

# An Alternative Method of Instruction for Honors Students in the Life Sciences<sup>1</sup>



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## Abstract

Increasing class size and a subsequent reliance on lecture-based instruction are growing challenges facing undergraduate education in the life sciences. Within these confines, the opportunity for discussion and peer-directed learning are decreasing, making it difficult for honors students who readily grasp basic course material to advance their intellectual development. In an effort to more completely meet the needs of these students, the Genetics Department at North Carolina State University sponsored the creation of an Honors course for undergraduates interested in genetics. Enrollment was capped at twenty students to allow for a nontraditional course design including in-class discussion, debates, comprehensive exams, guest speakers, and service-learning. Peer-led discussion and debate assignments encourage students to develop a greater understanding of genetic concepts and social issues surrounding genetics while improving their communication skills. The service-learning project and guest speakers expose students to real-life examples of how genetics interacts with the greater community. Course evaluations indicate advanced students are receptive to this alternative course design, describing their experience as both demanding and rewarding. This article illustrates the components of the Genetics in Human Affairs Honors (GN301H) course that distinguish it from traditional pedagogy and discusses the potential benefit of this design in the instruction of honors students.

## Introduction

For gifted high school students, average class size and faculty-to-student ratios are important considerations when deciding on an institution of higher learning. At large, research-based universities, enrollment in many courses often exceeds one hundred, making interaction between a student, their peers, and the professor more difficult. In particular, the trend toward increasing class size has been noted as a concern in courses pertaining to science and technology (Kuh and Shouping, 2001). In

order to accommodate the growing number of students in life sciences courses, universities have often found it necessary to enlarge enrollment caps. The science curricula lends itself to lecture-based instruction, allowing for adaptation to larger class sizes, but ultimately inhibiting the use of more interactive methods of teaching.

The honors student is said to have a “greater proclivity to understand complex interconnections of ideas, enjoy theory, and learn by insight (Glutting, et al., 2000).” Laura Lunsford, Director of the Park Scholarships Program at NC State University, relates that honors students have the ability to learn faster and at deeper levels than non-honors students (personal communication). They have a tendency to push harder in classroom settings with other honors students as they are naturally stimulated by the interaction with their peers (Winebrenner, 2000). Academically gifted individuals may therefore benefit from nontraditional methods of instruction that challenge them to apply course material to real-life situations and encourage their active participation in the learning process (Campbell, et al., 1996). Unfortunately, growing class sizes limit the available time for and feasibility of class discussion, peer interaction, and innovative teaching techniques. Studies show that increasing class size also results in a rise in absenteeism as students feel they can perform equally as well by gathering the necessary information from textbooks and internet resources in lieu of attending class (Hassel and Lourey, 2005). For advanced students who more quickly comprehend the basic material and have a desire to uncover deeper issues, this type of learning situation may not be the most useful or productive.

While some believe that honors work is simply a matter of increasing quantity, educational experts disagree, suggesting that true Honors courses are delineated both by the depth of the material and the extent to which they challenge students' entire intellect (Watters and Diezmann, 2003; Winebrenner, 2000). The development of exceptional instruction for honors students can be difficult and time-consuming, particularly when under the confines of

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large class sizes and diminishing resources. However, the need for this type of instruction is apparent as traditional teaching methods may not completely address all aspects of a gifted individual's educational or professional development (Hoback and Perry, 1980). Honors students are in a position to fully participate in their academic and personal growth but require the commitment of the undergraduate institution to provide specialized courses that effectively hone their skills.

Not unlike many large universities, there is currently a paucity of Honors courses in the life sciences curricula at NC State University that effectively engage gifted students to reach their fullest potential. The traditional Genetics in Human Affairs course (GN301) at NC State explores the technical aspects of genetics as well as the science's impact on society. The course enrolls approximately 700 students per year and utilizes lecture, resource books, videos, and guest speakers to supplement the information provided in the students' course pack. Assessment techniques include objective tests, summary reports of recent genetics articles, and a research paper on a topic of the student's choosing. This format works well for most students; the course is populated by science, engineering, and liberal arts majors alike. However, the large class size restricts discussion and peer interaction, minimizing the opportunity for honors students in particular to further explore the in-depth impact of genetics on society. The desire to provide an alternative learning environment for more advanced students led to the creation of the Genetics in Human Affairs Honors (GN301H) course.

## **Methods**

Development of the GN301H course evolved from pilot work involving recitation sessions for honors students who utilized a discussion-based, peer-led teaching technique. These ideas were expanded to create a full-semester syllabus (example syllabus available upon request). The GN301H course was first offered during a recent summer session at NC State University. Students were informed about the course through e-mail announcements sent to all Life Sciences academic advisors, fliers distributed throughout campus, brief presentations in spring semester Biology courses, and an announcement on the first day of class in the non-Honors Genetics in Human Affairs section. Enrollment was capped at 20 students; seven students ultimately completed the first offering of the course. All of the students except for one were participants in either the University's Honors or Scholars Programs.

## **Course Components**

### **Discussion-based Classes**

Discussion-based learning is powerful in that it requires students to articulate to others and to

themselves what they understand and believe. Nancy Callanan, Director of the Genetic Counseling Masters Program at the University of North Carolina at Greensboro, suggests that discussion-oriented classes are the best way to learn about science as they help one "unfold all the layers of the issue, making it become apparent that nothing in genetics, especially when it involves humans, is black and white (personal communication)." In order to adequately present the required course material, some lecture is inevitable. However, many class periods in the GN301H course are based entirely on peer discussion. The advanced abilities of these students allow them to successfully learn the material and express their ideas orally, creating an intimate classroom atmosphere where students can feel comfortable sharing their opinions. This peer interaction can be difficult for some initially, but the consistent and frequent opportunity to speak both in large and small groups helps everyone gain confidence in their communication skills. Particularly at the beginning of the semester, round-robin questions (where a single question is posed and each individual in the group is given the opportunity to respond) are used during discussion to allow everyone the chance to participate.

### **Comprehensive Testing**

Because of the burden of grading tests for large class sizes and the amount of technical material that needs to be evaluated, exams in many traditional undergraduate life sciences courses are heavily weighted with questions that ask students to reproduce lecture information. While such exams can be challenging, they may fail to comprehensively appraise the ability of the student to condense course content and apply, synthesize, and form an opinion about it. By contrast, the testing format for the GN301H course includes an objective section, an application or short answer section, and a choice of two out of three subjective essay questions. This evaluation method helps tease out each individual's understanding of the course material and provides them an opportunity to demonstrate mastery in diverse ways. Additionally, since students must not only recall pertinent information, but also analyze and present it both as application and opinion, they may be more apt to truly learn the material instead of memorizing it for the purpose of the test.

### **Practicing Professional Oral Communication**

As discussed, the intent of the Honors course is not only to provide an educational opportunity for advanced students in the life sciences, but also to challenge these students to perform well in every aspect of their intellectual environment. Professional development requires the ability to succinctly articulate one's point of view, providing appropriate and compelling support for one's argument while being able to appreciate alternative opinions.

## **An Alternative**

Organized debate assignments make up 25% of the student's overall grade in the Honors course. Students select a controversial issue facing genetics as it relates to society (i.e., stem cell research, cloning, genetic testing, etc.) and are asked to prepare both the pro and con sides of the argument. Students submit an outline of their arguments to the instructor for review and guidance. Two class periods prior to the debate, students are informed which side they are to argue: pro or con. Regardless of the side they present, students are required to research both aspects of the argument in order to gain a greater, more inclusive understanding of the issues at hand and to develop an appreciation for the varying beliefs surrounding the topic.

## **An Introduction to the Professional Community**

In a course that emphasizes how science impacts society, creating opportunities for students to interact with the greater community is critical. Guest speakers can invigorate course material by illustrating real-life applications of the science and attaching a face and person to a concept. In the GN301H course, students connect with professionals working in genetics as well as families dealing with genetic disorders. For example, during the first offering of the course, students heard from a nutritionist working with the NC Folic Acid Council, a prenatal genetic counselor, and the husband of a woman affected with Huntington disease. These speakers were scheduled strategically to coincide as closely as possible with applicable course material.

## **Service Learning**

Service-learning is a relatively new phenomenon in undergraduate education. The roots of this collaborative form of scholarship date back to the early 1900s, but comprehensive programs did not begin in schools until the 1980s (National Service-Learning Clearinghouse, 2001). Service-based education seeks to unite the university with the surrounding community, fostering learning based on practical experience and exchange of ideas. Honors students often have a developed sense of social responsibility and enjoy working on complex community problems (Watters and Diezmann, 2003). A service-learning project offers them an opportunity to move beyond the discipline per se and engage in real-life applications of the science. The service-learning model promotes reflection on how the experience affected participants as individuals, as students, and as citizens. This type of reflection is rarely a part of the classroom environment and yet it encourages students to intimately connect the course material to their own lives and the lives of others in their community.

Students in the Genetics in Human Affairs Honors course participate in a service-learning project dedicated to providing information to the

local community about the importance of taking folic acid. Maternal consumption of folic acid during the first few months of pregnancy helps prevent neural tube defects, a congenital condition involving a disruption in the prenatal development of the neural tube. The severity of the defect relates to its positioning along the spine. The more anterior defects result in the most severe symptoms and can be fatal if brain development is affected. Neural tube defects demonstrate multifactorial inheritance, meaning that both genetic and environmental components interact to cause the condition (Czeizel and Dudas, 1992; Nussbaum, et al., 2001). In recent history, North Carolina documented one of the highest rates of neural tube defects in the country (North Carolina Folic Acid Council, 2002). In response, the NC Folic Acid Council launched a widespread education campaign to help women of child bearing age receive the message about the preventative effects of taking folic acid (North Carolina Folic Acid Council, 2002). Recently, this education campaign has been expanded to include men and the elderly as additional research suggests folic acid may be important in the prevention of certain types of cancer (NIH Clinical Center, 2002). This public health issue provides a concrete example of the interconnection of genetics and the environment. As such, it is a valuable experience for students in the GN301H course to become involved in the education effort by supplying information about folic acid and its benefits to patrons at a large, local grocery store. In addition to written materials, using departmental resources, students purchase and distribute foods high in folic acid to offer a tangible example to patrons of daily food items that can be used to supplement their folic acid intake. In conjunction with the actual service, students complete a five-part journal series, a training session on folic acid given by one of the state's nutritionists, and a reflection session led by staff from the University's Faculty Center for Teaching and Learning.

## **Course Assessment**

Reflection and evaluation are consistent components of the GN301H course. The goals of these processes are to promote the personal and academic growth of the students as well as to aid the instructors in assessing the effectiveness of the course design. In addition to informal feedback, after each major in-class discussion, students complete a written reflection. The first portion relates directly to the discussion while the second portion asks their impression of a specified aspect of the course (i.e. service-learning, debate, reading assignments, etc.). Themes that emerge from the in-class reflections are shared with all students the next class period. This evaluation process preserves the reporting individual's anonymity while allowing all students to benefit from the collective reflection of the class as a whole. The overwhelming majority of students indicate that the discussion-based format of the course is their

**Table 1. Responses from Student Evaluations of GN301H Course**

Question	Responses
Would you recommend GN301H to your peers <input type="checkbox"/>	Yes (100%) No (0%)
What things would you highlight about the course <input type="checkbox"/>	Small class size (33%) Service-learning project (50%) Comfortable, open atmosphere (33%) Debates (17%) No cumulative final (17%) Opportunity for in-depth discussion (17%) Professor's enthusiasm for teaching (33%)
What things might you warn them about <input type="checkbox"/>	Frequency of writing assignments (33%) Difficulty of debate expectations (33%) Amount and depth of required work (83%) Participation requirement (33%)

favorite component. One student said, "Discussions help everyone understand and appreciate diverse opinions as well as help each individual solidify for themselves what they really think and believe."

In addition to the Department of Genetics' standard course/instructor evaluations, students are asked to complete a more comprehensive evaluation requesting their feedback on the overall course design and teaching methodology. Students submit this reflection anonymously and are encouraged to communicate freely and honestly about their experience in the course. How students represent the course to their peers is of particular interest, given that course demand in future semesters is, in part, related to the opinion of current students. Evaluations from the first course offering suggest students find the GN301H course challenging, but rewarding and would recommend the course to their peers. Specific questions and student responses from the comprehensive course evaluation are presented in Table 1 for further review.

### Summary

The importance of exceptional education for honors students in the life sciences cannot be overstated. While an appropriate and challenging education is possible for these students without the addition of specialized courses, their academic and personal growth may be more completely addressed with opportunities like the Genetics in Human Affairs Honors course. The positive feedback received from the students in this course suggests their endorsement of the course design and their commitment to actively participating in the educational process when given the opportunity. Future studies comparing the effectiveness of non-Honors and Honors GN301 course components on specific learning outcomes are needed to fully understand the impact of the proposed course design. Courses utilizing non-traditional teaching techniques similar to those articulated in this paper need to be developed and tested throughout the life sciences curriculum.

Individual instructors and academic departments will require the collaboration and support of the university's administration to adapt and implement these techniques in their respective academic settings.

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