Product Testing

You've probably noticed that some products look different than they used to. The running shoes you wore as a little kid would probably look funny next to the ones you wear today. The new sneakers may also help you jump higher or run faster. Cars also look much different from those of 10 years ago. They're also safer in a crash. Why and how do the structures of products like these change?

Designers are always trying to improve the products they are creating. To do this, designers do a lot of testing. Testing not only ensures that a product will act as intended, but it also sparks ideas for improvement.

Figure 1
Crash testing shows investigators how a car will act in a crash. By analyzing the results, they find ways to improve the structure and safety of the vehicle.

Crash Tests

When a car is being designed, prototypes are put through rigorous tests to see how well the car protects its human passengers in an accident. Of course, real humans can't be used during the test because of the danger involved. Instead, crash-test dummies are put behind the wheel. The car is then crashed into a concrete barrier to simulate a real collision (**Figure 1**). Cameras record the test so the results can be analyzed and changes made where necessary. Unfortunately, the process is very expensive: each test can cost over $150 000 to run!

Virtual crash tests save money. A model of the real car, a virtual prototype, is generated on the computer. Then the model is put through a simulated test, where it is crashed into a virtual barrier. It's a lot cheaper than a real test, since computers can carry out the same test over and over again without wrecking a single car. Designers can also get close-ups of particular parts, even those hidden inside the car, to see what's going wrong during the crash. They can then change the design and try again.

When all the necessary improvements have been made, a real prototype still must be built and tested to make sure the results are accurate. However, using simulations lets the designers try different things out without wasting money on the real thing.

Trial and Error

At one car company, car designers who used computer simulations discovered an unexpected way to make their cars safer. When hit from the side, the frame of their car tended to buckle dangerously near the head and body of the driver. The car designers first tried the obvious solution: reinforcing the frame with steel to make it stronger. Unfortunately, when they ran the computer tests on the new model, they found that this change actually made the buckling worse!

The designers experimented with different combinations on their computers until they found the answer. They discovered that making the lower part of the frame weaker, not stronger, made the buckling less severe higher up, near the driver's head and body. Like the crumple zone in the front of the car, this little weakness in the structure made the rest of the structure stronger. It's not likely they would have discovered this innovation except through trial and error and the power of simulation.

Try This — Testing the Rack

In the Try This in the Getting Started, you designed and built a CD rack. Imagine how that rack might be used and where it might be stored.

- 3F Create three tests you could carry out on your CD rack.

1. What results do you expect from the tests?

- Carry out the tests.

2. Based on the test results, how could you improve the design of your CD rack?

Understanding Concepts

1. Why are prototypes tested before they are mass-produced?

2. How does testing help to improve the products we use?

Making Connections

3. Cars are expensive to build and test, which is why car manufacturers use computer simulations instead of real crash tests. Shoes are much cheaper to make. What benefits could a shoe manufacturer gain from using simulations in testing?

4. 3F Do you ever have trouble with a door handle? Do your clothes seem to wear out before you want to buy new ones? Can you think of a way to improve a product that you use every day? How would you test your innovation?

Reflecting

5. Testing a prototype can yield unexpected results. Car designers discovered they should weaken, rather than strengthen, part of the car body to improve safety. Why would an unexpected result be important? What things should you consider if the results of your tests are unexpected?

Design Challenge

3F Testing a structure often reveals areas for improvement, and different tests will reveal different things. How will you test your designs for your Challenge?