Multiple teacher goals for the teaching of energy

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Teachers were asked a question about energy (below left) that their students were also asked.

We asked on a survey, "what you would do," if a student gave the most common incorrect answer to the question? (Sample answers below right.)

In a professional development workshop, we gave teachers several written teacher responses.

We asked these teachers, "What do you notice?"

Conclusions:
A PD community in which teachers discussed each other's thinking allowed for exploration of:
Structure (e.g., causality and mechanism)
Content (e.g., definitions of energy systems)
Pedagogy (e.g., simplifying instruction appropriately)
Student Ideas (e.g., honoring student knowledge)

Keep it simple for students

- "you don't want to get overly complicated"
- "The only thing we are trying to do is Law of Conservation of Energy, potential energy, kinetic energy, and friction. Anything more than that, that's – let them master this first, you know what I mean?"
- "Trying to keep the concept simple and concise is not always easy."

TEACHER GOALS AND MOTIVATIONS:

Help students master the basics.

Respect what students know and how challenging the material is for them.

Honor good student ideas

- "One of the difficulties of teaching physics is that it can get so philosophical." In particular, students might "bring in" ideas "that might be true."
- Wanting "to keep focused," but you "couldn't say no to them, because they're right, you know?"

TEACHER GOALS AND MOTIVATIONS

Students bring good ideas to the class.

Students ask good questions about the deep meaning of the physics.

Balancing teacher goals and student inquiry is a difficult task.

Think about energy, systems, and more

- "I do like the sentence, 'the maximum KE you can achieve is determined by the amount of potential energy you had in the first place,' I think that's good."
- "I did like also the sentence, 'if you have no energy to start, you have nothing to work with in order to create motion.' Well, that's true!"

TEACHER GOALS AND MOTIVATIONS

Respect for fellow teachers' ideas.

A broader understanding of energy systems - objects, space, *and* time.

Seek to understand this ourselves

- "What starts the movement?"
- "Did [the block] just automatically start moving with no apparent reason?"
- "What happened to the friction? The friction just disappeared?"
- "if we are talking about conservation of energy, where is this extra invisible energy?"
- "A ball would be better."

TEACHER GOALS AND MOTIVATIONS

Curiosity and a desire to understand.

Inquiry into mechanism and causality.

Pedagogical suggestions.

Use silliness in a good way

- The box "was up there, it was kind of creaking, it was really trying… to get started, and all it needed it was a little bit more stick to it until [it began moving]."
- Energy always comes from the sun: "That's how the block moved initially. It was sitting in the sun absorbing energy, until it got enough."

TEACHER GOALS AND MOTIVATIONS

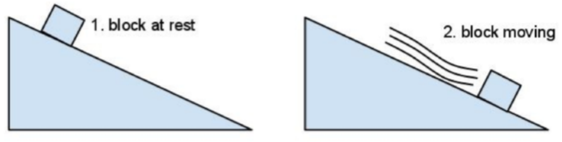
Testing out ideas in non-serious ways.

A community full of laughter and joking.

Survey question teachers answered:

What's the most common incorrect answer you might hear from your students?

12. The two pictures below show a block on a ramp. There is friction between the block and the ramp. In the first picture the block has not started moving yet. In the second picture the same block is sliding down the ramp.



What types of energy are in picture 1?_____

_____

What types of energy are in picture 2? _____

_____

For each type of energy identified in picture 2, say whether there is more than, less than, or the same amount as in picture 1.

Two teacher responses when given the most common incorrect answer

"There is no energy in picture 1..." – If a student answered this way in your class, describe in as much detail as possible what you would do. Please explain your reasoning.

Teacher 1

I would ask them where the energy went, when the block stopped moving at the end of the ramp. Remind them about the energy transfers and introduce the law of conservation of energy.

I would provide them with other examples so they could transfer the knowledge to other situations.

Also, demonstrate the situation because they retain information by doing the activity.

Teacher 2

I would begin by offering the scientific definition of energy, then introduce the concept of potential energy by stretching rubber bands and then firing them off, holding objects in the air and then releasing them, etc.

I would then explain how any kinetic energy, the energy of motion, has to result from the presence of potential energy to begin with. If you have no energy to start, you have nothing to work with in order to create motion. The maximum kinetic energy you can achieve is determined by the amount of potential energy you had in the first place.

Therefore you don't create energy when motion begins, but you've begun to transform that pre-existing potential energy into kinetic energy, but at no time is energy being created or destroyed, just changed.