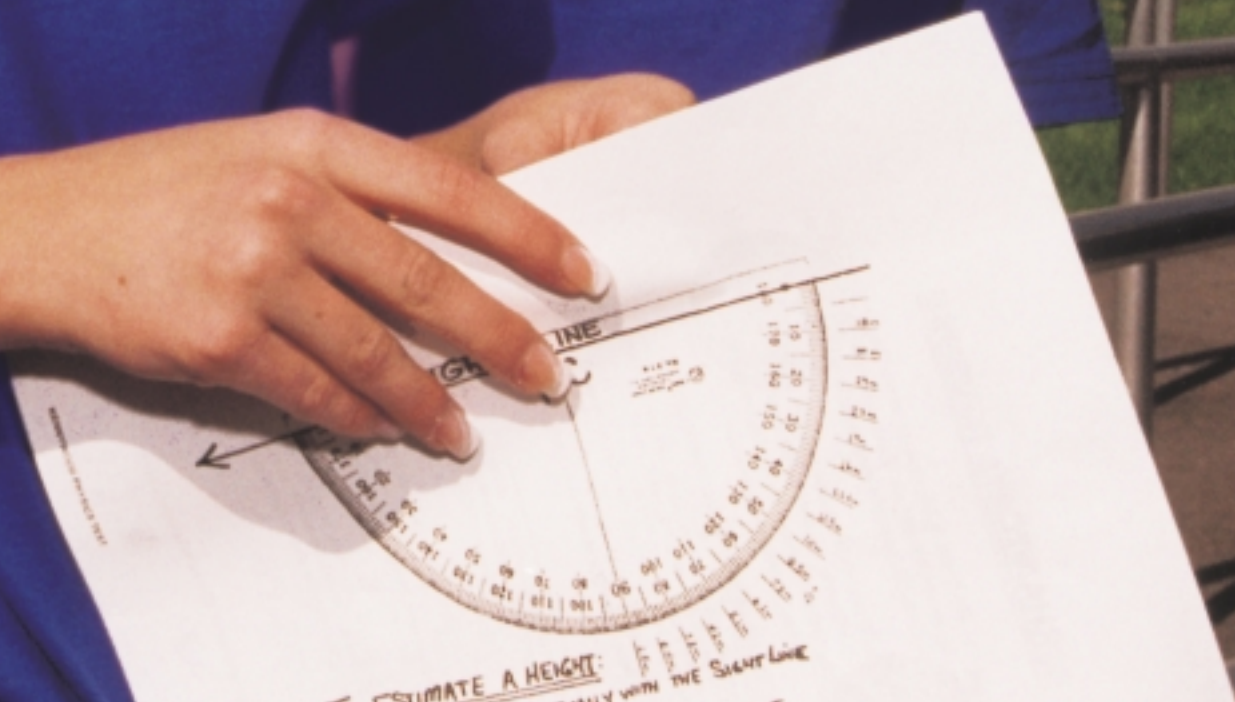


An inseparable foursome from Hampton Middle School celebrates coming up with an answer to one of the teacher-assigned Physics Day problems around The Phantom's Revenge, a roller coaster ride at Kennywood Park outside Pittsburgh.

GIRLS + MATH +

Try a quick physics lesson while waiting in the roller coaster line. How about a science quiz before the rock concert? A math tip at the mall? A foundation-led program is using catchy signage as the first step in a regional campaign to pique girls' interest in math and science.

SCIENCE



For 15 years, Pittsburgh area junior and senior high school students have converged on a large amusement park to work in teams solving physics problems. The answers are developed in a fun environment that shows students the practical implications. Here are some samples→

*By Brian Connelly
Photography by Joshua Franzos*

28

It's Physics Day for thousands of middle and high school students at Kennywood Park south of Pittsburgh. Across the Monongahela River where the smokestacks of the former U. S. Steel Edgar Thomson works are preserved as a memorial to the region's industrial past, future engineers and designers of its emerging high-tech economy step off school buses and file through the gates. Physics Day may be one of the few school field trips where an academic exercise is dressed up around a treasure hunt theme and ends in a group picnic. In the midst of it all, students enjoy rides while calculating the number of bolts in the frame of a roller coaster or determining the surface area of all the corn dogs sold in the park.

Among the 13-to 17-year-olds traveling in packs, there is a foursome of Hampton Middle School girls looking uncharacteristically serious as the brightly painted animals on the park's historic merry-go-round bob to the music. Two girls stretch a tape measure along the radius of the ride from center to edge; two of their friends pace the circumference while letting out a ball of string; two other girls ride the ponies while holding up a scalar plane to help calculate their speed.

Their science teacher, Michele Hurst, can't say what draws the girls to the merry-go-round, where there are few boys. "I just know that, in their problem packets, the girls take more time to explain things, to write out what they have been observing. I think they like the fact that they can work together."

The girls say it's easy to concentrate on the problems even in a crowd of gabbing teens. "Me, personally, I like to do hard math problems," says Alison McKelvey, a sixth-grader at Hampton Middle School, explaining why the girls have been at the same ride for two hours.

Several of the girls working on problems at the merry-go-round describe science or math as their favorite subjects. Gauging from the sixth-graders' excitement in tackling math and science problems, it's a mystery why statistics show that only a few of them will pursue university degrees in

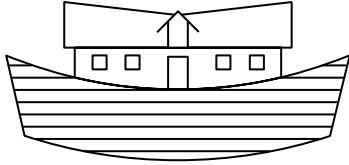


Two high school juniors do some quick calculating, responding to a Physics Day question on Kennywood Park's carousel: "Count the number of horses. Count the number of rotations and the distance that the horses travel in a set amount of time. Calculate the acceleration of the carousel."

*Brian Connelly is managing editor of FOCUS,
Carnegie Mellon University's faculty and staff newspaper.*

1 Noah's Ark

Calculate, by any means you can devise, the distance the end of the ark rocks upward above the horizontal.



2

If a spring were stretched from one end of the ark and generated only a transverse wave that had a speed of 3 meters per second, what would be the wavelength of the wave? (velocity = frequency \times wavelength)

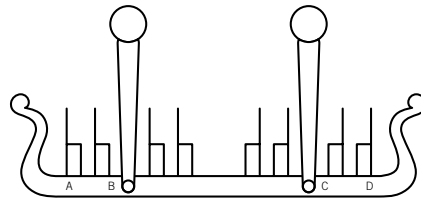


3 Flying Carpet

Calculate the centripetal force produced by the rotating arm on the Flying Carpet.

4

Do the riders at positions A and D experience the ride differently than the riders at points B and C?



30

engineering or physics. Within a few years, many studies have found, girls like these become much less likely than boys to be interested in math and science and less likely to perform well in those subjects.

Observing eighth-grade science students in southwestern Pennsylvania, the Regional Benchmarking Report of the 1999 Third International Math and Science Study identified a “significant gender bias” against girls. In earth sciences, chemistry and physics, boys had higher scores and described themselves as feeling more confident than girls. The report found a less significant gender bias against girls in mathematics.

This gender bias cycle—girls lose interest, don’t feel confident and eventually avoid math and science courses—is worrisome to teachers and employers because it greatly limits women’s future choices of professions. Of physicists in the United States, only 12 percent are women. Slightly fewer than 10 percent of all engineers are women. The numbers are even more discouraging—typically below 5 percent—for women working in technical specialties, from precision machining to aerospace and nuclear engineering.

While the gender gap in law, business and public service jobs is closing, it’s still a man’s world in science and math—the foundations of the research and technology economy.

Who or what is the culprit pushing girls away from math and science? It’s a question that high school teachers, university academics and employers in some of the country’s most important industries have been struggling to answer for decades. And there appears to be a group of factors, rather

In Pittsburgh, the foundation community is moving into activist mode through an innovative regional campaign to encourage girls—and their parents and teachers—to think positively about math and science. Last summer, Kennywood hosted an initial project by the Girls, Math & Science Partnership, a working group of educators brought together by staff from the Alcoa Foundation and The Heinz Endowments.

For the project, a group of designers and researchers at Pittsburgh-based Carnegie Mellon University and the University of Pittsburgh created a series of three large signs to hang along the snaking line for the park’s star roller coaster, “The Phantom’s Revenge.” In the signs, a team of four cartoon characters—two girls and two boys—present parents and children with a few practical physics lessons about the coaster they are waiting to ride.

The signage project, supported by grants from The Heinz Endowments and the Alcoa Foundation with cooperation from Kennywood’s management, is only a first step, says Marge Petruska, director of the Children, Youth & Families Program at the Endowments. “We wanted to experiment with a different approach to social marketing,” she explains. “The signs feature girls as spokespeople for physics, which right there sends a signal, and they’re a type of stealth education, reaching girls, as well as boys and parents, in an unusual place.”

Social marketing is a discipline that uses advertising, public relations and other communications techniques to “sell” ideas and changes in behavior. The Girls, Math & Science Partnership is working to develop a targeted social marketing

Of physicists in the United States, only 12 percent are women. Slightly fewer than 10 percent

than one significant force. In recent years, foundations have become active partners in the investigation, especially in funding studies that help researchers understand the scope of the problem.

campaign that will sell the region’s girls—and the people who influence them—on the idea that they can excel at math and science and should pursue careers in those fields.

The Kennywood signs are just one small part of that broader effort. But the project is receiving broad attention as

5 Potato Patch

Based on an 11-hour day,
estimate how many Potato Patch
french fries will be sold today.

it moves into its second summer, including an anticipated significant multi-year grant from the National Science Foundation to expand the program and to produce booklets and videos directed to parents and teachers. “It’s clear we’re on to something here,” says Petruska.

Years before foundation-directed programs were in the works, Barbara Lazarus, associate provost for academic affairs at Carnegie Mellon and a leader of the Partnership, had seen hundreds of young women with a passion for math and science forced to travel a tougher road than male students.

“I had an experience 10 years ago at an orientation for women starting in the Mellon College of Science. We would meet in little groups to talk. When I asked ‘What interests you in physics?’ a girl answered ‘When I was in high school, you were going to be a girl or a physicist.’” Other girls joined in with their own personal experiences in choosing science: no social life, no prom, no boyfriends. The distinguishing features our culture ascribes to those engaged in science are distinctly not girl-like, Lazarus explains. “A mental picture of a scientist is unlikely to be a fashion model, male or female.”

Lazarus sees the problem in girls’ motivation to study math and science. “For a long time, I thought that one reason is that girls really don’t know what science is. They think that science is really hard, that you have to be really smart to do it. People figure with math that if you don’t get it at some

point, then you won’t get it. But math is no harder to learn as an

adult than reading. We can offer adult education courses in basic reading — why not basic computation? The educational system doesn’t come in to rescue people who didn’t get it.”

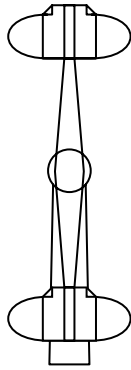
The concept of creating signs in parks and playgrounds began with Lazarus’s idea to do “something very simple that



READING AND RIDING

In partnership with Kennywood Park outside Pittsburgh, a group of designers and researchers at Carnegie Mellon University and the University of Pittsburgh have designed a series of three large, colorful signs to be positioned at kid-eye-level along the snaking line for the park’s star roller coaster known as *The Phantom’s Revenge*. Depicted on the signs is a team of four cartoon characters — two girls and two boys — who present their real-life peers with a few practical physics concepts connected to the coaster they are waiting to ride. The Kennywood signage is just the beginning of a program that Alcoa Foundation President Kathy Buechel admires for “a direct approach that is practical and not preachy.” As one of the prime funders, Buechel sees an expanded program as a national model for attracting more women and minorities to math and science.

of all engineers are women.



6 Roll-O-Plane

Calculate the centripetal force produced by the rotating arm.

7 Merry-Go-Round

What is the approximate distance traveled by the stationary tiger on the outside edge of the merry-go-round in one year? (Kennywood is open about 112 days a year and 11 hours a day.)

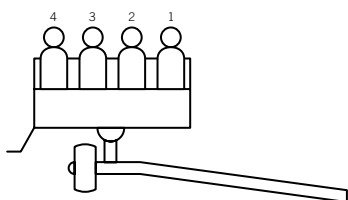
High School girls wait in line at The Phantom's Revenge, the star coaster ride at Kennywood Park. "They're the target group we want in a captive setting," says The Heinz Endowments' Marge Petruska. "It's an advertiser's dream situation, and now it's a tool for learning."



"The larger goal is to let people know that math and science are important for the region."

8 The Kangaroo

Why do the riders in position 4 experience more force than the other riders?



9 The Phantom's Revenge

Estimate the number of bolts needed to build the lift hill.

10 Corn Dogs

Estimate the total surface area of all the corn dogs sold in the last 20 years.

has been done in zoos for the last 40 years — to make it an entire educational experience — and to do the same for basic principles of science.” She focused on experiences from family road trips in her youth, passing by those story-telling Burma Shave road signs and remembering their power. “I wanted to make sure that, for the people standing in the line for rides, by the time you were through the line, you would understand something.”

In the wait line for “The Phantom’s Revenge,” the first sign greeting people introduces the four cartoon characters who create roller coasters together as “The Scream Team”: Can-Do Kay the Engineer, Raj the Design Dude, Ace the Physics Guru and Mick the Mind. Kay and Ace are girls. On the two other signs, the Scream Team show physics concepts that the riders experience. One sign — “No engine? No way!” — describes potential and kinetic energy by showing how the peaks and valleys of the track propel the cars without an engine. “Choose your adventure” describes how gravity and velocity affect riders in the front, middle and back seats of the car. If you want to experience the most negative G — falling faster than gravity — sit in the back.

Peggy Stubbs, project director, is with Pittsburgh’s Family Communications, the production company founded by Fred Rogers to produce the Mister Rogers’ Neighborhood television show. The company’s 30-plus years of experience in creating educational communications for children is now being put to use in Partnership projects.

Stubbs describes the Kennywood signs as an exciting prelude to a multiyear campaign that, in addition to targeting girls, also serves the general population. “The larger goal is to let people know that math and science are important for the region. Math and science literacy is just as important as reading literacy.” With the help of the anticipated National Science Foundation Grant, she says, the Partnership plans to

develop more signs for placement at Kennywood. They’re also in discussions with the Pittsburgh Parks Conservancy to create signs in public parks and playgrounds.

For The Heinz Endowments’ Petruska, the reasons for long-term support of the Partnership are the same as those behind job-creation funding to help lift the region’s economy. Pittsburgh and southwestern Pennsylvania will not thrive in the knowledge economy, she says, without women as full participants. “Why should we care? Our future is in industries like robotics, biotechnology and tissue engineering — areas where you need math and science,” says Petruska. “Half our region is being left out.”

Alcoa Foundation President Kathy Buechel also cites workforce development as a key reason for support, not only targeting women but finding ways to reach out to minorities as well. “We want to fix the leaks at the point where people drop out. If you don’t study algebra in seventh grade, you won’t become an engineer. The signage campaign shows the relevance of math and science in a direct approach that is practical and not preachy. The campaign has regional importance, but national implications as a model for getting people to think in novel ways about math and science.”

The Heinz Endowments’ Samantha Roth, who has worked directly with Partnership participants, says foundations are working on an even higher plane — to promote Pittsburgh as a learning region and to tear down barriers to education and job advancement.

She remembers only two years ago a local tour of an advanced manufacturing facility using robotics where the only women in the facility were in low-paying accounting and secretarial jobs. “I thought, as I watched all the men working, ‘Girls need to know they can do this, they need to know that math and science is the future. They need to know all the opportunities that exist for them.’” *h*