Heavy Boots

The following was a post to a newsgroup in 1992.

About 6-7 years ago, I was in a philosophy class at the University of Wisconsin, Madison (good science/engineering school) and the teaching assistant was explaining Descartes. He was trying to show how things don't always happen the way we think they will and explained that, while a pen always falls when you drop it on Earth, it would just float away if you let go of it on the Moon.

My jaw dropped a little. I blurted,"What?!" Looking around the room I saw that only my friend Mark and one other student looked confused by the TA's statement. The other 17 people just looked at me like, "What's your problem?"

"But a pen would fall if you dropped it on the Moon, just more slowly." I protested.

"No it wouldn't." the TA explained calmly, "because you're too far away from the Earth's gravity."

Think. Think. Aha! "You saw the APOLLO astronauts walking around on the Moon, didn't you?" I countered, "Why didn't they float away?"

"Because they were wearing heavy boots." he responded, as if this made perfect sense (remember, this is a Philosophy TA who's had plenty of logic classes."

By then I realized that we were each living in totally different worlds, and did not speak each other's language, so I gave up. As we left the room, my friend Mark was raging. "My God! How can all those people be so stupid?"

I tried to be understanding. "Mark, they knew this stuff at one time, but it's not part of their basic view of the world, so they've forgotten it. Most people could probably make the same mistake." To prove my point, we went back to our dorm room and began randomly selecting names from the campus phone book. We called about 30 people and asked each this question:

1. If you're standing on the Moon holding a pen, and you let go, will it
   a) float away b) float where it is, or c) fall to the ground?

About 47% got this question correct. Of the ones who got it wrong, we asked the obvious follow-up question:

2. You've seen films of the APOLLO astronauts walking around on the Moon; why didn't they fall off?

About 20% of the people changed their answer to the first question when they heard this one! But the most amazing part was that about half of them confidently answered, "Because they were wearing heavy boots."

I say, science education must be at an all-time peak.

The Heavy Boots article was forwarded to Adrian Melott, a professor of physics at a biggish state university. The following was his response.

I decided to settle this question once and for all. Therefore, I put two multiple-choice questions on my Physics 111 test, after the study of elementary mechanics and gravity.

13. If you are standing on the Moon, and holding a rock, and you let it go, it will
    a) float away
    b) float where it is
    c) move sideways
    d) fall to the ground
    e) none of the above

25. When the Apollo astronauts were on the Moon, they did not fall off because:
    a) the Earth's gravity extends to the Moon
    b) the Moon has gravity
    c) they wore heavy boots
    d) they had safety ropes
    e) they had spiked boots

The response showed some interesting patterns: the first question was generally of average difficulty, compared with the rest of the test; 57% got it right. The second question was easier; 73% got it right.

So, we need more research to explain the people who got #25 right, but did not get #13 right.

The second interesting point is that these questions proved to be excellent discriminators; i.e., success on these two questions proved to be an extremely good predictor of overall success on the test.

On the first question, 92% of those in the upper quarter of the test score got it right; only 20% of those in the bottom quarter did. They generally chose answers (a) or (b). On the second question, 97% in the upper quarter got it right and 33% in the lower quarter did. The big popular choice of this group was (c) 33% chose heavy boots, followed closely by safety ropes at 27%.

A telling comment on the issue of fairness in teaching elementary physics: two students asked if I was going to continue asking them about things they had never studied before in class.