Q: What is citizen science?

A: The systematic collection and analysis of data; development of technology; testing of natural phenomena; and the dissemination of these activities by research on a primary *avocational basis*.

Some Famous Citizen Scientists:
Charles Darwin, Albert Einstein, Benjamin Franklin & Laurence Klauber…
Citizen Science, and Crowdsourcing Environmental Monitoring Programs Origins Within The US:

1846 – The United States Coast & Geodetic Survey adds the use of drift bottles to its array of observation techniques.

1880 - Lighthouse Keepers began keeping bird strike information in 1880..

1890 - The National Weather Service Cooperative began recruiting volunteers in to report daily measurements of rainfall and air temperature. More than 11,000 volunteer weather stations now exist nationwide, and we have much knowledge of our nation's climate is based on that data.

1900 - The National Audubon Society started it’s Christmas Bird Counts.

1920 - The Izaak Walton League of America kicked off volunteer water monitoring when volunteers conducted the first national water survey for President Calvin Coolidge.
Citizen Science is applicable to all fields of science.

Clearinghouses for ideas, news, and resources in support of citizen science projects that answer real-world questions: www.citsci.org  www.birds.cornell.edu/citscitoolkit

Astronomy
www.galaxyzoo.org
http://faulkes-telescope.com
http://science.nasa.gov/citizen-scientists/
www.citizensky.org/

Fish Tagging Studies
http://fwie.fw.vt.edu/tagging/
www.littoralsociety.org/index.php/take-action/citizen-science

Ecosystem Inventories
www.inaturalist.com
http://education.nationalgeographic.com/education/programs/fieldscope/?ar_a=1
www.reefcheck.org/
www.restoretherockies.org/
www.appalachianforest.org/cem_conf_pg.htm

Meteorological and Climate Studies
www.cocorahs.org/

Public Health
www.communitysensing.org/
www.wheresgeorge.com/
Categories of Citizen Science Programs

**Contributory** – Scientist designed; participants collect data/samples.

**Collaborative** - Scientist designed; participants do more than just collect data/samples.

**Co-created** – Scientists and participants collaboratively design the project.

**Community based** – Participant/Community created and collect samples, take measurements, conduct tests and/or more …

**Educational -** STEM, Environmental Literacy, Gaming…
MYTH: Use Volunteers = Saving $$$

- Citizen Science is not free but it is cost effective
  - Citizen Science Requires Investing in Personnel Management & Data Acquisition

- Citizen Science Provides Tangible Benefit Beyond Simple Field Work & Data Acquisition
MYTH: Citizen science data is of unknown quality.

- Quality Assurance Project Plans (QAPP) based on EPA and SWAMP guidance are being implemented.
- Inter-calibration exercises are being held....
Citizen Science Improves ...

- Environmental & Science Literacy
- Public Input & Public Engagement
- Field Detection
- Data & Image Analysis
- Use of and Access to Local/Traditional Knowledge
- Refinement of Research Questions
- The Number and Diversity of Future Scientists and Environmental Resource Managers
Citizen Science Contributes to...

- **Management of Environmental Resources**
  - Species Management (Salmonid Monitoring)
  - Ecosystem Services (Wetlands Monitoring)
  - Climate Change (King Tides Crowdsourcing)

- **Environmental Protection**
  - Pollution Detection (Water Quality Monitoring)
  - Enforcement of Environmental Laws (MS4...)
  - 303(d)/305(b) Reporting (Impaired waters...)

- **Policy Making**
  - Adoption of Water Quality Standards (WQMPs, Permits)
  - Bans on Specific Pollution Sources/Agents (Pesticides, Shopping Bags)
  - Providing Informed Comments (Legal Disclosure Comment Periods,)

- **Obtaining Observational & Opportunistic Data**
  - Observing and Notifying Agencies about Spills (Oil, Sewage)
Citizen Scientists...

- Spread Knowledge
  - Shared Stories
  - Broaden Public Awareness
- Increase Local/Personal Env. Stewardship
- Advances Community Pride
- Quickens Environmental Management Decision Making
Citizen Science Changes How People See The World In Terms Of:

*Scientific*    *Educational*    *Social and Policy*

Collaborative and co-created approaches often have very **practical goals** derived from collaborating with citizens. These are expressed in actions and practical results rather than in emphasis on data gathering for mainly scientific interpretations and outcomes.

Facilitates **building mutual trust** between scientists, the general public and decision makers.
A Modeled Pathway of Citizen Science Influence

1) Generating scientific Information

(2) Facilitating direct (green arrows) and indirect (red arrows) public input and engagement.

Text in black refers to the policy cycle: problem or issue

Levels of Citizen Monitoring Engagement

- Water Quality Condition Assessments
- Sampling and Analysis
- Sampling
- Bioassessments
- Biosurveys
- Snapshots
- Visual Assessments
- Participatory Sensing
- Education
Citizen Science Data Collection Tools
Visual/Sensory
Physical Measurements

• Temperature

• Turbidity

• pH
Physical Measurements

• Conductivity/Salinity

• Dissolved Oxygen
Chemical

- Colormetric
- Colorimeter
- Spectrophotometer
- Fluorescence
- Test Strips
Biological
Smartphone and Tablet Revolution
THE CLEAN WATER TEAM

The mission of the Clean Water Team is to support the State’s Watersheds Stewardship through involvement by Citizen Monitoring in order to reduce and prevent water pollution and recover lost beneficial uses.

www.waterboards.ca.gov/water_issues/programs/swamp/cwt_volunteer.shtml
About the Clean Water Team
The Clean Water Team (CWT) is the citizen monitoring program of the State Water Resources Control Board. The CWT is a part of the Surface Water Ambient Monitoring Program (SWAMP). The CWT Citizen Monitoring Coordinator works statewide in order to provide technical assistance and guidance documents, training, QA/QC support, temporary loans of equipment and communication to citizen monitoring programs and watershed stewardship organizations.

Erick Burres, Citizen Monitoring Coordinator
SWRCB-OIMA-Clean Water Team
eburres@waterboards.ca.gov
213-576-67788
The Clean Water Team provides 6 Core Programs that support the production of actionable data from **CITIZEN SCIENCE**

- Technical Support
- Training
- QA/QC
- Loans of Equipment
- Outreach & Communication
- Event Support

Grassroots Organizations, Environmental Justice, Community Based Organizations, Resource Conservation Districts, Non-Profit Tribes, Farm Bureaus, Universities and Community Colleges, Advocacy Groups, Cities, Counties, Environmental Organizations

Est. 1999 with 4 PYs
Clean Water Team Communication Tools

Self-Subscribe Email Listserve
http://www.waterboards.ca.gov/lyrisforms/swrcb_subscribe.html

Webinars: CA Water Quality Monitoring Collaboration Network
Already started published HAB pics and weblinks:


Newsletter articles are in the works

www.waterboards.ca.gov/water_issues/programs/swamp/cwt_newsletter.shtml
Poster Presentations +

- 2017 CABW
- 2017 Watershed Health Indicator and Data Science Symposium
- 2016 CA Water Board Data Innovation Challenge
GUIDANCE COMPENDIUM
FOR WATERSHED MONITORING AND ASSESSMENT

Section 3.0 “Grab Samples” - Measurements Taken at One Point in a Water Body or in a Container (including Water Quality Fact Sheets)

<table>
<thead>
<tr>
<th>3.5.3</th>
<th>Freshwater Algae</th>
<th>SOP Freshwater Algae Protocol</th>
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<tr>
<td>3.5.3.1</td>
<td>Collecting Stream Algae Samples and Associated Physical Habitat and Chemical Data for Ambient Bioassessments in California</td>
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<th>What are harmful algal blooms (HABs)?</th>
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<td>SWAMP's California Freshwater Harmful Algal Bloom Field Guide</td>
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<td>BloomWatch App (Data submitted via the BloomWatch App is shared with the California Water Boards.)</td>
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<td>Eye On Water App</td>
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</table>

www.waterboards.ca.gov/water_issues/programs/swamp/cwt_guidance.shtml
Visual/Sensory Tools - Apps

- bloomWatch
- EyeOnWater.org
- HydroColor
More Visual/Sensory Tools

**General aviation (GA) pilots** functioning as citizen scientists can help develop an early warning system to alert communities of ensuing algal blooms.

**Balloon mapping** is a low-cost way to take aerial photos using a camera, attached to a balloon, on a spool of string. People have done this from a few hundred feet up all the way to over 4,000 feet in the air.

https://re.grc.nasa.gov/citizen-scientists-track-algal-blooms/

https://publiclab.org/wiki/balloon-mapping

https://publiclab.org/notes/abdul/10-13-2016/desktop-spectrometry-starter-kit-3-0-instructions
Meters

Fluorometry

• Handheld

• Bench-top
Test Strips

• Abraxis @ http://www.abraxiskits.com/products/algal-toxins/ - Strip tests; recreational water w/lysis (1-10 ug/L) - Adding anatoxin-a & cylindrospermopsin

• Beacon Analytical Systems @ http://www.beaconkits.com/welcome/category/algal-toxins - Microcystin ELISA tube kits (0.3-5 ug/L)