STATISTICS and STATISTICAL METHODS: *Ignorance on Parade*

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Ignorance on Parade

By JUDITH STONE

YOU SAY YOU DON'T KNOW A proton from a crouton? Well, you're not the only one. A recent nationwide survey funded by the National Science Foundation shows that fewer than 6 percent of American adults can be called scientifically literate. The rest think that DNA is a food additive, Chernobyl is a ski resort and radioactive milk can be made safe by boiling.

"Only about one in twenty adults knows enough about science to function effectively as a citizen and consumer when asked to help formulate public policy about issues like nuclear power or toxic waste", says Jon Miller, director of the Public Opinion Laboratory of Northern Illinois University, who tested the scientific savvy of more than 2,000 people.

Certainly I have no right to be smug. I have, after all, been known to whine that if God wanted us to use the metric system he would have given us ten fingers and ten toes. But, honestly, do you want these people deciding where to stash leftover plutonium? More to the point, would you like to ride a chair lift or hoist a frosty, glow-in-the-dark malted with them?

Only 28 percent passed the section of the test measuring knowledge of scientific terms and concepts, mostly through true-false questions such as "The earliest human being lived at the same time as the dinosaurs" (37 percent correctly answered false) and "Electrons are smaller than atoms" (43 per cent correctly answered true). The subjects were also asked short-answer questions such as whether Earth travels around the sun or *vice versa*. Those who knew that the former is true were asked whether this event takes one day, one month, or one year. Forty-five percent got it right; the rest had really enjoyed *The Day of Living Dangerously.*

Half the respondents aced the part that gauged their understanding of how science and technology affect their lives. That's where the radioactive milk came in; 36 percent weren't worried about its half-and-half-life.

Age proved not to be a factor in determining who was scientifically literate, although sex did: men scored somewhat higher than women. Miller attributes the difference to the way science has traditionally been presented in schools – as a stereotypically male realm that girls are subtly discouraged from entering. The best predictor of a high score was having taken a college science course.

At least we're not getting dumber; Miller conducted surveys in 1979 and 1985 and finds little difference in scores then and now. And a similar survey of 2,000 Britons, conducted last year by Oxford University, shows that they know as little as we do. A slightly higher percentage of Brits grasp the impact of science on society, but twice the number of Americans – about half – know what software is. More important, we know that Benny Hill just isn't funny. (We may soon have a chance to see how we measure up to the Japanese. Miller recently returned from Tokyo, where he was trying to arrange a study like the one he just completed here. You'll be relieved to know that he thinks the Japanese scientific literacy rate will turn out to be "not much more than twice ours".)

At the very least, we need a sort of street-smart science: the ability to recognize evidence, gather it, access it, and act on it.

Miller's figures are fascinating, but I wanted to know more about what people thought they knew. So for a few months, wherever I traveled, I asked people a number of questions about science, some from Miller's study, others inspired by recent news stories. I talked to people on airplanes, at restaurants, on the beach, on the street – basically, anyone who didn't pull a knife when I said, "Hi, what's the ozone layer?" My study of nearly 150 unarmed Americans, ranging in age from three and a half to 67, was rather informal but highly revealing. I was heartened to see how many respondents (just under oodles) could define the scientific method, but demoralized to discover how few (heaps, with a margin of error of plus or minus three bunches) seem to apply it to their lives. All answers were totally serious, except for those followed by the words "Just kidding".

First came my trickier reworking of one of Miller's questions: "How," I asked, "did the earliest human beings fight off dinosaurs?" You and I know that the last of these creatures vacated the planet more than 60 million years before any recognizable relatives of *Fredus flinstoniensis* moved in. But only about half the folks I polled had gotten the news. A 28-year-old actress/waitress at a Manhattan restaurant insisted that coexistence wasn't a problem since dinosaurs were vegetarians. According to an 18-year-old advertising major at San Francisco State University, "Early human beings would hide in caves, set up traps, or play dead when dinosaurs came upon them".

Thank heavens for Andrew, a three-and-a-half-year old San Francisco nursery school student majoring in fire engines, who declared, rather condescendingly, "There weren't any people. I saw a show." His father explained that they'd recently seen a play about dinosaurs at the University of California's Lawrence Hall of Science in Berkeley. Parents take note; otherwise your kid could end up like Buddy, an Alabama man visiting Pensacola, Florida, the southern tip of what the locals refer to as the Redneck Riviera. "First", Buddy said, "early man called the dinosaurs names – 'You ugly bastards!' Then he ate their eggs". He took a pull at his Bud Lite and inhaled a handful of Zapp's Crawtater Chips. "Just kidding".

More people correctly defined the ozone layer than any other scientific term; a librarian at the University of Virginia and a retired auto mechanic in Portland, Oregon, even knew that it's oxygen with an extra O. But a 12-year-old member of a Kilgore, Texas, church group identified it cryptically as "the middle layer." I believe she confused "ozone" and "Oreo", a slip even Nobel laureates sometimes make.

When asked to identify Isaac Newton, nearly all adults surveyed mentioned gravity (without going into further detail), and they correctly linked Charles Darwin with the theory of evolution. But a St. Louis woman told me, *sans* elaboration, that Darwin was "known for his use of force", and an 11-year-old Chicago boy stated confidently that the two men were actors – scientific method actors, no doubt. I know I especially loved Chuck "the Enforcer" Darwin in *The Originator.*

Recognizing Chernobyl would be a lead-pipe cinch, I thought, but I included the item anyway since in a recent Gallup poll a fair number of high school students thought it was Cher's real name. More kids drew a blank on this one than I expected. And a 39-year-old accountant returning to UCLA as a freshman really did think it was a ski resort. My favorite answer, from his mega-mellow 19-year-old classmate: "A Russian nuclear power plant that totally blew up, dude".

DNA, you'll be interested to learn, is a sickness (a nine-year-old girl from Little Rock said that), the smallest known molecule (according to a 26-year-old woman in Phila-

(*continued overleaf*)

delphia), a food additive (another Philadelphian, overheard in a Chinese restaurant saying, "I'll have the Hunan beef, but go easy on the DNA"), and an airport. This puzzling answer, from a Kilgore third-grader, was explained by an older friend: "I think she's thinking of DFW – Dallas-Fort Worth." Among the cognoscenti, the phrase "genetic blueprint" won the prize for Most Bandied About. An architect from Baton Rouge made a fashion statement: "It's the double helix that holds our genes together."

Oddly, this question yielded the only vaguely hostile answer, from the head of a New York City public relations firm who hollered in a French restaurant, waving his boudin for emphasis, "I don't know what DNA is and I don't want to know." Most people were apologetic or oddly proud about their ignorance, but always good-natured.

The hardest question on the survey, one I myself couldn't answer *extempore* even if you threatened to make me watch an endless loop of *Hello Larry* reruns, asked the respondent to explain how television works. You can guess how many wags from coast to coast felt compelled to say, "You push the button"; I got quiplash. The typical response was in the ballpark but not quite complete, like this one from a 30-year-old woman who's an art director on a Baton Rouge business publication: "Radio waves are sent through the air and electronically reorganized in your television." A Dallas eight-year-old said simply "Microchips," which was more than one child's answer to more than one question. "It's done with mirrors and reflections," said a San Francisco woman. And back on the Redneck Riviera, one answer sparked a lively debate. "Radio waves are sent and received," said good old Buddy. "But if they're *radio*," said a companion, how do they know when to turn into a picture?" "How," said Buddy sagely, "does a thermos know when to keep something hot and when to keep it cold?"

I especially enjoyed the responses of Gail Sipe's third-grade class at the A.B. McDonald Elementary School in Moscow, Idaho, a generally canny crew that includes one young *civis indignatus* who, when asked which is heavier, a pound of bricks or a pound of feathers, wrote, "Bricks!! Of Course!!!" That group also revealed that software is either "plastic knives and forks" or "clothes that keep us warm," and that the ozone layer "separates bad air from good air."

How alarmed should we be at these answers? Does not being able to explain DNA make you an awful person? Is it more important to know what Chernobyl is or to have the psychological savvy to judge the guy with his finger on the nuclear button? Just what, in this large loaf of data-nut bread that is the modern world, do we need to know?

We can't all be Einstein (because we don't all play the violin). At the very least, we need a sort of street-smart science: the ability to recognize evidence, gather it, assess it, and act on it. As voters, we're *de facto* scientific advisers. In the next few years we're going to be making, directly and indirectly, vital decisions about the greenhouse effect, acid rain, the pesticides that taint our foods, genetically engineered organisms, how much to spend on mending our torn ozone layer. If we don't get it right, things could go very wrong. The seas will rise, the trees shrivel, the snow turn to steam; nothing will taste good. If we don't get it right, they'll be shedding their thermal software in Antarctica.

1 From what is said in Judith Stone's article, the sample survey included the following questions:

- *The earliest human beings lived on earth at the same time as the dinosaurs.* True or False?
- *Electrons are smaller than atoms.* True or False?
- *Radioactive milk can be made safe by boiling.* True or False?
- *What is Chernobyl?*
- *What is software?*
- *What is DNA?*
- *What is the ozone layer?*
- *Does the earth travel around the sun or* vice versa?
  - *How long does one complete revolution take: one day; one month; one year?*
- *Which is heavier: a pound of bricks; a pound of feathers?*
- *For what is Isaac Newton famous?*
- *For what is Charles Darwin famous?*
- *Explain how TV works.*

How many of these questions could *you* have answered correctly?