A Table Symposium on Determining and Measuring Earth's Layered Interior

A Protocol for Analysis and Interpretation

Procedure for Teachers

1. After each team has created their graph introduce the fact that scientists may hold a *symposium* to share research related to important questions. Tell the students that they will participate in a *Table Symposium*.
2. Facilitate the formation of four member teams that will participate in a symposium at their tables. The team is to be comprised of one pair of seismologists and one pair of theoreticians.
3. Explain that there are professional norms that science symposium participants are to follow.

   Norms of our Symposium:

   - We activity listen when others speak and reflect on what is being said.
   - We ask appropriate questions to deepen our understanding.
   - We all contribute ideas.
   - We follow an agreed upon protocol.
4. Orally guide the students through a protocol, which is a series of short conversations. There is a recording template below but refrain from providing it until after the conversations have occurred. This is to prevent students from becoming overly focused on completing the form.

   Step 1: (3 minutes per team) Each pair is to show and explains their graph. Explain in detail the methodology that was used to construct the graph (i.e., how you developed the model).

   Step 2: (3 minutes per team) Each pair describes what they think their graph implies about Earth's interior?

   Step 3: (3 minutes) Team members work together to combine their data on a single graph.

   Step 4: (10 minutes) Compare the two datasets in order to answer our research question (Does seismic evidence support our hypothesis that the Earth is homogeneous?). Discuss what you notice and construct an interpretation that evaluates our hypothesis.

   Step 5: (5 minutes) In order to prepare to participate in a whole class discussion, record your ideas in the Symposium Recording Template.
5. As students hold the symposium walk the room to listen to their ideas. Some groups may not recognize that the delay in the seismology data as such. Help students get past hurdles without directly explaining the results or providing your own interpretation. Some strategies:
   - If the seismologists create a smooth fit through all the points, ask them how they might change their graphs if they used two lines rather than one. Ask if the fit of the points to the two lines would be better or worse than a single line.
   - If they don't recognize that the seismic waves arrive later than expected, ask them to reference the axes and vocalize a factual statement about several data points. Then ask another member to summarize what that means.
   - If they don't gather the implication that something (the core) is causing the seismic waves to arrive later than expected, remind them that the speed of seismic waves varies based on the density and rigidity of the rock, which would imply a change in material.
6. Hold a whole group discussion afterward. Plan out some talk moves to help drive the students to deep levels of reasoning.
   - Ask for evidence or reasons for conclusions.
   - Ask others to repeat what one student has said.
   - Ask students why they agree or disagree with something that was said.
7. Summarize what has been said and turn the teams back to their symposia to address a new challenge question: *How can we use these results to determine the size of the object (core) that seems to have slowed the seismic energy?* This lesson provides a solution in Activity 2 but offer students a chance to invent one.

A Symposium on our Research Question:

Does seismic evidence support our hypothesis that the Earth is homogeneous?

Our Hypothesis: Earth's interior is homogeneous in that it is comprised in general of a single type of rock.

Symposium Recording Template

We are (Seismologists or Theoreticians)	Our Colleagues are (Seismologist or Theoreticians)
Our Model	**Our Colleague's Model**
Description of our data:	Description of our data:
Interpretation - What our model implies about Earth's interior:	Interpretation - What our colleague's model implies about Earth's interior:
Our interpretation (a claim supported by evidence) regarding our hypothesis:	

Goals for Productive Discussions and Nine Talk Moves

Goal: Individual students share, expand and clarify their own thinking

1. **Time to Think:**

   Partner Talk

   Writing as Think Time

   Wait Time

2. **Say More:**

   "Can you say more about that?" "What do you mean by that?" "Can you give an example?"

3. **So, Are You Saying...?:**

   "So, let me see if I've got what you're saying. Are you saying...?" (always leaving space for the original student to agree or disagree and say more)

Goal: Students listen carefully to one another

4. **Who Can Rephrase or Repeat?**

   "Who can repeat what Javon just said or put it into their own words?" (After a partner talk) "What did your partner say?"

Goal: Students deepen their reasoning

5. **Asking for Evidence or Reasoning:**

   "Why do you think that?" "What's your evidence?" "How did you arrive at that conclusion?"
   "Is there anything in the text that made you think that?"

6. **Challenge or Counterexample:**

   "Does it always work that way?" "How does that idea square with Sonia's example?"
   "What if it had been a copper cube instead?"

Goal: Students think with others

7. **Agree/Disagree and Why?:**

   "Do you agree/disagree? (And why?)" "Are you saying the same thing as Jelya or something different, and if it's different, how is it different?" "What do people think about what Vannia said?"
   "Does anyone want to respond to that idea?"

8. **Add On:**

   "Who can add onto the idea that Jamal is building?"
   "Can anyone take that suggestion and push it a little further?"

9. **Explaining What Someone Else Means:**

   "Who can explain what Aisha means when she says that?" "Who thinks they could explain in their words why Simon came up with that answer?" "Why do you think he said that?"