

## Building Successes Out of At-Risk Students: The Role of a Biology Foundations Course

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The majority of students arriving at our community college with hopes of entering the nursing, physical therapist assistant, and other allied health programs (concentrations in pre-physical therapy, pre-occupational therapy, pre-pharmacy, and pre-physician's assistant) are at-risk students. They may have completed a general education degree program (GED) rather than having obtained a regular high school diploma. Many of the students may have had a poor background in the sciences. Some are from a foreign country and have difficulties with the English language. Of the approximately 15,000 enrolled students at Kingsborough Community College, about 30% are African-American, 9% Asian and 13% Hispanic. The remaining percentage is a mixture of students coming from many different countries, speaking various languages.

It should be pointed out that, although many students come to college with gaps in their education, whether they are weak in mathematics or English, one should not generalize that all students are "at-risk." Their needs are not all the same and they may even resent the stigma of labeling.

For all of the reasons cited above, several years ago, the Department of Biological Sciences at Kingsborough decided that two semesters of Human Anatomy and Physiology (A & P) are just not enough time to teach the fundamentals of the human body structure and function, in light of the extensive expansion of knowledge in the field. For example, there have been advances in our knowledge of the immune system, breakthroughs in genetics and developmental biology, and better understanding of the liver in human health and disease. This current knowledge necessitates the placement of the most fundamental concepts of A & P (cytology and histology, microscopic techniques, technical drawing,

use of laboratory equipment) into a separate Foundations course. The rationale for this course was to help students better understand the material that would be covered in the A & P courses down the road and, thus perform at a higher level in these courses.

A Biology Foundations course of this type could easily be adapted for use by high school biology teachers because the course may be taught as a lecture/demonstration combination, with several hands-on activities for students. The high school biology staff would require a minimum preparation time to implement this course.

### Description of Foundations Course

A Foundations of Human Anatomy and Physiology course (three credits, three hours) is being given by the Department of Biological Sciences at Kingsborough as one of the prerequisites for students in the pre-nursing curriculum and all the other allied health programs. Prior to enrolling in the yearlong Human Anatomy and Physiology (A & P) courses, students must take this course or the first semester of General Biology. However, students may opt to take and pass an examination, which exempts them from the Foundations course. The passing rate of this examination is quite low, as students study for this examination on their own.

In order to help students who wish to take the exemption exam, members of the Department of Biological Sciences may prepare an online version, which students could use to study for the exam. It has been determined that students who take and pass a course in General Biology may pick up the fundamental knowledge that is required for the A & P courses. For this reason, those students are exempted from taking the Foundations course.

A brief description of the Foundations course goals is shown in Table 1. These goals are accomplished by having students work in two-hour weekly laboratory sessions for the semester, as well as an additional one-hour weekly lecture

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**Table 1.**  
**Foundations of Human Anatomy and Physiology Course Goals.**

1. Demonstrate knowledge of basic biomedical concepts.
2. Demonstrate proficiency in use of basic laboratory equipment and instruments.
3. Use knowledge to distinguish normal from diseased states.
4. Demonstrate basic computer skills, and competence utilizing the Internet for solving problems.
5. Solve a biomedical problem through analysis and interpretation of tabulated and graphical data.
6. Collect laboratory data and make sense of it through charts, graphs, quantitative manipulations, logic and reasoning.
7. Demonstrate understanding of the scientific literature related to allied health fields through presentations of findings in written form and to an audience.
8. Develop and master the knowledge and biomedical skills to achieve career goals including acquisition of advanced training.

period. Course Goals #1 and #3 are both accomplished during lecture/discussion time. Goal #2 is accomplished during laboratory sessions. The course requires 12 laboratory exercises covering concepts such as anatomical terminology, metrics, microscope, chemistry, biochemistry, and cell and tissue structure. Goals #4 through #8 are accomplished by having students do assigned projects.

The Vital Signs project carries over on a weekly basis, and requires students to learn how to use clinical instruments such as the blood pressure cuff and stethoscope. Furthermore, they learn to analyze data on their own pulse, blood pressure, body temperature, and respiration rate. Students learn from this project how to gather scientific data, to construct graphs, and to read statistical information. They then have to relate their individual data to the norms

**Table 2. Survey Questions for A & P Students.**

1. The oral presentation facilitated your understanding of cell structure.
2. The written report facilitated your understanding of basic biological concepts.
3. The Vital Signs project helped you learn how to collect and analyze data.
4. The experimental studies performed in laboratory (such as the enzyme experiment) increased your knowledge of the scientific method and how it is used.
5. The dissection of the rat aided you in learning basic anatomy and anatomical terminology.
6. The course material gave you a good foundation in the understanding of basic biological chemistry (inorganic and organic molecules).
7. The course work facilitated your use of the metric system.
8. The Connective Tissue project (identification & function of tissues) helped you with your studies in Human Anatomy and Physiology class.
9. The Cell Organelle project helped you with your studies in Human Anatomy and Physiology class.
10. Overall, the Foundations of Human Anatomy and Physiology class was beneficial to you in comprehending the subject matter of your Human Anatomy and Physiology class.

in a written report. Students must use the Internet and other sources for background materials for the report.

The Cell Structure project enables students to do an oral poster presentation and written report on a particular cell organelle of their choosing. Figure 1 is an example of student's Cell Organelle project. The Tissue project requires that students draw each type of epithelial and connective tissue on index cards, with functions noted on the back of each card. These index cards may be used as review materials in the following A & P courses. These projects are hands-on exercises that require individual students' involvement, which allows them to take responsibility for their own learning.

**Figure 1. Photograph of a Cell Organelle Project.**



## Study Design

The authors surveyed the students who were currently enrolled in the first semester of A & P, after having taken and passed the Biology Foundations course. The purpose of the survey was to determine students' input concerning the Foundations course. The timing of this survey, the end of the first semester of the A & P course (after the final examination) was chosen so that students could answer questions honestly, without any pressure, about a course they had already taken and passed.

Students were asked to voluntarily and anonymously fill out a 10-question survey concerning the Foundations course shown in Table 2. One hundred and sixteen students, who had previously taken the Foundations course, completed the survey. The first nine questions concerned topics covered in the Foundations course. Question #10 asked students about their overall feelings concerning whether the course gave them a good fundamental background

**Table 3. Survey Responses from A & P Students.**

Q	SD	SD%	D	D%	SWD	SWD%	SWA	SWA%	A	A%	SA	SA%	Tot Resp.
1	5	4	9	8	8	7	22	19	43	37	28	24	115
2	7	6	7	6	9	8	29	25	49	43	13	11	114
3	8	7	6	5	11	10	18	16	36	32	35	30	114
4	6	5	3	3	6	5	23	20	49	42	29	25	116
5	6	5	2	2	5	5	13	12	46	41	39	35	111
6	5	4	5	4	5	4	35	30	42	36	24	21	116
7	8	7	10	9	13	1	41	36	28	24	15	13	115
8	5	5	6	6	12	11	21	19	36	33	28	26	108
9	4	4	7	6	16	14	21	19	36	32	27	24	111
10	4	4	4	4	11	10	25	22	30	26	40	35	114

1 = Strongly Disagree      3 = Somewhat Disagree      5 = Agree  
 2 = Disagree              4 = Somewhat Agree              6 = Strongly Agree

to better perform in the A & P course in which they were currently enrolled. On the basis of this survey, the department may be inclined to modify the Foundations course.

A Likert-type scale, with responses from 1 to 6 was used for this survey (Edwards, 1983). The responses ranged from strongly disagree (1), disagree (2), somewhat disagree (3), somewhat agree (4), agree (5), and strongly agree (6), and are shown in Table 3. Each question was individually graphed in order to determine the trends of students' responses (Figures 2-11).

## Results

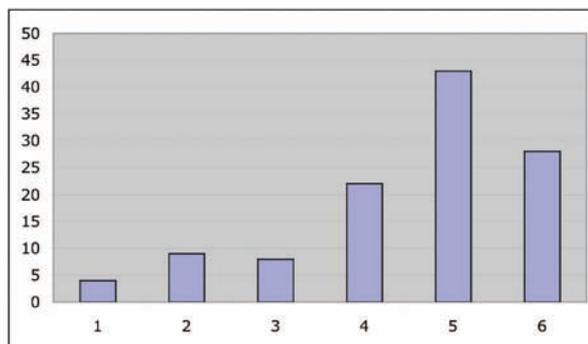
Figures 2-11 graphically illustrate results of the survey and clearly indicate that, on all questions, the majority of the answers were in the 3-6 range on the Likert scale. Students, in general, felt very positive concerning their preparedness for the A & P course. Question #10 showed an overwhelming 80% of students believing that the Foundations course provided them with the needed background to succeed in their A & P courses. All the graphs showed little variations in the "Agree" category, which would be expected for students who had passed the Biology Foundations course. On the other hand, the "Strongly Agree"

category demonstrated the degree of confidence that students had in their achievement.

On Question 1, students indicated that they benefited from the oral presentation on the cell organelle structure. Eighty percent of students agreed that they had learned a great deal about cell organelles from their presentations. Seventy-nine percent of the students felt they had learned how to collect and analyze data from the Vital Signs project. A large majority of students (87%) felt they benefited from experimental studies done during the laboratory sessions. The rat dissection exercise, that students performed in order to understand anatomical terminology and mammalian body structure, was a big hit with 98% of the students indicating that they had learned a great deal about mammalian anatomy. Eighty-seven percent of students agreed that they had received a good foundation in biochemistry.

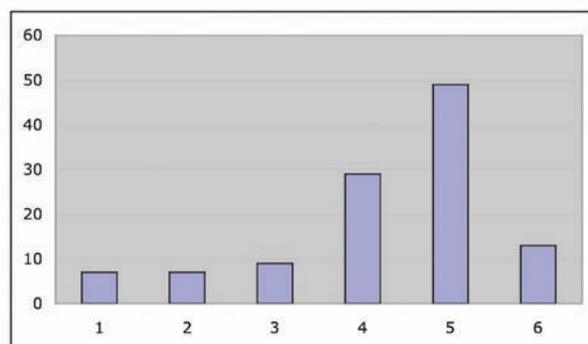
Students' responses were lukewarm concerning whether they had mastered learning the metric system, which is illustrated by weakness in the "Strongly Agree" category in response to Question #7 (Figure 8). Students' response to this question can be expected given their above-mentioned weakness in mathematics. The Tissue project was well received by students, with 85% feeling that they could more effectively identify tissue types and comprehend their function. The highest "Strongly Agree" designations were seen in questions concerning students' hands-on participation activities, such as the Vital Signs project and the rat dissection.

**Figure 2. Question 1: The oral presentation facilitated your understanding of cell structure.**



1 = Strongly Disagree      3 = Somewhat Disagree      5 = Agree  
 2 = Disagree              4 = Somewhat Agree              6 = Strongly Agree

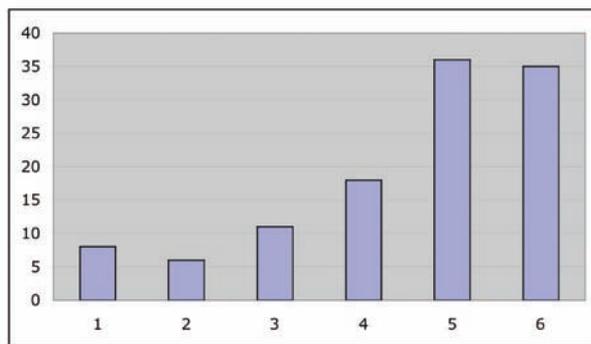
**Figure 3. Question 2: The written report facilitated your understanding of basic biological concepts.**



1 = Strongly Disagree      3 = Somewhat Disagree      5 = Agree  
 2 = Disagree              4 = Somewhat Agree              6 = Strongly Agree

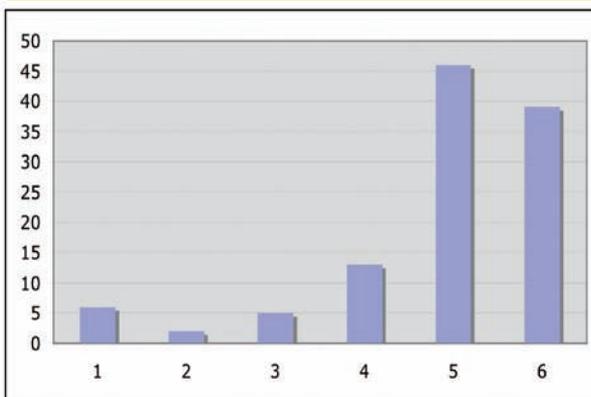
Figure 3, concerning the written report, illustrated a low rating in the "Strongly Agree" category. These results may be explained vis-à-vis students' language issues and the high

**Figure 4. Question 3: The Vital Signs project helped you to learn how to collect and analyze data.**



1 = Strongly Disagree    3 = Somewhat Disagree    5 = Agree  
 2 = Disagree            4 = Somewhat Agree        6 = Strongly Agree

**Figure 6. Question 5: The dissection of the rat aided you in learning basic anatomy and anatomical terminology.**



1 = Strongly Disagree    3 = Somewhat Disagree    5 = Agree  
 2 = Disagree            4 = Somewhat Agree        6 = Strongly Agree

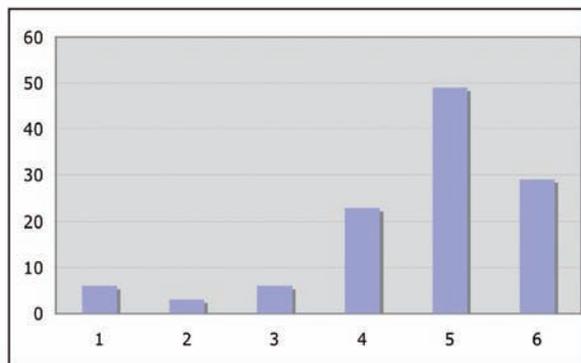
number of students for whom English is a second language. On the other hand, hands-on activities, such as the rat dissection, seem to help bridge the language barriers in education. Whereas languages may have different cultural explanations of a concept, hands-on experiences help connect these differences.

Students' responses to Question #9 (Figure 10), concerning the Cell Organelle project, demonstrated a high rating in the "Agree" and "Strongly Agree" categories. These results were expected because faculty teaching the course often reported students' enthusiasm in completing and presenting the project, which combines written, oral, and hands-on experiences. As previously indicated, an example of the Organelle project is depicted in the photograph in Figure 1.

## Discussion

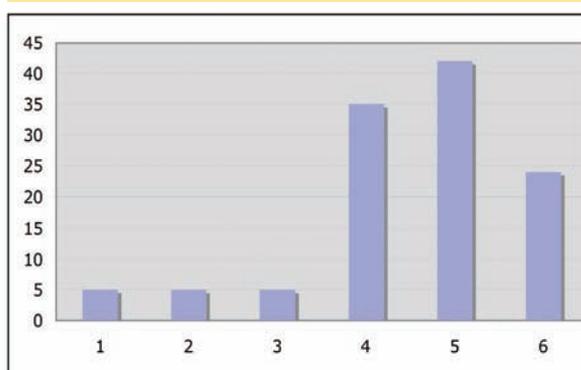
In the past, the effectiveness of college level biology courses was often evaluated by giving students pre- and post-tests (Allamong et al., 1975). These types of efforts did

**Figure 5. Question 4: The experimental studies performed in the laboratory (such as the enzyme experiment) increased your knowledge of the scientific method and how it is used.**



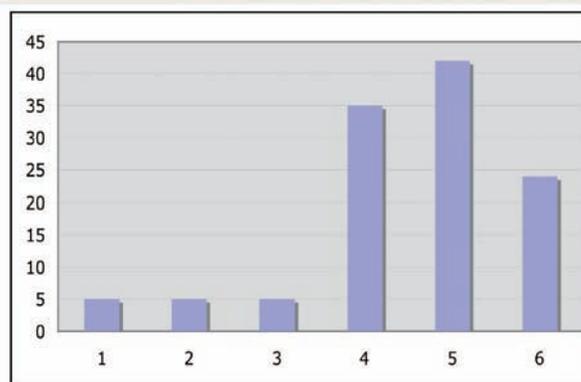
1 = Strongly Disagree    3 = Somewhat Disagree    5 = Agree  
 2 = Disagree            4 = Somewhat Agree        6 = Strongly Agree

**Figure 7. Question 6: The course material gave you a good foundation in the understanding of basic biological chemistry (inorganic and organic molecules).**



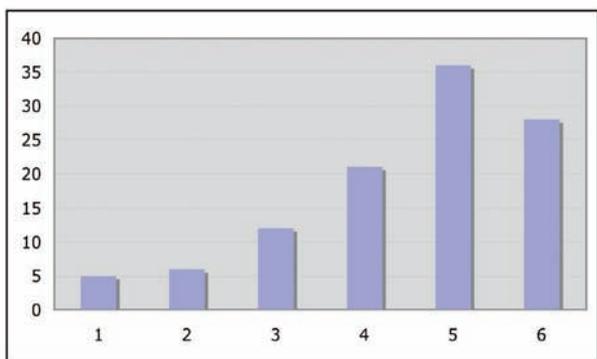
1 = Strongly Disagree    3 = Somewhat Disagree    5 = Agree  
 2 = Disagree            4 = Somewhat Agree        6 = Strongly Agree

**Figure 8. Question 7: The course facilitated your understanding of the metric system.**



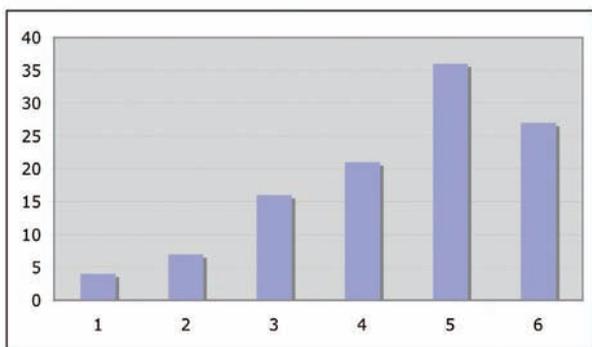
1 = Strongly Disagree    3 = Somewhat Disagree    5 = Agree  
 2 = Disagree            4 = Somewhat Agree        6 = Strongly Agree

**Figure 9. Question 8: The Connective Tissue project helped with your studies in Human Anatomy and Physiology class.**



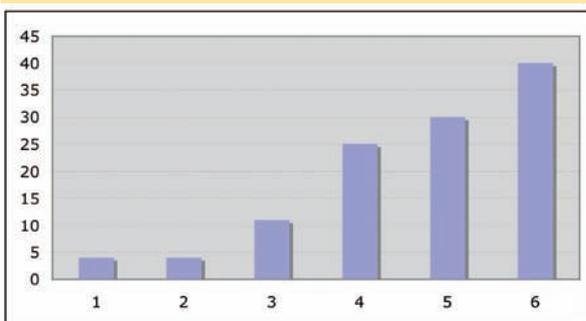
1 = Strongly Disagree    3 = Somewhat Disagree    5 = Agree  
 2 = Disagree            4 = Somewhat Agree        6 = Strongly Agree

**Figure 10. Question 9: The Cell Organelle project helped you with your studies in Human Anatomy and Physiology.**



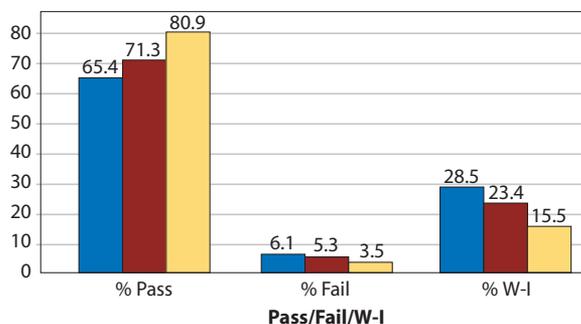
1 = Strongly Disagree    3 = Somewhat Disagree    5 = Agree  
 2 = Disagree            4 = Somewhat Agree        6 = Strongly Agree

**Figure 11. Question 10: Overall, the Foundations of Human Anatomy and Physiology class was beneficial to you in comprehending the subject matter of your Human and Anatomy and Physiology class.**



1 = Strongly Disagree    3 = Somewhat Disagree    5 = Agree  
 2 = Disagree            4 = Somewhat Agree        6 = Strongly Agree

**Figure 12. A & P Course Data from 1994 – 2004.**



N = 2527. Percentage Pass/Fail/Withdrawal (W)/Incomplete (I)  
 Blue = No Foundations or General Biology course  
 Red = Foundations course  
 Yellow = General Biology course

not necessarily achieve definitive answers to the question of effectiveness. However, the idea of questioning students concerning the assessment of a biology course goes back to the 1970s. Dowdeswell (1978) assessed a college level biology course for three consecutive years. Students and faculty both were given assessment questionnaires and their responses were compared in order to improve the course and correct any problems that were highlighted during the evaluation process.

In the present study, at-risk students assessed a college level Biology Foundations course and clearly indicated that they did benefit from the various aspects of the course prior to taking A & P courses. An informal study of a similar Kingsborough biology student population (Dawson, 2005) showed that 57% of those biology students felt that they also benefited from having taken a pre-requisite biology course prior to having taken A & P courses. In Dawson's study the prior courses were either General Biology 1 or a Foundations of Human Anatomy and Physiology.

An unpublished study (Figure 12) performed in our department (Pilchman & Zeitlin, 2004) indicated that students taking the Biology Foundations course or General Biology 1 had a higher passing rate in the subsequent A & P course when compared with students who had not taken either course. The study also indicated that fewer students failed and fewer students withdrew or took an "incomplete" from the group that had taken the Foundations course or General Biology 1.

In summary, students in our study responded very positively to the Foundations of Biology course. We suggested that our department consider incorporating more use of the metric system into the Foundations course, as well as in the subsequent A & P courses. Despite students' positive responses to the survey concerning the Biology Foundations course, some students still resist taking this course. Allied health students already have a full program, and an additional course may be difficult for them. We therefore supported the department's proposal to develop an online version of the Foundations course to help those students attempting to

pass an exemption examination. However, notwithstanding the difficulties that some students might have in fitting the Foundations course into their busy schedule, we feel that this survey's results confirm the course goals in providing students with a jumpstart to overcome the rigors of two semesters of A & P and get them on track for a hoped-for career in nursing or other allied health programs.

## Acknowledgment

We would like to thank Drs. Peter Pilchman and Arthur Zeitlin, Department of Biological Sciences, Kingsborough Community College/CUNY for providing the data shown in Figure 12.

**Note:** The Biology Foundations course is currently on hold and not being offered.

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