The questions

Real-world problems without "right" answers

The items designed for DiscoTest are open-ended, probed questions without “right” answers. They are similar to the kinds of questions used by cognitive developmental psychologists who study student reasoning and understanding. To answer these questions, students must write short essays that explain their thinking. Each DiscoTest is composed of 5 or more items of this kind and takes about 20 to 30 minutes to complete.

Sample question

The figure on the left shows a ball that is just about to be dropped from a height of 100 centimeters. Please describe what is happening to the energy of the ball as it nears the floor. Kinetic energy, or energy gained from movement, gets higher and higher as the ball drops, starting at an initial point of acceleration. The kinetic energy can go up or down according to whether speed is added or taken away. Since the ball gains more speed as it is falling, it also gains more kinetic energy. When it hits the floor, some of the energy is converted to heat energy.

Sample response

"The kinetic energy of the ball becomes greater and greater as it nears the floor. Kinetic energy, or energy gained from movement, gets higher and higher as the ball drops, starting at an initial point of acceleration. The kinetic energy can go up or down according to whether speed is added or taken away. Since the ball gains more speed as it is falling, it also gains more kinetic energy. When it hits the floor, some of the energy is converted to heat energy."" When it hits the floor, some of the energy is converted to heat energy.

The rubrics

Low-inference

DiscoTest rubrics are “low-inference”. This means that coders (students or teachers), rather than making a general judgment about the quality of a performance, make a series of specific judgments. In fact, they make about 20 such judgments when coding an assessment.

Sample

The figure below shows one of the pull-down menus that are used to code the Energy Teaser—the very first DiscoTest. Both students and teachers can use these menus, which simply require the rater to match a coding category on a specific topic to the performance.

Algorithm

When all of the rubric items have been coded, an algorithm is applied to the results, and the performance receives a score between 9:1 and 11:2 (the typical range for middle and high school students). The student report is based on this score and the performance receives a score between 9:1 and 11:2 (the typical range for middle and high school students).

The reports

What the score means

This student’s score was 10:2. At this level, students think:

• that energy comes in different forms, kinetic (the energy of motion), potential (stored energy), and sound energy, heat energy, and/or elastic potential energy; and
• that energy can move from one object to another, and change from kinetic energy into potential energy and back again, or be changed from motion into heat or sound.

Teacher feedback

“Nice work. You’re showing a much better understanding of kinetic and potential energy and how they are related”

Learning suggestion

Try exploring how force and energy are related in the Energy Skate Park [url]. Ask yourself, “What are the factors involved in creating a great skate park?” Then, think about how your observations relate to the principles and math discussed at [url].

For the teacher: Curriculum suggestions

Students performing in this phase should be encouraged to transfer their knowledge to new situations. For example, they can be encouraged to consciously employ what they have learned about the energy of roller coasters, skateboarders, or baseballs. They can also be encouraged to link their knowledge of mechanical energy to Newton’s laws. See [url] for specific activities.