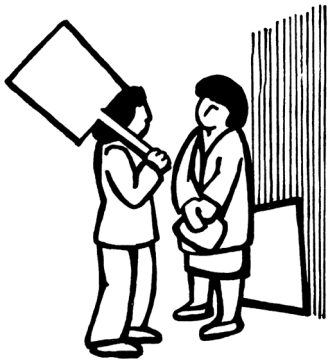
Welcome to Statistics for Action!

Statistics for Action (SfA) is a project based at TERC, a not-for-profit educational research organization based in Cambridge, MA. TERC has partnered with environmental advocacy organizations to help people in communities affected by environmental contamination. At any stage of an environmental campaign, *SfA* can help groups and individuals:



- Understand basic terms, units, and concepts in environmental data
- Analyze data and claims critically to find the story behind the data
- Assess risks to health from environmental contamination
- Communicate findings from data clearly to others

All Materials Free at sfa.terc.edu

SfA's **workshops and activities** can be used by anyone, with no special training. They're easy to adapt for different community situations and skill levels. Most have participant materials in both English and Spanish.

SfA also has **magazine-style guides** to build understanding of environmental processes like soil and water quality testing and remediation. Also available in Spanish.

SfA created a **set of videos** on a range of topics. Short videos give a quick overview of an concept; longer videos explore a community story to show the way different concepts link together.

SfA co-wrote an issue of the education magazine ***The Change Agent*** with the theme *Staying Safe in a Toxic World.* It features 52 pages of environmental stories and data. Activities and discussions are also included, to strengthen the math and science connections.

THE CHANGE AGENT
Adult Education for Social Justice: News, Issues, and Ideas

SfA can even be used by **classroom teachers**, to build student skills using a compelling story with real environmental data. The *SfA* website includes a guide showing alignment with Common Core and GED 2014 standards for math, science, reading, and social studies.

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About SfA activities

Statistics for Action activities are organized by the four topics shown on the right. Each topic has:

- an overview detailing all the activities and when to use them
- a 60-90 minute workshop called *A First Look at...* that introduces ideas and help groups prioritize
- shorter 15-30 minute activities focused on a particular idea or skill
- Spanish versions of many participant materials

Activities work in many settings

- at a community meeting to meet group goals
- with a smaller group of leaders, to build understanding before a meeting
- to explore ideas covered in an *SfA* guide
- at a staff training or environmental conference
- in a class or study circle, to engage adults or youth

Read facilitator instructions carefully!

The first page of each activity has instructions. Based on your situation, they'll prompt you to choose:

- one of multiple versions (e.g. for soil, air, water)
- a sample data set, or your own data
- using fact or strategy sheets with the activity, or as standalone handouts

Available topics & activities

Understanding

Making Sense of the Data (Overview)
Common Units (Fact Sheets)
Limits and Levels (Fact Sheets)

- A First Look at Technical Documents
- Converting Between Units
- Compare to Standards
- Mapping Data

Analyzing

Drawing Your Own Conclusions (Overview)

- A First Look at Challenging Claims
- Finding Newsworthy Data
- Inside Averages
- The Summary vs. The Lab
- Sampling Plans

Assessing Risk

Pieces of the Risk Puzzle (Overview)

- A First Look at Health Studies
- As Toxic As ... ?
- Risk: Points of Contact
- Exposed!

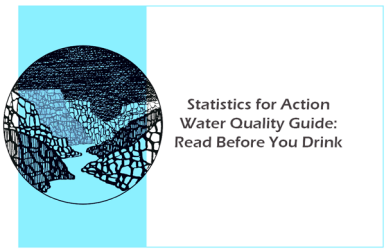
Communicating

Communicating with Numbers (Overview)

- Memorable Messages
- Memorable Graphs
- Design a Fact Sheet

These guides each provide a narrative overview of some aspect of environmental quality. Each describes an environmental process, advice about what to look out for, and how communities can be involved. Useful for an organizer, or community leader who wants a quick overview of the topic. The first three guides are also available in Spanish.

Water Quality Guide: Read Before You Drink (20 p)

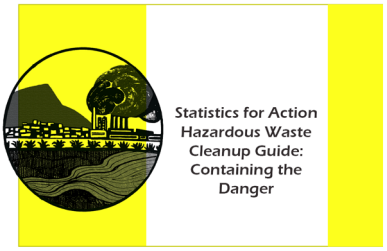


An overview of water quality testing: collecting samples, testing for contamination, reading the results, and communicating to the public. También en Español: La calidad del agua: Lea antes de beberla (20 pp). The extended version (116 pp) of this guide has more details about groundwater and surface water, case studies, and regulations and data tables that the EPA uses.

Soil Quality Guide: Digging into the Dirt (18 p)

An overview of soil quality testing: collecting samples, testing for contamination, reading results, and communicating to the public.

Hazardous Waste Cleanup Guide: Containing the Danger (16 p)



An overview of hazardous waste site remediation, assessing the problem, reviewing cleanup options, setting cleanup goals, monitoring progress, and reporting back to the community.

Guide to State Cancer Profiles: The Ins and Outs (15 p)

A guide to using the CDC's State Cancer Profiles web resource, including how to navigate the data on cancer trends, and how to compare your local data to statewide or national data.

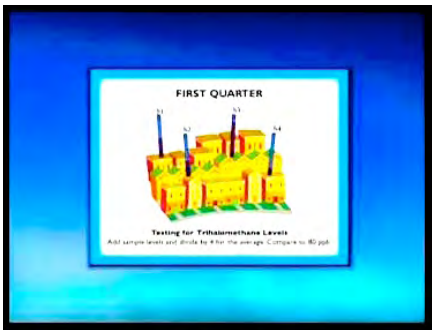
Air Quality Monitoring Guide

Available September 2013!

SfA has produced videos that illustrate key concepts that arise in communities affected by toxic contamination. Find them online at sfa.terc.edu/materials/video.html

Quick Concepts (1-5 minutes)

What's a Liter? Parts per Million in Water
Milligrams per Kilogram: Parts per Million in Soil
ND = Not Detected
Bioaccumulation and Biomagnification
Averages Can Be Political
The Cost of Bottled vs. Tap Water
Stats Can Get a Lawmaker's Attention
Importance of Statistics Based on Science
Soil Contamination and Gardening
Expert Advice on Health Studies



Community Stories (5-12 minutes)

From Superfund Site to Community Park
Sampling and Testing Contaminated Soil
Will the Health Study Prove Liability?

EcoAlert TV (30-minute episodes)

Soil Contamination
Tap Water Quality
Community Water Contamination

Understanding Us

Making Sense of the Data

Communities affected by environmental contamination often see long reports full of data. Take time to understand these reports, it can save you time and money. Industry officials, decision-makers, and the community will take you more seriously if you show you understand the numbers and terms.

People were surprised – as soon as the stuff was on the wall, we could puzzle out the bigger story together.

Slowing down lets the group figure some things out themselves. It also helps them decide what they want to ask an expert about.

Start with a first look...

A First Look at Technical Documents

Look carefully at a document like

- a report of environmental test results
- an environmental impact statement
- a permit document.

See what you can figure out as a group. Then, list and prioritize the questions you still have.

...then practice giving the data meaning.

Converting Between Units: Practice converting ppm or ppb to mg/kg and µg/kg or mg/L and µg/L.

Mapping Data: Put data onto a map to see hot spots.

Compare to Standards: Compare test results to health-based standards to find the worst contamination.

If you get stuck on a definition, review a fact sheet.

Common Units: Fact sheets (with optional activities) for common units in environmental testing.

- Order of magnitude
- Metric prefixes (kilo-, milli-, micro-)
- Cubic meters (m^3)
- Liters, milliliters, deciliters (L, mL, dL)
- Kilograms, grams, milligrams, and micrograms (kg, g, mg, µg)
- Acres and Hectares
- Tons and Tonnes
- Watts (W) and more
- Parts per million and billion (ppb, ppb)

Limits and Levels: Fact sheets about common limits and levels in environmental testing:

- Detection Limits and Reporting Limits
- Background Levels
- Reference Dose (RfD)
- Cancer Slope Factor and Unit Risk Factor
- Reference Concentration (RfC) for Inhalation
- Water quality standards
- Soil quality standards
- Air quality standards
- Occupational Safety and Health Administration Permissible Exposure Limits (OSHA PELs)

Drawing Your Own Conclusions

There are many ways to interpret data. Industry, government, and media may interpret data based on their own priorities. Once you understand the units and terms, you can look deeper and draw your own conclusions. These activities help you look critically, to find the numbers you care about most, and to challenge questionable claims about the data.

Still having trouble reading data? Start with **Making Sense of the Data**

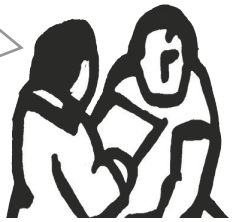
A First Look at Challenging Claims

Step through the process of finding and challenging dubious claims.

- Find numbers and data, even if they're hidden
- Make sure there's no mixup of units
- See if "typical" numbers really are typical.
- Verify that estimates or predictions are valid
- Check that the any health-based standards used were the most protective.
- Verify claim about increases or decreases
- Check for ambiguities and press for detail

After finding potential challenges, rate them based on how easy the challenge will be, and how much it might help your campaign.

The impact statement for the power plant expansion didn't account for the 300 tons of NO_X per year from the diesel trucks trucking in fuel and trucking out waste.



The report says tests didn't detect any benzene in the factory air. But the testing equipment can't detect anything below 2 ppm. That's four times the legal limit.

Arsenic levels are over the legal limit in 12 people's tap water. In one home, the level is 24 times the limit.

TCE levels are only 2% lower than this time last year. The cleanup isn't working – we need a more aggressive remediation plan.

Finding Newsworthy Data

Examine data to find and describe:

- Contaminants with the highest levels compared to legal limits
- Diseases with the highest rates compared to what's typical
- Inconsistent or fluctuating data
- Contamination or disease rates coming down too slowly or rising suddenly
- Contamination not detected, but detection limits are set above health-based standards

Drawing Your Own Conclusions

Scrutinize data for more specific mistakes, mixups, and negligence.

The Summary vs. the Lab helps ensure the summary of a report accurately reflects lab data.

Inside Averages highlights ways an average can be presented as "typical" when it isn't.

Sampling Plans helps a group think about where a site should be tested for contamination. Can be used before testing, or afterwards if the sampling plan was inadequate.

*The report summary says the highest soil lead level was 62 µg/kg. But in the lab results, the actual reading was 62 **mg**/kg. That's 1,000 times more!*

The asphalt plant reported that their average monthly emissions are within their permit. But they operate 5 months per year – that average doesn't represent what we're breathing in July!

Three soil samples for each house is insufficient. We want 3 in the front yard, 3 in the back yard, and 2 on each side of the house.

Also, check out **Pieces of the Risk Puzzle** to analyze health risks. Consider factors like toxicity, exposure, and susceptibility. Think carefully about pursuing a health study to measure health effects.

Pieces of the Risk Puzzle

Why is it so hard to get a simple answer about risk? Risk assessors put many pieces together to try to see the whole picture. Asking "Am I at risk?" is really asking:

"If I am *exposed* to a certain *concentration* of a *hazardous toxin*, and my body gets a *dose* of it, what is the *probability* that I will be *susceptible* to a *severe effect*?"

Many of these "pieces of the risk puzzle" involve a standard to which you can compare your own situation. As each comparison goes up or down, so does the level of risk.

Hazard / Toxicity: *How toxic?*

Compare the Reference Dose (RfD) for your toxin to the RfD for other similar toxins. The most toxic contaminants will have the lowest RfD.

SfA *As Toxic As...?* data *EPA IRIS*

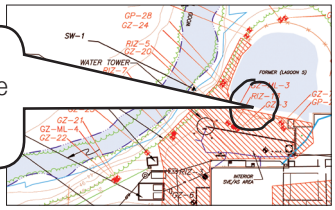
The RfD for Aroclor-1254 is 30 times smaller than the RfD for cyanide. So Aroclor-1254 is 30 times more toxic than cyanide!

Concentration: *How much? What levels?*

Compare test results to a comparison value or legal limit. Was it under or over the limit? How much?

SfA *Compare to Standards* data *ATSDR ToxFAQs*

The TCE levels in well #5 were more than 10 times the legal limit!



Exposure Type: *How does it get in me?*

Research how easily the toxin gets into the body in different ways: Touching, eating, breathing, drinking.

SfA *Risk: Points of Contact* data *ATSDR ToxFAQs*

The factory is closed, but winds keep blowing factory dust towards my house. I wonder if it's in the ground water too...

Exposure Time: *How often? For how long?*

Longer exposure means more risk. You can be at risk from acute exposures (intense, for a short time) or chronic exposures (light, over a long time).

SfA *Exposed!*

The air is bad where I work... but how long am I exposed? Hmmm... 40 hours a week, 52 weeks per year, minus vacation and holidays...

Dose / Body Burden: *How much <u>did</u> get in me?*

Dose is the amount of toxin absorbed per kilogram body mass; compare to Reference Dose (RfD) for that toxin. Body burden is the concentration of a toxin in body fluids or tissue, as determined by medical tests; compare to public health guidelines.

data *EPA IRIS Summary*

There's lead paint in my house, so I get my kid tested. The CDC says that over 10µg/dL is unsafe. Fortunately, his levels were less than 1 µg/dL.

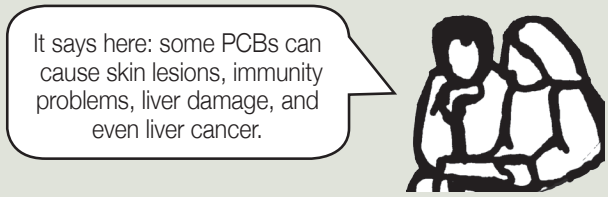
Pieces of the Risk Puzzle

To explore all topics below, see: *A First Look at Health Studies*

Health Effect or Outcome: *What could happen to me?*

Different toxins and exposures may have different effects: Cancer, asthma, reproductive, immunity, etc.

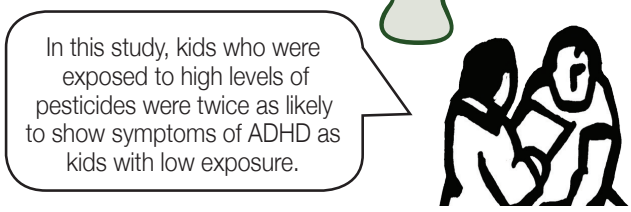
ATSDR ToxFAQs



Probability: *What percent get sick? With what?*

Compare your risk factors with other cases of similar exposures and outcomes: How many were affected?

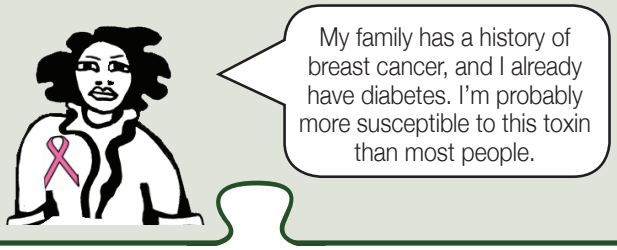
EPA IRIS Summary



Susceptibility: *Am I more at risk than others?*

The probability of some effects varies with factors like age, weight, sex, reproductive stage, diet, smoking, combinations with other toxins, and family history.

ATSDR ToxFAQs



Uncertainty: *Is this the key concern?*

We're surrounded by toxins. It's hard to prove a health problem comes from just one thing.

***Statistics for Action* Activities:** sfa.terc.edu/materials/activities.html

Activities for each component of risk that can help you explore that component in greater depth.

***Statistics for Action* Data:** sfa.terc.edu/data/public.html

ATSDR ToxFAQs and ATSDR Toxicological Profiles: ToxFAQs are an alphabetical list of toxins, each with a short, simple description of where it's found, how it can harm people, and any relevant regulations. Toxicological profiles are similar but with much more technical and medical detail.

EPA Standards: Maximum Contaminant Levels (MCLs) in drinking water, soil screening levels, air quality standards. Also, check your state's environmental department; they may have stricter standards.

EPA IRIS (Integrated Risk Information System) Summary: Summaries about risk from specific toxins, like Reference Dose (RfD), Reference Concentration (RfC), Cancer Slope Factor, Unit Risk Factor.

CDC WONDER: Wide-ranging Online Data for Epidemiologic Research. Data about disease and mortality by county. Your state public health department may have data on a town-to-town levels.

Communicating with Numbers

How do you turn data and number facts into a compelling message? Start by considering:

Who is your target audience?

An official or board/commission – elected or appointed, seasoned or new
Regulators with technical knowledge
Reporters with no technical background
The general public – informed, apathetic, outraged but uninformed

What is your audience's attitude?

They agree and just need to be supported or spurred to action
They disagree and need to be convinced or pressured
They're unaware and need to be alerted

What is the setting?

A public hearing or meeting
A private meeting or interview
A flyer, fact sheet, or newspaper ad
A rally or press conference

What is the format?

Spoken: How much time will you have?
Printed: How much space? Black and white? Text only? Color graphics?

Memorable Messages and **Memorable Graphs** can jump-start creative thinking about ways to present a key fact. If you don't have time or a group to do the activities, each has a handout offering tips for making memorable messages and graphs: choosing strategies, avoiding common pitfalls, and polishing your message and graphics.

Design a Fact Sheet pulls together all the work you've done above into a single fact sheet or poster.

Too soon? If you haven't found the key facts you want to highlight, look through the activities and resources in:

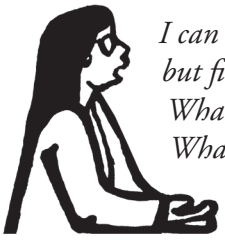
Drawing Your Own Conclusions and **Pieces of the Risk Puzzle**. Analyze your situation to find newsworthy data or claims to challenge.

Smart Moves

Do you worry that participants will tune out if you use tables and charts with lots of numbers? No need to skip over the math and no need to do all the heavy lifting yourself! Use the Smart Moves described below to engage participants. They will remember more if they are actively involved in making sense of the information. Empower them!

Slow Down

Pause. Really. Before moving past a slide with numbers, invite participants to note one or two observations and one or two questions.



I can tell you what I see,
but first, take a look...
What do you notice?
What questions do you have?

Talk it out

Encourage participants to talk out their observations and questions with a partner. Give people who don't understand a chance to puzzle it out together.

Appeal to the senses

Bring in some props to pass around. Will you mention liters or kilograms or cubic meters? Give people a chance to hold a kilogram, or to stand next to a cubic meter.

Connect ideas to what people already know

Use analogies to help volunteers to connect the information to their own situations, comparing state regs, types of emissions, or how to adapt a media strategy to a community of their size.

So, comparing our water tests to state water standards works just like comparing soil tests to state soil standards!

Show numerical relationships in more than one way

Use friendly numbers, convert units, and provide analogies, like "1 part per million is like 1 drop of ink in a large kitchen sink."

Encourage verification

Think about how you check yourself. Recommend strategies such as checking online resources, consulting experts, and double-checking figures with a calculator.