Achieve

SCIENCE TASK ANNOTATION

ANNOTATION KEY

EQUITY
Supporting a wide range of diverse students.

SCENARIOS
Information provided to elicit performances.

SEPs
Opportunities to demonstrate science and engineering practices.

DCIs
Opportunities to demonstrate understanding of disciplinary core ideas.

CCCs
Opportunities to demonstrate understanding of crosscutting concepts.

SENSE-MAKING
Opportunities for reasoning about phenomena and problems.

ASSESSMENT PURPOSE
Highlights how the task features connect to intended assessment use.

UNIT 2: TYPES OF INTERACTIONS-"MAGLEV"

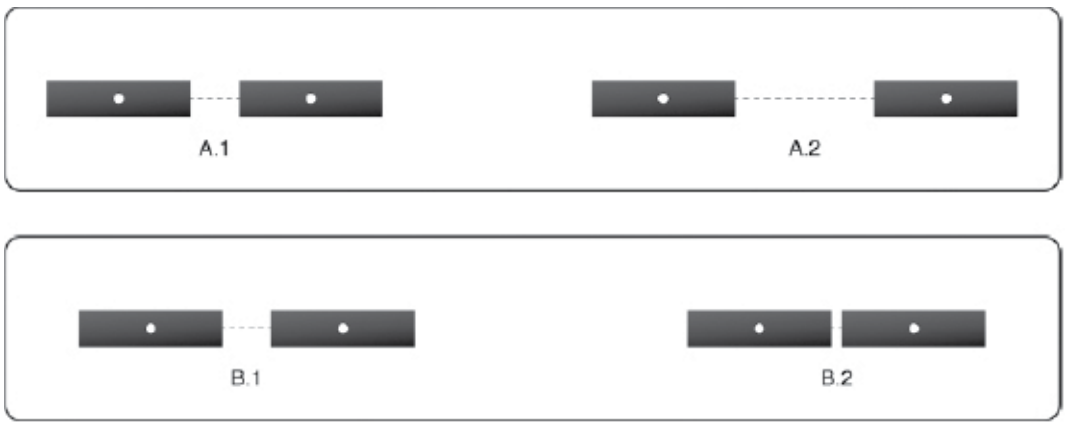
Task overall: this task requires students to integrate the DCI and SEP in service of explaining a simple set of observations.

DCIs SEPs SENSE-MAKING

Scenario 1: Tom found two bar magnets stuck to the fridge. He held the magnets close to one another, let one of them go and observed what happened. He then did that again, only this time flipping one of the magnets. In the first try, the magnets were repelled and in the other, they were attracted (pictures A and B).

This item is connected to a specific real-world instance. It is not particularly intriguing or puzzling, as high school students have likely encountered magnets attracting and repelling several times. As presented, elementary or middle school understanding is sufficient to make sense of this phenomenon as presented—so while questions might specifically ask students to use high school level DCIs, the scenario itself will not drive such engagement. This limits the degree of sense-making required by students.

SCENARIOS SENSE-MAKING



UNIT 2: TYPES OF INTERACTIONS-"MAGLEV" (CONTINUED)

Item 1

Draw a model explaining the difference in the magnetic fields and the forces acting on the magnets.

Successfully answering this question requires that students can draw a diagram that explains that the orientation of the magnetic objects results in magnets attracting or repelling each other because of the direction of the magnetic forces and the shape of the magnetic field. This most closely connects to:

- Part of the HS DCI PS3.C "when two objects interacting through a field change relative position, the energy stored in the field is changed."
- To a lesser degree, part of the MS SEP element "develop a model to describe phenomena" is required to respond to the question. It is true that students must be able to develop the model, but because the phenomenon is somewhat limited, the focus of this question is clearly on the DCI. While the scoring guide suggests a more complex modeling element, this item only required students to consider a single variable: the orientation of two magnets relative to one another. This is more appropriate to the MS-level element. The model here is used to connect science ideas to a phenomenon, requiring some (but limited) sense-making.
- Students do not need to understand cause and effect to respond to this item. The model students develop is an example of a cause and effect relationship, but does not assess whether students understand and can use ideas of cause and effect to explain phenomena.

DCIs SEPs CCCs

SENSE-MAKING

While the SEP is used to address the phenomenon, the foregrounded aspect of this question is DCI understanding relative to the scenario.

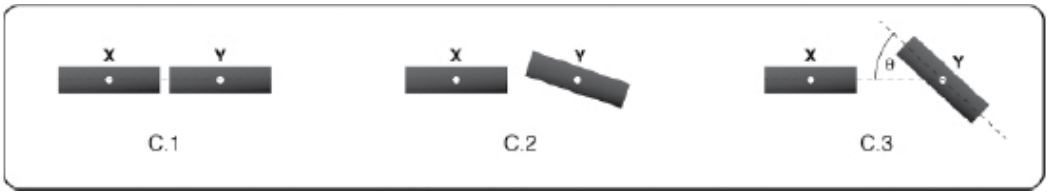
SEPs DCIs

UNIT 2: TYPES OF INTERACTIONS-"MAGLEV" (CONTINUED)

Scenario 2: As Tom continued playing with them, he observed something interesting. He took two bar magnets (noted X and Y in the picture) and held them close to each other, as shown in picture C.1. As he let go of magnet Y, he noticed that magnet Y did not only move back but also rotated (picture C.2 And picture C.3).

This is a nice example of building scenario complexity as needed for items, helping students identify which information is most relevant for a particular item and scaffolding the task appropriately. In this scenario in particular, it is very helpful to have both the image and the text to support student understanding.

SCENARIOS EQUITY



Item 2

Modify your model of the magnet system you drew in item #1 to explain why the magnet rotated. In your response, address the pole orientation of both magnets and the forces acting in the system.

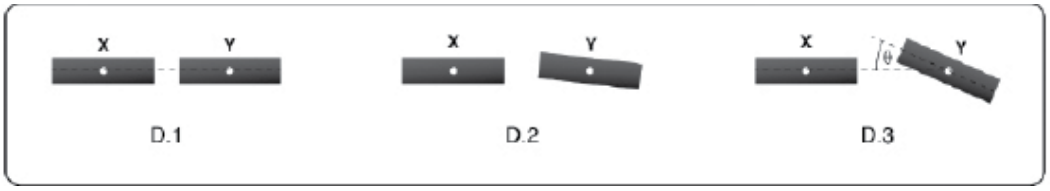
This is a slightly more puzzling scenario, and more directly requires students to use the DCI and SEP identified above in service of sense-making. Together, items 1 and 2 more thoroughly require students to demonstrate knowledge in use as they make sense of a specific, intriguing phenomenon using grade-appropriate science ideas. Additionally, the more intriguing scenario—one that is less easily explained using rote or simpler understanding—is more likely to elicit student understanding of how cause and effect relationships involving magnet orientation and changes in the magnetic fields explain the rotation. Similar SEPs, CCCs, and DCIs are required for the remainder of the task.

SEPs DCIs CCCs

SENSE-MAKING

UNIT 2: TYPES OF INTERACTIONS-"MAGLEV" (CONTINUED)

Scenario 3: Tom decided to try it again, only this time holding the magnets farther apart before letting go of magnet Y. The result is shown below in picture D:



Tom repeated this a few more times, each time changing the initial distance between the magnets and measuring the rotation angle. The results are shown in the table below:

Position	Initial Distance (cm)	Initial Distance (cm)
1	0.3	42°
2	0.5	34°
3	0.8	29°
4	1.3	15°

Item 3

Use the pattern in the relationship between the positions of the magnets to explain the force exerted by the magnetic field.

This question is confusingly worded—it would be more appropriate to say "use the pattern in the relationship between the position of the magnet and the resulting angle of rotation as evidence to explain the force exerted by the magnetic field" or "use your understanding of magnetic fields and forces to explain why Tom observed the pattern present in his data". With the current wording, many students may be confused or unclear on what is being asked, obscuring evidence of student understanding of the targeted SEPs, CCCs, and DCIs.

EQUITY

Students must identify a pattern in the data, but they are told to do so—this means that students did not need to understand that patterns can be used as evidence in order to complete the task, although successfully completing the task is an example of doing so. This task assesses 1) whether students can identify a very simple pattern, and 2) connect this to the targeted DCI.

CCCs

UNIT 2: TYPES OF INTERACTIONS-"MAGLEV" (CONTINUED)

Item 4

Compare data for each position in the data table to explain which position has more energy stored in the system.

Students need to use the same patterns identified in question 3 along with their understanding that the higher the angle of rotation, the more energy is stored in the system. The scoring guidelines suggest that the CCC "empirical evidence is needed to identify patterns" is used here—while empirical evidence IS indeed used, students didn't need to know "empirical evidence is needed to identify patterns" in order to answer this question. This is an example of the CCC, rather than using the CCC in service of sense-making.

CCCs