1. What is a Data Discussion

Data are at the heart of science. A challenge for teachers is helping students make sense of the data they collect and engage them in the intellectual work of analysis. This classroom case is about students learning to discuss and make sense of their own data.

In the fourth grade class you’ll see today, it is still very early in the school year and the class is working with numerical data for the first time. The group is also in the early stages of learning to discuss their ideas. In today’s class, students have gathered weight data in small groups to answer the question “If you compare equal volumes of different materials, will the weights be the same or different?”

When it’s time to collate results in a class data table, the teacher, Aadina, decides to fill in the table in the discussion circle so students are clear about where the numbers come from. Whenever students collect weight data, you can expect variation or discrepancies in the measurements. Developing strategies for dealing with results that aren’t neat, tidy, or consistent is part of learning to work with data. In this case students begin with just the water data and are challenged to come up with a single value for the weight of 40cc of water based on five different measurements. Through discussion, students discover there is more than one reasonable way to reach an agreement.

Discussion time always has limits. Aadina decides to give priority to gathering ideas about how to use group results to come up with a single value for the weight of each sample. She does not ask students to develop claim statements and describe their evidence – that will come later – but leaves them with a provocative question, “What do our findings tell us about earth materials?”

As you watch these clips think about the decisions a teacher must make as she plans this first data discussion. For example, How will I pique students’ interest in discussing their data?, What will make the information in the data table clear and understandable?, What discussion question will motivate students to notice patterns and grapple with variation in their data?

With more knowledge and experience with data, students have more to talk about and a richer language for communication. Over time, they will need less and less support from their teacher.
2. Organizing class data in a table

Teacher: How much water did we have in that container? The volume of the water? Tiffany?

Tiffany: 40

Teacher: 40 cubic centimeters. How much sand did we have? Julianna?

Julianna: 40 cc's

Teacher: 40cc's or 40 cubic centimeters. And Dalhia, how much organic soil did we have?

Dalhia: 40 cubic centimeters.

Teacher: 40 cubic centimeters. So, we have the same amount of stuff or the same volume in every container. So, I'm going to go to each group, and I'm going to have each group or one representative from each group, tell me what the weight was for their material.

Teacher: At Table 1, what was the weight of your water?

Student: 39 grams

Teacher: It was 39 grams. At table 2.

Esther: 38 grams

Teacher: What do you notice about the weight of the water in each of our samples? Esther.

Esther: They each of have 30, and besides one number apart from the other one.

Teacher: Okay, so we're about 1 gram off because our scales, like I said, they only weigh or measure to the nearest gram. So it doesn't really give us the little pieces that are less than a gram so our scales may have teetered a bit. But if we had to come to an agreement on how much we think 40cc's of water weigh, what do you think would be a good number for us to agree on?

Text on final screen
Organizing Class Data in a Table
- Before students can discuss and debate the meaning of their data, they must first learn how to “read” the tables.
- Students are more invested in data analysis when they work with their own data.
3. Grappling with Variation in Class Data

Text on screen
What can we claim about the weight of 40cc of a material when our measurements aren’t all the same?

Teacher: So if we had an agreement, what do you think would be a reasonable class agreement for the weight of that mineral oil?

Look carefully at the weights. We had a group that measured 33 grams, 30 grams, 32 grams, 39 grams and 24 grams.

If we had to just narrow this down and come up with a weight that seems reasonable for 40cc of mineral oil, which seems the most reasonable if we had to come to an agreement?

If we had to agree on one weight that represented that 40cc of mineral oil, what do you think would be a reasonable weight for us to go with?

Jordan: 36?

Teacher: Why 36?

Jordan: Because it’s like in the middle of, like in the middle of the numbers, so it can be even, I mean it’s even and 33 and 32 and 29 and 39 is close to 36.

Teacher: So they’re all close to 36. I heard you say something about the number being in the middle. Well, in order to find out the middle number, what are the two numbers we need to know?

Text on screen
One student’s strategy for dealing with variation in a data set is to find a number in the middle (the median).

Teacher: But if I had to come up with an agreement for our whole class about what 40cc of sand might weigh, what can we agree on?

Dalhia: 62

Teacher: Why would you say 62 as a whole class agreement?

Dalhia: Because mostly almost everybody had 62 and probably one group probably had a mistake and they probably got 48 but everybody else was sure that it was 62 so there was 62.

Teacher: OK. Can I have one more person say why they maybe agree with Dalhia? I think 62 is a good weight for us to come to an agreement? Who thinks they can share their
thoughts on that? Victoria, what do you think? Do you agree?

Victoria: Yes

Teacher: Why, do you agree with 62 grams?

Victoria: Because there’s more people that got 62 than 58 so I think 62 would be a good class agreement.

Teacher: OK

Text on screen
Another strategy for dealing with variation in the data set is to find the most frequent value (mode)

Text on final screen
Data discussions often focus on “cleaning up” inconsistencies or variation in the data.

4. Discussing Surprises in the Data

Teacher: Look really closely at our data, Does something surprise anybody? I know this was something that we got a chance to even think about yesterday after you did your investigation. Was there anything you found surprising: Did anything stupefy you? Esther, something surprised you?

Esther: The water was less than the soil that we checked.

Teacher: Was the water less than the soil?

Esther: No than the sand.

Teacher: And that surprised you?

Esther: Yes. Because at the beach if you get sand and you put it in your hands that wouldn’t be that heavy but if you go in the water and the waves push you, it’s really heavy.

Teacher: So water feels more powerful so it almost feels like it should be heavier?

Esther: [she nods] It should weigh more than the sand.

Teacher: Who also was surprised by that” Was anyone surprised that the water was less than the sand? So let’s think. Was there anything else that surprised someone? Esther shared something. Nikia, was there something that surprised you?
Nikia: That the water was heavier than the mineral oil.

Teacher: Okay, you were surprised that these [points to containers with 40cc of water and 40cc of mineral oil] had different weights. Why was that surprising to you?

Nikia: Because they’re the same I thought the mineral oil was going to be heavier than the water because the mineral oil doesn’t move quickly.

Teacher: Tiff tell us a little bit about what you were thinking that surprised you as well. Why is it that you thought the mineral oil was going to weigh more?

Tiffany: The same thing as like Nikia, because the mineral oil doesn’t move as quickly as the water.

Teacher: So what does that tell you about the mineral oil? What does that make you think about the mineral oil because it doesn’t move as easily or as quickly as the water?

Victoria: I wouldn’t even think that it was kind of harder, like a little bit harder than the water, because it doesn’t move as like swiftly.

Teacher: Okay. Other thoughts? Jordan?

Jordan: I agree with Victoria too. It’s like I thought the mineral oil was going to weight more too because the way it moves looks like it’s thick.

Teacher: Okay. So the thickness made us seem in our minds that it could be heavier? Can anyone else try to explain that in our own words?

Text on final screen

Discussing Surprises in the Data
A question like “What surprised you?” provides an opportunity for students to connect their data to their prior experience and initial ideas.

5. Explaining the Findings
Teacher: Again, I have the same volume, the same amount of material inside each container, and I’ve already seen that they all have a different weight [points to the data table]. What does that teach me about earth materials? What does that teach me about earth materials?

Esther: Earth materials each have their own different weight and they their own different types of texture and they
have very different habitats or places that they stay at. And they weigh all differently and not the same.

Teacher: Okay. Does anyone want to add to that or maybe explain their own thinking? Tiffany, I saw your hand go up. What does that teach us about earth materials to know that they have the same volume here, but all of them had a different weight?

Tiffany: They have a lot of mineral materials that come naturally from the earth. They have different weights.

Teacher: Okay. Do you want to say anything more about that?

Tiffany: No

Teacher: Okay. How about one or two other ideas? Something we've learned about earth materials?

Dayson: Some are heavy and some are light.

Teacher: Some are heavy, some are not. Other ideas? Nikia?

Nikia: That maybe because of the volume of the sand it would be different, different weights …

Teacher: Okay

Nikia: …and maybe if the volume is different, then it would be the same weight.

Teacher: Whoa! Can somebody repeat what Nikia just said? She brought up a really interesting point. Who caught it? Who caught it? Just Janise and Victoria? Nikia, I'm going to ask you to repeat it one more time, then I'm going to see who can catch it a second time. Really, really listen, because she just brought up a very interesting point.

Nikia: That if the volume is different, then it might … the weight might be the same.

Teacher: Hmm Now I can tell some people were listening. Who can repeat that, because that's a really interesting idea to think about?

Tiffany: Nikia said that if the materials have different volumes, they might weigh the same.

Teacher: Aha. I'm going to have one more person repeat that because, goodness, gracious, this is a really interesting idea and I'm hoping we're going to get a chance to explore this idea. Jordan, do you think you could repeat that idea because I want to make sure Jaydon, John, Dayson, Jazzie, I want to make sure everyone heard it.
Jordan: I heard that she said that the materials ... [long pause]
Teacher: Maybe we can ask her to repeat it
Jordan: Can you repeat what you said please?
Tiffany: Nikia said that if ... all the minerals, I mean...
Teacher: Materials.
Tiffany: ...materials have a different volume, they might weigh the same.
Teacher: Okay. I need to have one more person really home in on this for me. Someone repeat again because I can still see some friends struggling to kind of catch this.

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**Explaining the Findings**
The question “What does that [the data] teach me about earth materials?” encourages students to suggest explanations. The question asks for ideas reasoned from evidence, not “right” answers.