Compare to Standards

Facilitator Instructions contributed by Michael Pitula

Reflection

I used this lesson with an Intermediate High Adult Basic Education class in Chicago's Humboldt Park neighborhood. Because the students are not directly involved in an environmental project or campaign, I saw the need to provide greater context in the lead-up to this activity. In a previous meeting, the class first read *Fighting Contamination in a Chicago Neighborhood* by Elvia Saltillo in The Change Agent, March 2011. This article provided a social context of soil contamination issues in urban areas.

Following this activity, it was necessary to introduce *A First Look at Technical Documents*. I chose to run this activity using Sample Data from the Former D.A. Stuart Oil Co., Troy St, Chicago, IL. I explained to the students that the sample data used is not for the same site as that which is discussed in the Change Agent article but that it is part of the overall scenario in Little Village.

After the *First Look* we still needed to spend time building a familiarity with units, limits and levels. The class read and discussed the *Common Units Fact Sheet: Parts per Million (ppm) and Parts per Billion (ppb)* and the *Limits and Levels Fact Sheet: Residential Soil Screening Levels (RSSLs) Industrial Soil Screening Levels (ISSLs)*.

I then introduced the *Compare to Standards* activity. Students examined Table 5 of the Troy Street, Chicago Phase II Site Assessment. I explained that in this table, Tier 1 Soil Remediation Objectives (SROs) would be used as Limits in place of either RSSLs or ISSLs. The class was divided into 3 small groups. Each group was responsible for comparing the test results for a different contaminant to the Tier 1 SROs for that contaminant. The groups compared benzo(a)anthracene and benzo(b) fluoranthene to Residential Ingestion SROs and naphthalene to the Construction Worker Inhalation SRO. Students followed the Strategies for Comparing to Standards to calculate by dividing the ratio of contaminant found to the standard safety limit. Students calculated these amounts by hand using division, as practiced in previous lessons. The instructor and an assistant checked students' calculations for accuracy. Students performed calculations for results from all soil borings which exceeded the SROs in question.

Once calculations were finished, the students and teacher created a vertical scale and began placing Post-its for the results for each contaminant along the scale, discussing the placement as we went. Once the placement was complete, we discussed how the placement of the calculated rational numbers differed from what the students originally thought the placements should be based on reviewing the results without comparing them to the standards. We also discussed how the appropriate scale for different contaminants varied depending on the results.

While the lesson went well, the fact that this was a classroom setting removed from the actual environmental/community setting on the ground meant that some context was missing. If I were to do the lesson again, I would emphasize that students should imagine that the data came from a lot near their homes. In general, students found the activity interesting.

Skill:

GED Q.1.d Identify absolute value of a rational number as its distance from 0 on the number line and determine the distance between two rational numbers on the number line, including using the absolute value of their difference

GED Q.2.a Perform addition, subtraction, multiplication, and division on rational numbers

GED Q.2.e Solve one-step or multi-step arithmetic, real world problems involving the four operations with rational numbers, including those involving scientific notation.

Objectives:

Interpret tables

Divide rational numbers

Compare relative values of rational values and their differences on a number line.

Time: 35 minutes

Materials

3 Facilitator Supplement (1 for instructor, 2 extra for assistants)

6 Participant Instructions (2 per group)

6 Printouts of Summary table of key data from Phase II Environmental Site Assessment for Former D.A. Stuart Oil Co., Troy St, Chicago, IL (2 per group)

4 Pads of sticky notes, different colors, if possible

24 Pens or markers (enough for everyone)

12 Calculators (1 for each student)

Preparation

Prior to class, students have already read and discussed *Common Units Fact Sheet: Parts per Million (ppm) and Parts per Billion (ppb)* and the *Limits and Levels Fact Sheet: Residential Soil Screening Levels (RSSLs) Industrial Soil Screening Levels (ISSLs)*.

Choose the contaminants that seem most troubling for the group to focus on. Think of how you will divide up that data among your group.

Choose pages of the Summary table of key data to enlarge.

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Activity Overview

Participants compare environmental test results to health-based standards for contamination in soil (for details, see fact sheets for health-based standards in the *Limits and Levels* resource.) They post the results on the wall and determine which results are highest compared to the standard.

Steps

1. Launch the Activity

- Review definitions and examples of parts per million from previous reading of *Common Units Fact Sheet*.
- Review definition of Residential and Industrial Soil Screening Levels (RSSL/ISSL) from the *Limits and Levels Fact Sheet*.
- We have our test results. It's tempting to just look for the biggest numbers. But some contaminants are more toxic than others. So first, we need to compare each result with a health-based standard for that contaminant. In our case, the standard is not the RSSL or ISSL but the Soil Remediation Objective (SRO).
- Divide class into small groups of 3-4 students.
- Hand out test results, participant instructions, pens, calculators, and sticky notes.
- Divide up the data among the groups. Each group is responsible for studying the results for one chemical.
- If needed, do one contaminant together as a group.

2. In Small Groups

- Compare each result to its standard, as shown on the participant instructions.
- As groups finish, ask, "Who has the result that is highest compared to its standard?"
- Guide the group in posting the results on the wall, as shown in the Facilitator Supplement.

3. Debrief

- What strikes you about the results?
- What contaminants or locations should we worry about most?
- Are there any we probably don't need to worry about?
- Is the scale that we created equally useful for all 3 contaminants studied?
- How do your conclusions about the results on this scale compare to your initial impressions based on the results in the table?

Worth Noting

- Prior lesson activities discussed in the Reflection above may be necessary to properly scaffold this lesson.
- We were able to complete the activity in an hour and twenty minutes.

Identify the health-based standards for each contaminant. If they are not listed in the results, look them up and bring them to the meeting.

Confirm the units for the samples match the units for the levels of concern.

Helpful Definitions

The following terms were previewed with the group by using the materials from *A First Look at Technical Documents*, *Common Units Fact Sheets*, and *Limits and Levels Fact Sheets*. Students read the handouts for this activity together in small groups to identify new words and develop an understanding of the terms from the contextual examples. For terms like parts per million or parts per billion, we then shared predictions of which example we thought was the correct.

Concentration: The amount of a substance per defined space

Data: facts or information used usually to calculate, analyze, or plan something

Exceed: go over a limit

Ingestion: to take in by eating or swallowing

Inhalation: to take in by breathing

Migration: moving from one place to another

Objective: something you are trying to do or achieve

Parts per million (ppm): A part per million could be one drop per one million drops, one gram per one million grams, etc. example, 1 drop of ink in a large kitchen sink (about 13 gallons).

Parts per billion (ppb): Example, One penny in $10,000,000

Remediation: the act of fixing or remedying

Screening: a first pass at soil testing

Soil: a medium composed of different sized particles —sand, silt, clay.

Tier: a rank or layer.

- I chose contaminants with numerous exceedances but similar SROs. With the results available, the ratio and the absolute values were mostly similar, meaning that there was not a gross difference in the results compared to standards and the results on their own. Still, there were cases where disparities between absolute and rational results were clear enough to illustrate, or where two disparate test results had the same rational relationship to the relevant standards. It may be worth a closer look at the data in advance to choose data with a greater difference in toxicity and/or in detection.
- Roleplay—To increase the potential for personal impact and to convey a relevant message that hits home, spend time framing the activity in terms of human health and safety.

Smart Moves

√ Slow down.

√ Talk it out.

√ Use your senses.

Connect ideas to whar people already know.

√ Play with different ways to show it and say it.

Show numerical relationships in more than one way.

Encourage verification.

Supplementary materials and anything else

N/A

Answers

The table below shows ratios, to the nearest tenth, of the test results compared to the SROs.

Sample ID	TP-1	TP-2A	TP-2B	TP-2C	TP-3A
Sample Depth	2’	4’	2’	2’	3’
benzo(a) anthracene	14.2x	4.4x	0.9x	1.9x	1.7x
benzo(b) fluoranthene	3.4x	5.4x	1.6x	3.2x	1.6x
naphthalene	1.3x	0x	4.5x	0.4x	0.1x

TP-3B	TP-3B	TP-5A	TP-5A	TP-5B	TP-5B
2’	5’	2’	5’	2’	5’
2.3x	1.5x	1.7x	1.5x	2.8x	6.5x
0.5x	1.5x	3.1x	1.7x	4.3x	8x
0.2x	0.1x	2.9x	3.1x	0.1x	0.1x

What contaminants or locations should we worry about most?
Benzo(a)anthracene at TP-1, 2’
Benzo(b)fluoranthene at TP-5B, 5’

Are there any we probably don’t need to worry about?
Benzo(a)anthracene at TP-2B
Benzo(b)fluoranthene TP-3B, 2’
Naphthalene at TP-2A, TP-2C, TP-3A, TP-3B and TP-5B

Is the scale that we created equally useful for all 3 contaminants studied?
Each contaminant on its own might have a different scale. The results pool differently on the scale for each contaminant. This scale is fairly useful for all 3.

How do your conclusions about the results on this scale compare to your initial impressions based on the results in the table?
The conclusions are about the same but in some cases, our impression based on the raw data would lead us to prioritize one boring site over the other. However, upon comparing to the standards, we see that the exceedance is about the equal between sites or the reverse of our initial impression.