Humor in the physics classroom

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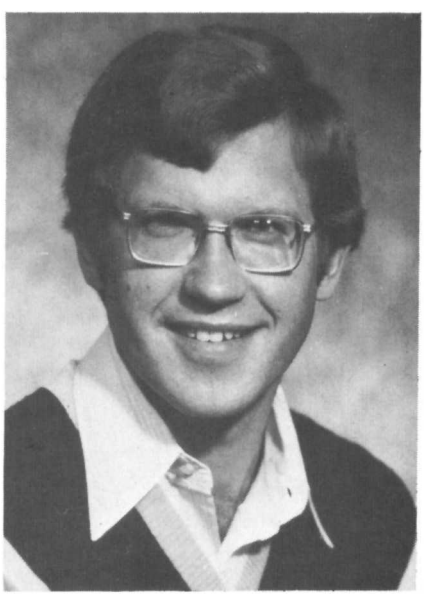


Ivars Peterson *graduated from the University of Toronto with a B.Sc. (physics and chemistry, 1971) and a B.Ed. (1972). He taught high school physics, chemistry, and mathematics for eight years in Ontario. Now he is a graduate student in journalism at the University of Missouri-Columbia. He is writer, editor and publisher of the "Physics for Fun" magazine,* **Photon**. *(510 High St. Apt. 225, Columbia, Missouri 65201)*

Peter Ustinov echoed the memories of many when he wrote, "Of physics I could understand nothing at all. Why imaginary wheels should gather speed running down hypothetical slopes, and create friction, I could neither understand in the terms in which it was taught, nor care about."[1] A physics teacher should not leave a student with this impression of physics.

Doing physics can be a stimulating, exciting experience. It can also be fun. If the concepts and applications of physics are approached with a sense of humor and with imagination, then all the hard work involved will seem lighter.

Writers such as Arthur Koestler[2] have argued that scientific discovery, artistic originality, and comic inspiration are closely related. The same kind of creativity that is required to find the humor in a situation is also needed to solve a problem or design an experiment. Laughter, in Koestler's words, arises out of seeing an idea in two self-consistent but usually incompatible frames of reference. It involves a spontaneous flash of insight that shows a familiar situation in a new light. This leads to learning. There is an element of riddle in every good joke.

A similar flash of insight is involved in many scientific discoveries. An early biographer of Newton wrote, "We went into the garden and drank tea under the shade of some apple trees . . . he told me he was just in the same situation as when formerly the notion of gravitation came into his mind. It was occasion'd by the fall of an apple, as he sat in a contemplative mood."[3] There is an element of surprise in good humor and in great scientific discoveries. Remember Archimedes' shout of "Eureka!"

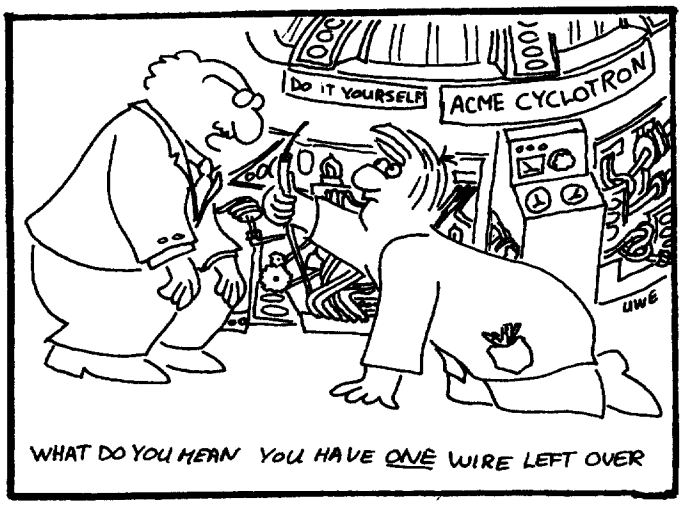
A good place to start, if you are interested in adding a little humor to your courses, is with cartoons. In less than five years I was able to collect several hundred cartoons with subjects related to science. I made it my practice to use cartoons in my lessons and to post cartoons on the bulletin board.

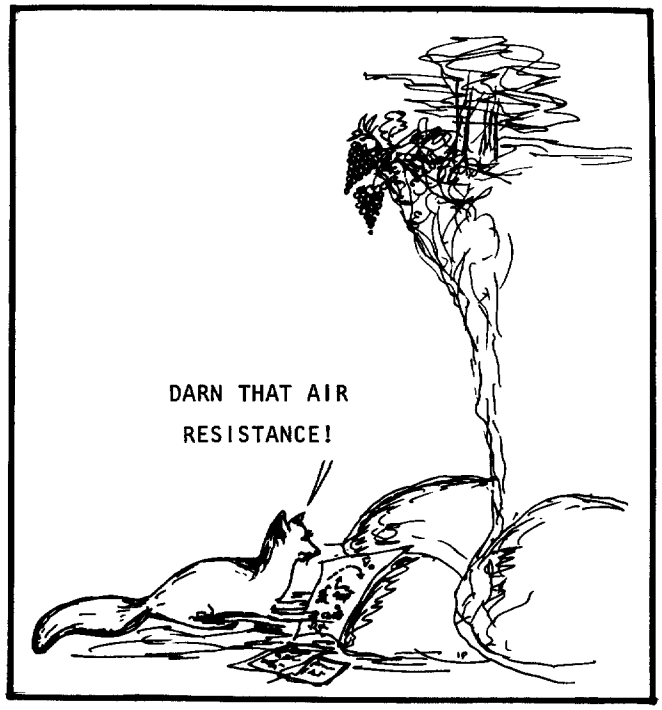
The "cartoon of the day" was changed daily. The most effective location was a notice board outside the classroom. Very quickly students, including many not enrolled in physics, began to go out of their way to check the latest offering (and there were strong complaints when I was late or failed to change the cartoon). One bonus was that some students would ask about a cartoon which they could not understand or did not find amusing. Sometimes I was able to give a quick physics lesson to an interested boy or girl.

Cartoons can be used effectively to illustrate important points in a lesson, to introduce a topic and to indicate common misconceptions in physics. The following dialogue appeared in a cartoon.

Archie: How's your roller skating job, Betty?
Betty: How *was* it, is more like it!
Archie: What happened?
Betty: Well, I had this great big platter of food. I made a sharp *right* turn and the platter made a sharp *left*!

When used in a discussion of centripetal force, this cartoon highlights a common error that many people make.





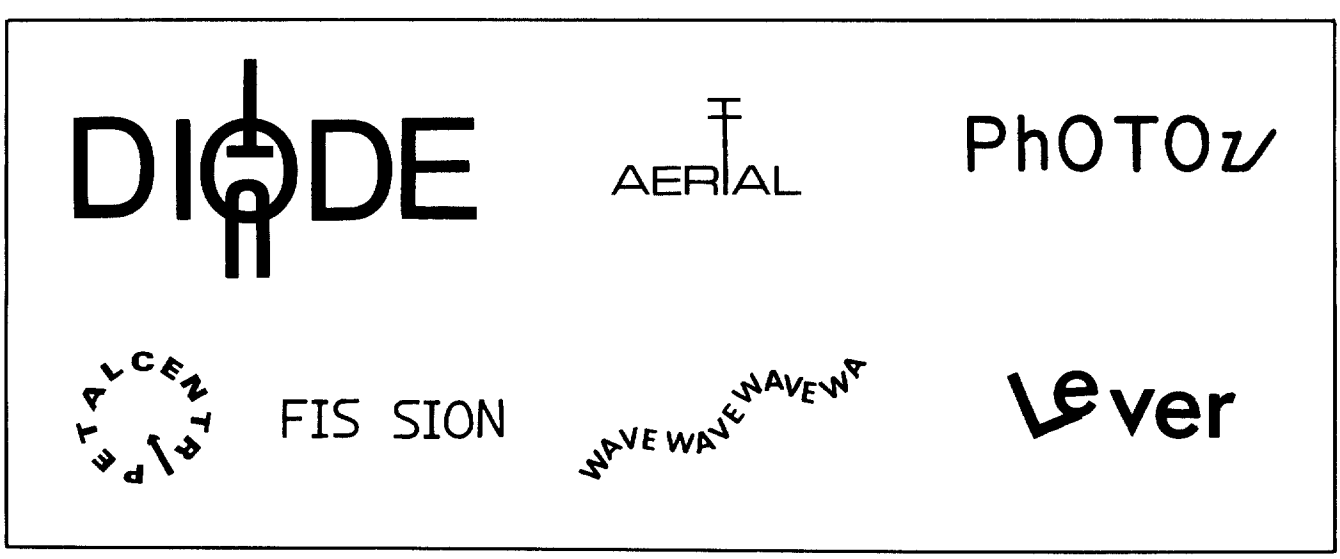
Cartoons sometimes contain good physics problems. One well-known cartoon, discussed in *The Physics Teacher*,[4,5] showed the determination of the depth of a well in terms of the time it takes one to hear the splash of a stone dropped into the well. A 16-s well works out to be 868 m deep!

I have also used cartoons as the basis for a student assignment. "Select a cartoon and make up a physics problem for the situation shown. Evaluation will be based on the ingenuity and originality of the problem and on its correct use of physical principles. A complete solution must be included. State all assumptions you make." This exercise forces students to look for physics in "everyday" situations and to learn about the assumptions and simplifications that must be made in order to solve a problem. Remember that "a physicist is a person who can't solve a problem until it is simplified."

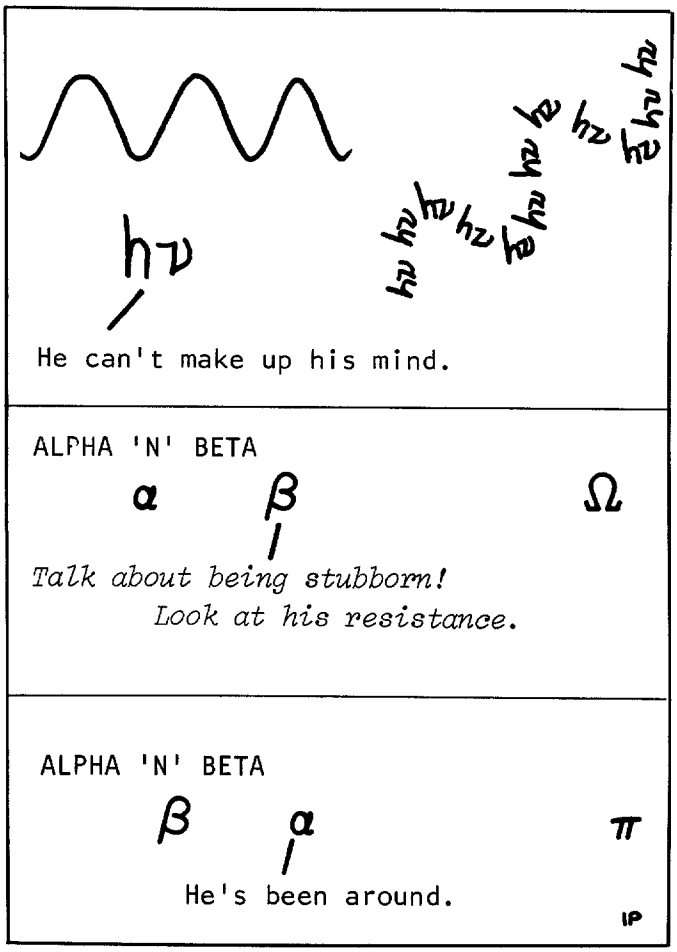
The best cartoon problem submitted by a student showed an ant lifting a snowball. The question was how many ants would be required to throw the snowball so that it would hit a man in the face. The data for this problem in projectile motion came from measurements made on the drawing itself, scaled appropriately.

A pun has been described as "two strings of thought tied together by an acoustic knot."[6] Puns, no matter how terrible, do give listeners the satisfaction of being clever enough to see the joke. Learning words or definitions can be made easier and less tedious by using puns. Metric prefixes, in particular, lend themselves to this approach. There are groans in the classroom but it is amazing to see how diligently and quickly students work through long lists which may contain the following: 10^{12} bull; 10^{9} le; 10^{-9} goat; tro 10^{-12} 1; 10^{-2} fic; and 10^{-9}, 10^{-9}.[7]

A "visual pun" is a picture in which the letters of words are modified to suggest an aspect of the concept involved. Students enjoy creating these and at the same time begin to learn important definitions and symbols. Here are some examples.



Physics requires the frequent use of symbols, including Greek letters. In order to familiarize students with the symbols I use the following.



While puzzling through these, students learn some physics, too.

Central to almost any physics course is the solving of problems. Every problem does not have to involve mass A connected by a massless rope to object B sliding down a frictionless plane C. It is worthwhile to use problems that relate physics to real-life situations or to put problems in an amusing setting, as long as the basic principles involved are not obscured by too many irrelevant details.

One simple way of achieving this is to use unusual units of measurement. This emphasizes the fact that the name of the unit is not relevant to the concept involved. Pressure is pressure whether it is measured in atmospheres, pascals or ghlerfs. A ghlerf sounds like an appropriate unit in a problem related to submarines.

It is worth the effort, just to see the surprise on a student's face, to create and insert a problem like this one into an assignment or even a test or exam.

> In the far corner of our galaxy (if galaxies have corners) hangs the planet of ID, with one moon slowly orbiting it. The inhabitants of ID (the IDiots?) wish to send a rocket to their moon. If their moon has a mass of 1000 finks, and their planet has a mass of 81 000 finks, at what shortest distance from the centre of ID will the rocket experience no net gravitational force? The distance between centres of ID and its moon is 100 000 wizards.[8]

It isn't the "same old problem" and the unusual setting may trigger new ideas in the mind of the student.

You can't always trust the physics that you see on the screen or read in print. Flash Gordon, for example, lives in a very curious universe.

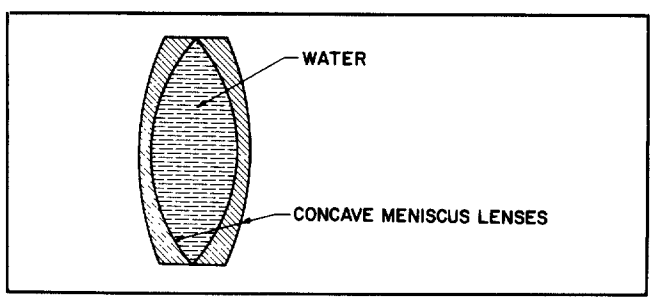
> "Velocity means speed multiplied by the weight of the object, of course, to quote a bit of elementary physics." Zarkov grinned. "You would have to regulate the speed with the weight of the object transmitted. Too much speed would crush a large object; too little speed would cause a smaller object to explode."
>
> "Oh," Dale said, impressed."[9]

There are numerous examples of scientific errors, sometimes with amusing consequences. Once the idea is introduced students will discover many more examples, particularly in television programs.

In the novel *Lord of the Flies* a group of schoolboys find themselves on a deserted island. One of their first necessities, in order to survive, is a fire. The fire is started using the lenses from the spectacles of one of the boys, someone who is extremely short-sighted.

> Ralph moved the lenses back and forth, this way and that, till a glossy white image of the declining sun lay on a piece of rotten wood. Almost at once a thin trickle of smoke rose up and made him cough.[10]

The situation described can lead to an interesting discussion in the physics classroom, particularly if the novel is on the course of study in English. Since the boy's lenses must be concave, a fire could not be started unless they were concave meniscus lenses and were arranged as shown below.



However this does spoil a good story. Another excellent book to use is *The Invisible Man* by H. G. Wells.[11]

It is sometimes possible to illuminate a concept by turning the physics inside out. An article that appeared in the *Journal of Irreproducible Results* begins,

> There is no such thing as light. What there is in the universe is dark. It is obvious from simple observations that this is so.
>
> What we call light is merely the absence of dark. Dark is continually created. As fast as it is whisked away, more fills up the space.[12]

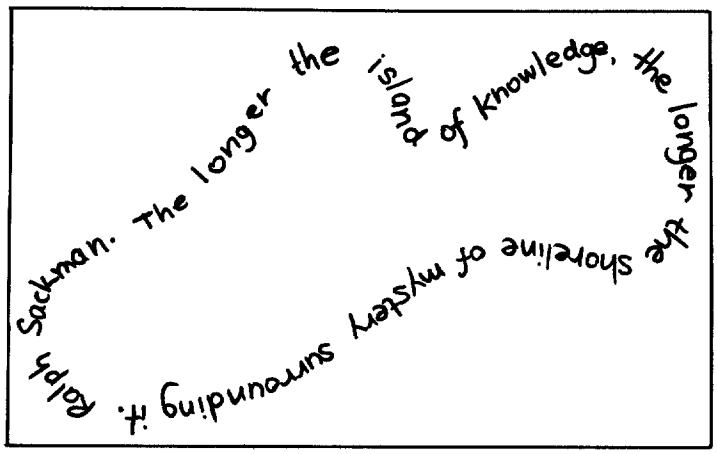
The article continues with a discussion of dark-sinks, the speed of dark and darktons. Using this model, how would you explain how a "dark bulb" works?

In a similar vein, "what if" questions can lead to deeper insights even while providing amusement. What if gravity were "turned off" under a small area? What if gravity fluctuated from day to day in the same way as the weather – today's gravity report? What if you tried to bake a cake in Skylab? What would you wear if there were no friction? The possibilities are endless and reminiscent of Einstein's question, "What would a light wave look like to someone keeping pace with it?"

Decorating the classroom with posters also helps to enliven the atmosphere. Sometimes a quotation or an aphorism captures the essence of a physical concept better than a long mathematical derivation or a detailed definition. These are very suitable subjects for poster work.

> In questions of science the authority of a thousand is not worth the humble reasoning of a single individual.
> *Galileo*

An echo is like hearing yourself in the mirror.
ABSOLUTE ZERO IS O K
IMPULSE CHANGES MOMENTUM
FRICTION IS A DRAG
Pornography in physics is a bare naked number. Clothe it in units.
AXIS: SOMETHING TO TORQUE ABOUT



Jim Nelson, a physics teacher at Harriton High School in Rosemont, Pennsylvania, has an interesting way of reviewing work at the end of a term. The classroom becomes a game show for one period. He uses a wild mixture of questions, requiring answers that may be outrageous puns or historical facts. These are a few questions selected from his collection.

1. What is the center of gravity?
2. What element is named after an Italian physicist?
3. Name a unit of measurement named for an American scientist?
4. Who invented the radiometer?
5. What is the definition of a "law of nature"?
6. What is a little joule?
7. What is the mass of a 90-kg man on the moon?
8. What do you call people who vote "yes" for better tractors?
9. Who said, "It is by logic that we prove, but by intuition we discover"?
10. What is the beginning of eternity and the end of space and time?[13]

I have a special problem set that I hand out as a "Christmas treat."

PROBLEM SET

TO BE HANDED IN BY 12:00 PM (Midnight), December 24 (or else Santa won't come!)

If you feel essential data is missing, invent your own.

1. Calculate the force Rudolph exerts when he stumbles against a cloud and brings Santa's sleigh and its eight tiny reindeer crashing to the ground. Comment on the expression on Santa's face as Rudolph tries to explain the laws of physics to Santa.
2. Prove by direct experiment that the total work done in carrying a 25-kg Christmas tree upstairs to the third floor and then down again to the starting point is zero.
3. Plot a displacement-time graph for a chicken crossing the highway. Comment on the points when the acceleration is greatest, and how the chicken selected the direction of his initial velocity. Determine the minimum speed of a car which can make an impact with coefficient of restitution equal to zero with the chicken crossing the highway. Describe the subsequent motion of the car.
4. Calculate the initial velocity and trajectory a fox must have in order to reach a bunch of grapes. Prove to your and the fox's satisfaction that the grapes were sour anyway.
5. Junior delivers a horizontal blow with a blunt instrument to the Christmas tree at a point 0.5 m up from the floor. Determine the motion of the star at the top of the tree and the reaction of the family.
6. Measure the minimum force necessary to crack each Christmas nut, and draw a histogram showing the number of nuts in each suitably chosen force range. Determine the median, mean and root mean square force and the quartiles. Compose an appropriate letter of complaint to the nut-growers.

BONUS

Two identical dishes, loaded with cranberry sauce, and each of mass M, rest on a frictionless Christmas table. A perfectly rough insect of mass m jumps from the center of one dish to the center of the other and back to the center of the first. Show that the ratio of the velocities of the dishes is M + m: m and determine the fate of the insect.

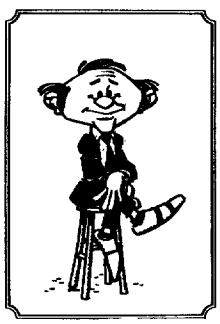
So far, I have received three very amusing solutions to the problem set, one with a grape (for testing and tasting) attached. Parents have also remarked on the curious things that seem to be going on in the physics classroom, often referring to this particular "assignment."

The physics teacher does not need to be a comedian,

continually cracking jokes, inventing puns and tossing off one-liners. But the judicious use of humor at just the right times can lead to a more happy and creative atmosphere in the classroom. Besides, your students want a chance to show you how clever they can be.

Notes and References

1. Peter Ustinov, *Dear Me*, Penguin Books, Baltimore, 1977.
2. Arthur Koestler, *The Act of Creation*, Pan Books Limited, 1964.
3. Dr. William Stukeley, *Memoirs of Sir Isaac Newton's Life*, 1752, pp. 19-20.
4. Bradlee Chang, "The depth of a well," Phys. Teach. 16, 489 (1978).
5. "More on the depth of a well," Phys. Teach. 17, 327 (1979).
6. Arthur Koestler, *The Act of Creation*, Pan Books Limited, 1964, p. 65.
7. Answers: terrible; giggle; nanny goat; tropical; scientific; nano, nano (Mork's greeting on the TV program *Mork and Mindy*).
8. Phil Eastman, *A Decade of SIN*, Physics Department, University of Waterloo, Waterloo, Ontario, 1979.
9. Alex Raymond, *Flash Gordon: The Time Trap of Ming XIII*, Avon Books.
10. William Golding, *Lord of the Flies*, Faber and Faber Limited, London, 1954, p. 45.
11. Ivars Peterson, "Blind Sight," *Photon*, No. 27, March, 1980.
12. Kirk R. Smith, "The Age of Enlightenment Ends," *The Journal of Irreproducible Results*, Vol. 20, No. 1, June 1973.
13. Answers: 1. the letter "v," 2. Fermium, 3. henry, bel, or sabin, 4. Crookes, 5. "A guessed generalization based on imperfect observation of nature," 6. erg, 7. 90 kg, 8. protractors, 9. Poincaré, 10. the letter "e."



How do you use humor in your classroom? Send your ideas to the editor.

A POEM FOR PHYSICISTS

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As a "fun" project in a topical physics course for nonscience majors, I asked each student to apply one or more subtopics of the course to some facet of a major field of study, and present the project to the class during the last week of the course.

One of the most gratifying presentations was a simple poem by an English major. The student stated that his application was a concrete poem which he wrote on the chalkboard. A concrete poem, with a nod to Piaget, is one that must be *seen* to obtain a complete understanding.

Since Robert March[1] thinks that poets should understand physics, then shouldn't it follow that physicists should understand poetry? Prove it, by deducing the general topic of the course for which the poem was written, and the subject matter subtopic.

I SAW I WAS I

untitled poem by George Good

Reference

1. Robert H. March, *Physics for Poets*, McGraw-Hill, New York, 1970.

Look on p. 673 for the answer.