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Format: Pre/post, Multiple-choice, Agree/disagree

Duration: 15-22 minutes

Focus: Beliefs / Attitudes (epistemological beliefs, structure of knowledge, nature of knowing and learning, real-life applicability, evolving knowledge, source of ability to learn)

Level: Intro college, High school

How to give the test

- Give it as both a pre- and post-test. This measures how your class shifts student thinking.
 - Give the pre-test at the beginning of the term.
 - Give the post-test at the end of the term.
- Use the whole test, with the original wording and question order. This makes comparisons with other classes meaningful.
- Make the test required, and give credit for completing the test (but not correctness). This ensures maximum participation from your students.
- Tell your students that the test is designed to evaluate the course (not them), and that knowing how they think will help you teach better. Tell them that correctness will not affect their grades (only participation). This helps alleviate student anxiety.
- For more details, read the **PhysPort Guides** on implementation:
 - **PhysPort EBAPS implementation guide** (www.physport.org/implementation/EBAPS)
 - **PhysPort Expert Recommendation on Best Practices for Administering Belief Surveys** (www.physport.org/expert/AdministeringBeliefSurveys/)

How to score the test

- Download the scoring scheme from PhysPort (www.physport.org/key/EBAPS)
- Each item is scored on a scale of 0 (least sophisticated) to 4 (most sophisticated). The scoring scheme is non-linear to take into account question-by-question variations in whether, for instance, neutrality is more or less sophisticated. A subscale score is simply the average of the student's scores on every item in that subscale. (When an item within a given subscale is left blank, the average is calculated without that item included.) You can multiply by 25 in order to report subscale scores on a scale of 0 to 100.
- See the **PhysPort Expert Recommendation on Best Practices for Administering Belief Surveys** for instructions on calculating shift and effect size (www.physport.org/expert/AdministeringBeliefSurveys/)
- Use the **PhysPort Assessment Data Explorer** for analysis and visualization of your students' responses (www.physport.org/explore/EBAPS)

Part 1

DIRECTIONS: For each of the following items, please read the statement, and indicate (on the scantron answer sheet) the answer that describes how strongly you agree or disagree.

A: Strongly disagree B: Somewhat disagree C: Neutral D: Somewhat agree E: Strongly agree

1. Tamara just read something in her science textbook that seems to disagree with her own experiences. But to learn science well, Tamara shouldn't think about her own experiences; she should just focus on what the book says.
2. When it comes to understanding physics or chemistry, remembering facts isn't very important.
3. Obviously, computer simulations can predict the behavior of physical objects like comets. But simulations can also help scientists estimate things involving the behavior of *people*, such as how many people will buy new television sets next year.
4. When it comes to science, most students either learn things quickly, or not at all.
5. If someone is having trouble in physics or chemistry class, studying in a better way can make a big difference.
6. When it comes to controversial topics such as which foods cause cancer, there's no way for scientists to evaluate which scientific studies are the best. Everything's up in the air!
7. A teacher once said, "I don't *really* understand something until I teach it." But actually, teaching doesn't help a teacher understand the material better; it just reminds her of how much she already knows.
8. Scientists should spend almost all their time gathering information. Worrying about theories can't really help us understand anything.
9. Someone who doesn't have high natural ability can still learn the material well even in a hard chemistry or physics class.
10. Often, a scientific principle or theory just doesn't make sense. In those cases, you have to accept it and move on, because not everything in science is supposed to make sense.
11. When handing in a physics or chemistry test, you can generally have a sense of well you did even before talking about it with other students.

A: Strongly disagree B: Somewhat disagree C: Neutral D: Somewhat agree E: Strongly agree

12. When learning science, people can understand the material better if they relate it to their own ideas.
13. If physics and chemistry teachers gave *really clear* lectures, with plenty of real-life examples and sample problems, then most good students could learn those subjects without doing lots of sample questions and practice problems on their own.
14. Understanding science is really important for people who design rockets, but not important for politicians.
15. When solving problems, the key thing is knowing the methods for addressing each particular type of question. Understanding the “big ideas” might be helpful for specially-written problems, but not for most regular problems.
16. Given enough time, almost everybody could learn to think more scientifically, if they really wanted to.
17. To understand chemistry and physics, the formulas (equations) are really the main thing; the other material is mostly to help you decide which equations to use in which situations.

Part 2

DIRECTIONS: *Multiple choice. On the answer sheet, fill in the answer that best fits your view.*

18. If someone is trying to learn physics, is the following a good kind of question to think about?

Two students want to break a rope. Is it better for them to (1) grab opposite ends of the rope and pull (like in tug-of-war), or (2) tie one end of the rope to a wall and both pull on the other end together?

- (a) *Yes, definitely.* It's one of the best kinds of questions to study.
- (b) *Yes, to some extent.* But other kinds of questions are equally good.
- (c) *Yes, a little.* This kind of question is helpful, but other kinds of questions are more helpful.
- (d) *Not really.* This kind of question isn't that great for learning the main ideas.
- (e) *No, definitely not.* This kind of question isn't helpful at all.

19. Scientists are having trouble predicting and explaining the behavior of thunder storms. This could be because thunder storms behave according to a very complicated or hard-to-apply set of rules. Or, that could be because some thunder storms don't behave consistently according to *any* set of rules, no matter how complicated and complete that set of rules is.

In general, why do scientists sometimes have trouble explaining things? Please read all options before choosing one.

- (a) Although things behave in accordance with rules, those rules are often complicated, hard to apply, or not fully known.
- (b) Some things just don't behave according to a consistent set of rules.
- (c) Usually it's because the rules are complicated, hard to apply, or unknown; but sometimes it's because the thing doesn't follow rules.
- (d) About half the time, it's because the rules are complicated, hard to apply, or unknown; and half the time, it's because the thing doesn't follow rules.
- (e) Usually it's because the thing doesn't follow rules; but sometimes it's because the rules are complicated, hard to apply, or unknown.

20. In physics and chemistry, how do the most important formulas relate to the most important concepts? Please read all choices before picking one.

- (a) The major formulas summarize the main concepts; they're not really separate from the concepts. In addition, those formulas are helpful for solving problems.
- (b) The major formulas are kind of "separate" from the main concepts, since concepts are *ideas*, not equations. Formulas are better characterized as problem-solving tools, without much conceptual meaning.
- (c) Mostly (a), but a little (b).
- (d) About half (a) and half (b).
- (e) Mostly (b), but a little (a).

21. To be successful at *most things in life*...

- (a) Hard work is much more important than inborn natural ability.
- (b) Hard work is a little more important than natural ability.
- (c) Natural ability and hard work are equally important.
- (d) Natural ability is a little more important than hard work.
- (e) Natural ability is much more important than hard work.

22. To be successful at *science*...

- (a) Hard work is much more important than inborn natural ability.
- (b) Hard work is a little more important than natural ability.
- (c) Natural ability and hard work are equally important.
- (d) Natural ability is a little more important than hard work.
- (e) Natural ability is much more important than hard work.

23. Of the following test formats, which is best for measuring how well students understand the material in physics and chemistry? Please read each choice before picking one.
- (a) A large collection of short-answer or multiple choice questions, each of which covers one specific fact or concept.
 - (b) A small number of longer questions and problems, each of which covers several facts and concepts.
 - (c) Compromise between (a) and (b), but leaning more towards (a).
 - (d) Compromise between (a) and (b), favoring both equally.
 - (e) Compromise between (a) and (b), but leaning more towards (b).

Part 3

DIRECTIONS: *In each of the following items, you will read a short discussion between two students who disagree about some issue. Then you'll indicate whether you agree with one student or the other*

24.

Brandon: A good science textbook should show how the material in one chapter relates to the material in other chapters. It shouldn't treat each topic as a separate "unit," because they're not really separate.

Jamal: But most of the time, each chapter is about a different topic, and those different topics don't always have much to do with each other. The textbook should keep everything separate, instead of blending it all together.

With whom do you agree? Read all the choices before circling one.

- (a) I agree almost entirely with Brandon.
- (b) Although I agree more with Brandon, I think Jamal makes some good points.
- (c) I agree (or disagree) equally with Jamal and Brandon.
- (d) Although I agree more with Jamal, I think Brandon makes some good points.
- (e) I agree almost entirely with Jamal.

25.

Anna: I just read about Kay Kinoshita, the physicist. She sounds naturally brilliant.

Emily: Maybe she is. But when it comes to being good at science, hard work is more important than "natural ability." I bet Dr. Kinoshita does well because she has worked really hard.

Anna: Well, maybe she did. But let's face it, some people are just smarter at science than other people. Without natural ability, hard work won't get you anywhere in science!

- (a) I agree almost entirely with Anna.
- (b) Although I agree more with Anna, I think Emily makes some good points.
- (c) I agree (or disagree) equally with Anna and Emily.
- (d) Although I agree more with Emily, I think Anna makes some good points.
- (e) I agree almost entirely with Emily.

26.

Justin: When I'm learning science concepts for a test, I like to put things in my own words, so that they make sense to me.

Dave: But putting things in your own words doesn't help you learn. The textbook was written by people who know science really well. You should learn things the way the textbook presents them.

- (a) I agree almost entirely with Justin.
- (b) Although I agree more with Justin, I think Dave makes some good points.
- (c) I agree (or disagree) equally with Justin and Dave.
- (d) Although I agree more with Dave, I think Justin makes some good points.
- (e) I agree almost entirely with Dave.

27.

Julia: I like the way science explains how things I see in the real world.

Carla: I know that's what we're "supposed" to think, and it's true for many things. But let's face it, the science that explains things we do in lab at school can't really explain earthquakes, for instance. Scientific laws work well in some situations but not in most situations.

Julia: I still think science applies to almost all real-world experiences. If we can't figure out how, it's because the stuff is very complicated, or because we don't know enough science yet.

- (a) I agree almost entirely with Julia.
- (b) I agree more with Julia, but I think Carla makes some good points.
- (c) I agree (or disagree) equally with Carla and Julia.
- (d) I agree more with Carla, but I think Julia makes some good points.
- (e) I agree almost entirely with Carla.

28.

Leticia: Some scientists think the dinosaurs died out because of volcanic eruptions, and others think they died out because an asteroid hit the Earth. Why can't the scientists agree?

Nisha: Maybe the evidence supports both theories. There's often more than one way to interpret the facts. So we have to figure out what the facts mean.

Leticia: I'm not so sure. In stuff like personal relationships or poetry, things can be ambiguous. But in science, the facts speak for themselves.

- (a) I agree almost entirely with Leticia.
- (b) I agree more with Leticia, but I think Nisha makes some good points.
- (c) I agree (or disagree) equally with Nisha and Leticia.
- (d) I agree more with Nisha, but I think Leticia makes some good points.
- (e) I agree almost entirely with Nisha.

29.

Jose: In my opinion, science is a little like fashion; something that's "in" one year can be "out" the next. Scientists regularly change their theories back and forth.

Miguel: I have a different opinion. Once experiments have been done and a theory has been made to explain those experiments, the matter is pretty much settled. There's little room for argument.

- (a) I agree almost entirely with Jose.
- (b) Although I agree more with Jose, I think Miguel makes some good points.
- (c) I agree (or disagree) equally with Miguel and Jose.
- (d) Although I agree more with Miguel, I think Jose makes some good points.
- (e) I agree almost entirely with Miguel.

30.

Jessica and Mia are working on a homework assignment together...

Jessica: O.K., we just got problem #1. I think we should go on to problem #2.

Mia: No, wait. I think we should try to figure out why the thing takes so long to reach the ground.

Jessica: Mia, we know it's the right answer from the back of the book, so what are you worried about? If we didn't understand it, we wouldn't have gotten the right answer.

Mia: No, I think it's possible to get the right answer without really understanding what it means.

- (a) I agree almost entirely with Jessica.
- (b) I agree more with Jessica, but I think Mia makes some good points.
- (c) I agree (or disagree) equally with Mia and Jessica.
- (d) I agree more with Mia, but I think Jessica makes some good points.
- (e) I agree almost entirely with Mia.