Letter 2 from Donald Ablestein
Explain: To Be Fair …

Class,

I want to give you some more information about fair tests. By definition, a *fair test* is one that does not show any favoritism in the results. In a fair test, all elements that are being tested must be treated the same.

Consider this example of a test. In our company, one of the things we do is to test materials for rockets and boats. In one test, we wanted to find the best kind of foam insulation to go on the outside of a rocket. Foam insulation is important to rockets because it keeps the oxygen and hydrogen tanks on the outside from heating up too much. It can also keep ice from forming on the tanks before the rocket is launched. Oxygen and hydrogen are very cold liquids. In the past there have been problems with foam insulation falling off rockets. In this test, our company engineers wanted to find out which kind of foam insulation was best.

The engineers tested four different kinds of foam insulation. They attached the foam to four different oxygen tanks. Then the engineers put the tanks with foam 1 and foam 2 in freezers with different cold temperatures and left them there for a week. They put the tanks with foam 3 and foam 4 in ovens with different hot temperatures and also left them there for a week. After the week was up, the engineers took the four types of foam off the tanks. They looked at whether the foam had broken apart in the different temperatures. They concluded that, based on this test, foam 1 and foam 2 were better because they did not show any signs of breaking apart.

You probably noticed that there were several different factors involved in the test.

- There were different kinds of foam.
- There were tanks.
- There were different temperatures, both hot and cold.
- There was the length of time the foam was tested.
- After the test, the foam was studied to determine whether it broke apart.

Each of these factors is called a **variable.**

There are different types of variables to think about when you are doing an investigation. One type of variable is called the **independent variable.** The independent variable is what you are changing in your experiment. You might also think of it as what you are testing.

There is also the **dependent variable.** The dependent variable is what you are observing in your investigation. It *depends* on or responds to what you change in your investigation.

Some of the variables should be kept the same in your test. These are all the variables that you are not testing. You should do everything you can to keep them constant. Keeping all the variables the same except for the one you are testing is what makes a test fair.

Another thing to think about when you are testing is how to determine that the results are due to your experiment. What if the foam broke down after a week even if it was sitting at room temperature? How would you know that? To help solve that problem, many experiments need a **control.** A control is what you use to compare the tests. It is almost the same as what you are testing except that the independent variable does not change. *Not all experiments have a control.* It is not always possible to keep all the other variables constant when you are doing an experiment. That does not mean the test is not fair.

A final thing to consider when you are testing is how many times you try the test. If you only do one test, are you sure that the results are correct? You usually need to try a test a few times to make sure you get similar results each time.

Since our original foam insulation test, we have started paying much more attention to fair testing. If we were going to do that experiment today, we would do some things differently. We would make sure that all four types of foam sat at the same temperature in each test. Remember, in our earlier test, two types were at a cold temperature and two types were at a hot temperature. We also would have several pieces of foam on different tanks so that we would be testing more than one sample. We would make sure that more pieces of foam sat at room temperature for the length of the test. That way we would know that any breakdown was due to the cold or heat, not just because the foam falls apart after a week.

I hope this information helps you as you review the boat product testing. We want to be confident of the test results, so we are very concerned about making sure that fair tests were run. Because of that, your work is very important to us.

Sincerely,

Donald