Washington Dept. of Fish and Wildlife, Northwest Trek Wildlife Park and the Tacoma Nature Center</p>	<p>The Nisqually BMA Bioblitz</p>	<p>Citizens, area landowners and experts team together to conduct a 24-hour biological inventory of the taxa in a Biodiversity Management Area. Teams will include botany, invertebrates, mammals, prairie species, butterflies, amphibians and reptiles.</p>	<p>http://depts.washington.edu/natmap/about/howto.html</p>
<p>Beaver Creek Reserve Citizen Science Center in partnership with the Wisconsin Department of Natural Resources</p>	<p>Acoustic Bat Monitoring</p>	<p>Trains volunteers to conduct acoustic bat surveys using an AnaBat detector attached to a PDA with GPS to compile information about phenology, species presence, migration timing vs. residence, and trends of the bat species in Wisconsin.</p>	<p>http://www.beavercreekreserve.org/CSC.htm</p>
<p>Big Sky Institute at Montana State University in partnership with the USGS Northern Prairie Wildlife Research Center and the USGS National Biological Information Infrastructure</p>	<p>Butterflies and Moths of North America (BAMONA)</p>	<p>BAMONA data are updated regularly and come from a variety of sources, including citizen scientists. Individuals become involved by documenting butterflies and moths in their neighborhoods and submitting photographs for review.</p>	<p>http://www.butterfliesandmoths.org/</p>

<p>Natural Resources Research Institute of the University of Minnesota - Duluth</p>	<p>Great Lakes Worm Watch</p>	<p>Citizens actively contribute to the development of a database documenting the distributions of exotic earthworms and their impacts across the region</p>	<p>http://www.nrri.umn.edu/worms/</p>
<p>Indiana Department of Natural Resources - Division of Fish and Wildlife in partnership with the Natural Resources Education Center</p>	<p>Hoosier Riverwatch</p>	<p>The program was started in 1994 to increase public awareness of water quality issues and concerns by training volunteers to monitor stream water quality. Funding is provided in part by the Federal Sport Fish Restoration Fund.</p>	<p>http://www.hoosieriverwatch.com/</p>
<p>McGill University and the National Sea Grant (NOAA)</p>	<p>Invasive Tracers, a Citizen Scientist Initiative: Marine Invasive Species Monitoring Organization (CSI MISMO),</p>	<p>This project seeks to demonstrate that a large group of people working together can collect enough scientifically valid data for predicting the spread of recently introduced non-native crab species.</p>	<p>http://biology.mcgill.ca/faculty/leung/invasivetracers/index.htm</p>
<p>Journey North</p>	<p>Spring Monarch Butterfly Migration Monitoring</p>	<p>Participants track the Monarch Butterfly's spring migration by reporting their first sighting of an adult monarch butterfly. They also report the first spring sightings of milkweed, monarch butterfly eggs and/or caterpillars.</p>	<p>http://www.learner.org/jnorth/monarch/</p>

<p>NOAA Office of National Marine Sanctuaries in partnership with the Marine Science Institute at UC Santa Barbara, Farallones Marine Sanctuary Association, UC Santa Cruz, and <u>three National Marine Sanctuaries</u></p>	<p>LiMPETS</p>	<p>LiMPETS (Long-term Monitoring Program and Experiential Training for Students) are an environmental monitoring and education program for students, educators, and volunteer groups throughout California. Approximately 3,500 teachers and students along the coast of California are collecting rocky intertidal and sandy beach data as part of the LiMPETS network.</p>	<p>http://limpetsmonitoring.org/</p>
<p>The Department of Entomology at Cornell University</p>	<p>The Lost Ladybug Project</p>	<p>Over the past twenty years several native ladybug species that were once very common have become extremely rare. During this time several species of ladybugs from other places have greatly increased both their numbers and range. To help the nine spotted ladybug and others, scientists need to have detailed information on which species are still out there. You Can Help! 1. Go out and find ladybugs. 2. Photograph them! 3. Upload your digital images using our submission form or mail us photos, along with the time, date, location, and habitat. 4. Return ladybugs to the wild.</p>	<p>http://www.lostladybug.org/</p>
<p>The University of Minnesota</p>	<p>Monarch Larva Monitoring Project</p>	<p>A citizen science project involving volunteers from across the United States and Canada in monarch research to collect long-term data on larval monarch populations and milkweed habitat. The overarching goal of the project is</p>	<p>http://www.mlmp.org/</p>

		to better understand how and why monarch populations vary in time and space, with a focus on monarch distribution and abundance during the breeding season in North America.	
University of Hawaii in partnership with Reefcheck Hawaii	OPIHI: Our Project in Hawaii's Intertidal	A school-based monitoring program of Hawaii's rocky intertidal where students monitor opihi, a large limpet found only in the rocky intertidal in Hawaii whose status is threatened.	http://www.hawaii.edu/gk-12/opihi/index.shtml
Kansas State University Konza Environmental Education Program, Konza Prairie Biological Station	Prairie Phenology	Observations taken each year at the same place over a long period of time are valuable for showing phenological trends. This project lists the first sightings of the most common birds, mammals, reptiles, amphibians and insects that migrate, hibernate or otherwise appear on the landscape after an absence. These lists are not exhaustive but represent those plants and animals easily observed or abundant. The data added by volunteers and students becomes part of a long-term data set to show trends and relationships among plants or animals across Kansas.	http://keep.konza.ksu.edu/Animal%20List.htm
South Carolina Department of Natural Resources	SCORE: South Carolina Oyster Restoration and Enhancement	Involves volunteers of all ages in hands on habitat-restoration along the coast of SC. Volunteers also monitor reef development and water quality, entering data online. Volunteers can work with marine scientists on related aspects of the project (e.g. sampling fish and invertebrates using created habitats).	http://score.dnr.sc.gov/

<p>Red Admiral and Painted Lady Research Site, organized in partnership with</p> <p>Iowa State University Geographic Information Systems Facility, Iowa Nature Mapping and the</p> <p>Iowa Environmental Mesonet</p>	<p>The Vanessa Migration Project</p>	<p>Citizen observers in North America report their sightings of date, location, flight direction, and other activity of four butterflies of the genus <i>Vanessa</i> (<i>V. atalanta</i>, <i>V. cardui</i>, <i>V. virginiensis</i>, and <i>V. annabella</i>). Objectives include 1) monitoring butterflies and their yearly seasonal distribution; 2) tracking migrations and outbreaks; and 3) studying effects of weather and climatic patterns on butterfly activity.</p>	<p>http://www.public.iastate.edu/~mariposa/homepage.html</p>
<p>Gulf of Maine Research Institute</p>	<p>Vital Signs</p>	<p>Vital Signs a community-based education program that links middle school students, citizen scientists, and scientists in the collection and analysis of environmental data related to invasive species.</p>	<p>http://www.gmri.org/education/vitalsigns.asp</p>
<p>Jug Bay Wetlands Sanctuary in partnership with</p> <p>Friends of Jug Bay and the</p> <p>Chesapeake Bay National Estuarine Research Reserve System</p>	<p>The Jug Bay Volunteer Program</p>	<p>Each year, more than 200 volunteers donate over 7,000 hours of their time, skills, and enthusiasm to reach Jug Bay Wetlands Sanctuary's goals in environmental education, scientific research, and the protection of the vulnerable wetland ecosystem. This is the equivalent of a \$100,000 donation. These volunteers have a variety of backgrounds--- teachers, librarians, construction workers, chemists, college and high school students,</p>	<p>http://www.jugbay.org/</p>

		and yes, some are even professional wetland ecologists! What they have in common is an interest in nature, pleasure in being outdoors, and a desire to explore the ecology of natural habitats such as wetlands and forests. At the Sanctuary, they collect water samples . . . clear trails . . . weigh turtles . . . guide visitors on nature walks . . . draw maps . . . lead canoe trips . . . make posters . . . seine for fish . . . host the Visitor Center on weekends . . . and so much more!	
Appalachian Mountain Club	Mountain Watch	AMC's Mountain Watch is a citizen scientist monitoring program whereby hikers monitor and report the timing of alpine and mountain forest flowers bud break and flowering and document air quality from mountain vistas. Mountain Watch plant observations will aid researchers in understanding how and by what magnitude the biota on the mountains are responding to observed statistical changes in climate variables like temperature and snowmelt.	http://www.outdoors.org/conservation/mountainwatch/index.cfm
University Corporation for Atmospheric Research Office of Outreach and Education in partnership with the Chicago Botanic Garden and the	Project BudBurst	Project BudBurst engages people from across the United States in the collection of important climate change data based on the timing of leafing and flowering of trees and flowers. Project BudBurst participants take careful observations of the phenological events such as the first leafing, first flower, and first fruit ripening for a variety of plant species including trees, shrubs, flowers, grasses, weeds and ornamentals. Project BudBurst is particularly interested in observations of native	http://www.windows.ucar.edu/citizen_science/budburst/

<p>University of Montana, College of Forestry and Conservation</p>		<p>plant species. The citizen science observations are reported online to a national database. As a result valuable environmental and climate change information is being collected in a consistent way across the country. Scientists can use this data to learn about the responses of individual plant species to climatic variation locally, regionally, and nationally, and to detect longer-term impacts of climate change by comparing with historical data.</p>	
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