

## **Results of Testing** with students from Columbus Public Schools and Hilliard City Schools

The test administered is the one included in (FILL IN SECTION NAME OR PROVIDE LINK). The test was designed to determine the level of knowledge students had in:

1. Understanding the forces of gravity, push, pull, and friction.
2. Predicting the outcomes of various motions and forces.
3. Understanding the application of various simple machines to work situations.

The test was administered to all test classes either immediately prior to using the site or the class period before (in some cases, this was the hour before, in others the day before). Students were told that the test was NOT for a grade, but were asked to do their best on it. This was to allay fears and alleviate frustrations for students that had not previously had any instruction on simple machines. After using the site for a range of 15 to 20 minutes, the students were given the post-test immediately following. For both pre- and post-tests, teachers were specifically instructed NOT to “teach to the test” or give instructions above and beyond logistical ones, such as time remaining to finish the test or clarification of instructions for each section. Approximately 215 students took both the pre- and post-tests. An additional 15 students took one or the other, but these tests were discarded and not counted in the final analysis. The students tested were in grades 5 and 6. About half the students had covered simple machines during the same school year, but none had any instruction within four months of the pre-test being administered.

Tests were scored by participating teachers and Edheads personnel. Questions that were skipped or left blank were counted as wrong. All tests were entered into a database that recorded right or wrong answers for each question. After a single use of the site, students showed a 4.20% improvement in scores. The average score on the pre-test was 15.11 answers correct or 60.44% correct. The post-test average score was 16.16 answers or 64.64% correct. Participating teachers agreed that further use of the site would most likely improve scores further, and ALL students indicated a willingness to continue using the site, many asking for the URL to use at home or requesting the opportunity to further explore the site during class time or during study periods or free times during the day.

The results of the testing were very interesting in that the majority of students seemed to have difficulty with the last page, which asked them to determine what simple machines went into a compound machine (wheelbarrow and axe). However, students that did well on this page often did poorly on the preceding pages. This would indicate that identification of simple machines does not translate into an understanding of the forces involved when using them or an ability to predict what will happen when forces are applied to simple machines. It would seem that students would have an easier time identifying simple machines than understanding the forces involved. But many high scoring students that only missed one or two answers missed the ones on the last page. This was a somewhat puzzling result. An overwhelming number of students thought there was an inclined plane in the axe. Testing with the first Edheads simple machines activities indicated that more students were confused by the inclined plane than by any other simple machine. It could be that confusion translates into confusion about something like an axe, that could be thought to LOOK like an inclined plane. But further testing and conversations with students would be necessary to confirm that. In any case, it is advised that teachers spend a bit more time on the inclined plane in order for students to fully understand it.

Students across the board seemed to do much better on the questions that had illustrations. The seven questions that had illustrations showed an average score that was 15% higher than the questions without illustrations on the pre-test and 8% higher on the post-test. Questions 14 and 16 (both illustrated) showed a drop on the post-test that is difficult to explain. Question 14 was directly dealt with in the activity, and the majority of students got it right during testing of the activity. However, the question asks about the direction a gear will move. In the test, obviously, the gear is stationary, while in the activity, many gears were moving around the one asked about. The moving illustration may have helped students in the activity but they might not have been able to visualize the movement for the test.

The test questions that saw the greatest gains in student scores are # 1, 5, 8, and 15. All but 15 are directly dealt with in the activity. In other words, students didn't have to apply knowledge but simply repeat what was learned. Question 15, while not dealt with directly in the activity, was about gravity, and there are at least 8 questions in the activity about gravity. Clearly, knowledge was applied by students to increase their scores on this question in the post-test.

The test question with the biggest drop in score is #14, asking which way a gear will turn if a force is applied to it. As mentioned above, students had little problem with this question in the activity and the test question is taken directly from the activity. It is not known exactly why students did poorly on this in the post-test, but the lack of moving images may be part of the problem. See below for a detailed list of question scores and changes between pre- and post-tests.

## SM II Test Analysis

Pre-Test	1 slide	2 rock	3 floating	4 spring	5 wedg e	6 pulling	7 wind	8 water	9 seesaw	10 predict	11 bat	12 catapu lit	13 forces
	44.87	69.58	76.43	38.78	45.25	74.90	58.94	43.73	39.92	71.10	74.90	74.90	63.12
Post-Test	62.74	66.92	75.67	41.83	66.92	77.19	65.40	54.37	41.06	76.43	75.29	76.81	64.64
% chg	17.87	-2.66	-0.76	3.04	21.67	2.28	6.46	10.65	1.14	5.32	0.38	1.90	1.52

Pre-Test	14 gear	15 car	16 elephant	17 balance	18 wh- IP	19 wh-WA	20 wh- Lev	21 wh-W	22 axe-IP	23 axe-WA	24 axe- Lev	25 axe-W	Raw Score	Percent correct
	69.20	43.73	76.05	68.82	44.11	76.05	49.05	66.92	41.44	72.24	58.56	71.10	15.11	60.44
Post-Test	62.74	56.27	75.67	69.96	47.53	76.43	51.33	71.10	44.49	74.14	66.16	74.90	16.16	64.64
% chg	-6.46	12.55	-0.38	1.14	3.42	0.38	2.28	4.18	3.04	1.90	7.60	3.80	1.05	4.20

One of the areas of greatest concern to Edheads is the possibility of gender bias in our activities. In testing students for the first set of simple machines activities, the only students to have lower scores on the post-test were females. However, gender information was only collected for a

very small sample of students tested. This raised the possibility that the activity somehow was a better educational tool for boys than for girls. Since we worked hard to make it gender neutral, we wanted to really look at how both boys and girls scored for this activity. I'm VERY happy to say that there was no indication of gender bias in the scores based on the chart below. It would be interesting to know why more boys had the same score on both pre- and post- tests, but that is beyond the scope of this type of testing. The changes in scores by gender are as follows:

	<b>Students Scoring Higher on Post-Test</b>	<b>Students Scoring Lower on Post-Test</b>	<b>Students Scoring the Same on Post-Test</b>
Females	75 students, 36.41% of students tested	23 students or 11.16% of students tested	16 students or 7.77% of students tested
Males	54 students or 26.21 % of students tested.	18 students or 8.74 % of students tested	21 students or 10.19 % of students tested