Interdisciplinary Symposium Keynote I
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Goals and Criteria for Interdisciplinary Teaching

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I'm a faculty member in History and part of the Program on Science, Technology, & Society courses. As you know, STS courses will migrate into the new Interdisciplinary Perspectives category – so it would seem we STS faculty should have something to offer about our experiences with interdisciplinary scholarship and teaching. My field is the history of biology, rooted in the disciplines of ecology and evolutionary biology and history. I've done interdisciplinary research, both in my own work and in collaboration. At NC State, I've taught every level from first-year to grad students. I've used just about every model of interdisciplinary delivery – solo integrative courses, team-teaching with faculty from other disciplines, lecture courses, seminars, inquiry-guided, and even a weak attempt at course linkage. Today I'll present my own particular take on interdisciplinary courses – although I'll talk about my experiences, they're informed by much discussion in my department and college. And I want primarily to provoke discussion, not expecting that I'll lay out some master plan. These are not limiting models but concrete examples of delivering interdisciplinary teaching, to help in the later discussion this afternoon.

We have a good starting point for continued faculty elaboration. The Task Force gave us general definitions and goals, and some structures that we might want to tweak. I don't want to reopen the entire discussion. But I will suggest some guiding principles for how we might judge what kinds of courses or delivery we accept.

The first question to address then is the value we see added to general education with the IP category. In the design of the new GEP plan, we have devoted two of the twelve courses in general education to IP.[1] I don't think we've seen agreement on what this implies. So I'll comment on some core assumptions and their implications for our interdisciplinary teaching.

Assumptions:

1. High value of interdisciplinarity as an experience and foundation for later integrative understanding.
2. High value of interdisciplinarity as a method.
3. Problem that our students cannot do interdisciplinary integration.
4. Two courses are necessary to accomplish the goals of interdisciplinarity in general education.
5. The 38 hours of General Education will be taken during the first and second years.

I hope that opening some questions about definitions and goals will help reveal what we want. And that will lead to suggestions, for our discussions, about strategies for course design.

Comment on #1 : High value of interdisciplinarity as an experience of and foundation for later integrative understanding.

It's easy to accept the value of the Task Force's goal for the IP category in general education:

> To prepare students for a complex world that will require them to integrate the knowledge and skills that they learn in their majors with the broader understanding of multiple modes of inquiry that they will acquire through general education.[2]

The key phrases for me are **integrating knowledge and skills** and **multiple modes of inquiry**. The Task Force retained the design of a general education via structured curriculum, rather than a free-choice "cafeteria" approach. Thus in the new GEP we will have choice within required categories – a cafeteria with essential food groups? This recognizes a desirable breadth of education, grounded in the disciplines. Our students at least will be exposed to the strengths of the research disciplines across the university.

The label of "Perspectives" notes the value of integration also as a mode of research and creativity. The intent is not to suggest the obsolescence of disciplinary knowledge, or disparage the disciplines. What we have is a new explicit objective, to add something more to our

students' general education. "Modes of inquiry" implies a distinct experience with **problem-solving**.

In discussing Interdisciplinarity, we should avoid cheerleading, or assuming some singular value or accomplishment of interdisciplinarity. Individual problems can have quite different degrees of integration and contribution from their contributing disciplines. Sometimes bringing a new, interdisciplinary perspective to a problem does not create new synthesis or integration. Instead, it might break down a synthesis or rearrange the foundational principles of a problem. Finally, some disciplinary problems really don't need it.

Notice that nothing is being said about the value of knowledge or content. There are no particular interdisciplinary theories or explanations that a student should know. The focus is methods brought to a problem or topic. The criterion for course suitability, then, should be evidence of bringing multiple questions, evidences, and explanatory styles to bear on an issue.

Comment on #2: High value of interdisciplinarity as a method.

However, there is no universal method of interdisciplinarity. There is no "field" of interdisciplinary studies. A common definition for discipline is "a socio-political organization which concentrates on a historically linked set of problems."[3] There is plenty to indicate that interdisciplinarity exists in American universities as a socio-political organization. There are specialists devoted to issues of definition and goals, pedagogy, and institutional support in the academy. But there is no field of interdisciplinary studies because there is no core knowledge, no set of explanatory concepts and facts. Nor are there the shared problems of the kind that bring scholarly focus to a disciplinary community. Thus it's harder, in practical terms, to determine **which faculty who** should set criteria for courses. It's easier to determine **what** Interdisciplinary Perspective means.

Interdisciplinary "Perspective" is best described as an **approach** to **problem-solving**. Although "Interdisciplinary Studies" is a grab-bag of individual problems, a common goal is integrating knowledge or methods from multiple fields. Let's use the Task Force Rationale to emphasize what courses must demonstrate throughout their design:

1. to synthesize knowledge and skills essential to the understanding of **complex problems**,
2. to make **connections** between fields of study,
3. to consider more than one disciplinary **approach** or methodology, and
4. to bring to bear the **insights** from two or more disciplines in examining and/or responding to the complex problems facing our world.[4]

Such an emphasis on approach, rather than defining some particular content, is appropriate. This follows our model for the disciplines themselves, as the Task Force has asserted that in general education it is "critical for students to gain an understanding of how a variety of disciplines approach questions and problems."[5] Notice that the goal evades the issue of precisely what knowledge constitutes a college-educated person. Take, for example, the rationale for the category of natural sciences:

> Training in the natural sciences is essential to help students develop skills to distinguish between testable and un-testable ideas, recognize scientifically valid tests of theories, and understand how information relates to those tests. By studying the natural sciences, students learn to reason both inductively and deductively, develop and test scientific hypotheses, and understand the value and limitations of scientific studies. [6]

This is valuable as the foundation for future learning – the skills of investigative methods and explanatory styles become primary goals. As in my field, for instance, it is not history of science to chronologically list a series of events or scientific discoveries. Without historical modes of investigation **and** a narrative explanation that connects human activities to motivations and circumstances, it isn't history.

Many of my colleagues have been rightfully concerned with the rigor of IP courses. Taken too superficially, applying disciplines with little student preparation abuses the rigor and integrity of the constituent disciplines. I'm not saying it's impossible, but this is one boundary condition for good interdisciplinary teaching. If integration, or an enhanced understanding, is to emerge, it must be grounded in the disciplines. The notion of "leverage" is useful – the student learning how new possibilities emerged by using more than one set of questions or explanations. That's something I see reflected in the Task Force's defined Objectives for Interdisciplinary Perspectives courses:

Each course in Interdisciplinary Perspectives will provide instruction and guidance that help students to:

1. explore and synthesize the approaches or views of two or more disciplines; and
2. identify and apply authentic connections between two or more disciplines; and
3. distinguish between the essential concepts of the individual disciplines.

What we really want are strategies for bringing more than one discipline to bear on a problem.

Let me give you an example of what I do and expect in my STS class, HI 322: The Rise of Modern Science. The overarching theme of the course is a consideration of how science develops and changes. I expect that students already possess, from general education or their majors, much of the perspective of the practicing scientist or engineer. My role is demonstrate what a historian brings to the understanding of scientific activities. Students start with an understanding of science as a model of rational construction – the scientific method, explanatory systems for particular fields, how hypotheses are supposed to be generated and tested, and how theory is adjusted. I teach how, by asking historical questions, to analyze this idealized version of how science is supposed to develop. Has it worked like that? How did those standards develop? How do scientists work, more broadly, in their social context or circumstances?

In teaching, how do I get students to "distinguish between the essential concepts of the individual disciplines"? I model for them the activity of the interdisciplinary scholarship of science studies. In the lecture presentations and readings, we draw back from the empirical material (ideas, events, circumstances) and explicitly highlight what we gain by posing the historical question. I also guide or coach students through assignments to practice such analyses.

An example of a student activity – to create awareness of interdisciplinary analysis – is their study of Thomas Kuhn's model of paradigm shifts. For a scientist, scientific revolutions are often a model of how they see their fields, run by paradigms. This is an intersection of social construction with rational construction of evidence and logic. Through their case studies, students become aware of the contrast of perspectives. I prod students to consider what is the best, more complex explanation they can construct.

The integration is an understanding the student may acquire. I don't expect the most advanced or sophisticated synthesis or creation of new explanations, but I believe I accomplish

the goal of general interdisciplinary education. Students learn how to think more broadly about how science develops. They have tools for considering the conditions that limit or promote science, what social structures might be necessary for the ongoing nature of discovery and application. At an introductory level, this fulfills an essential goal of IP – a foundation for awareness of how a question gains new insight by engaging a second scholarly approach. I don't think it's necessary for us to demand too much synthesis, new explanations, or even very deep ability to apply the disciplines.

One conclusion here is that we should avoid the common notions of hierarchy. Or that what we want is restricted to one type of inquiry or one level of result. I would reject, for our general education goals, the distinctions presumed between

> **Multidisciplinary** – separate contributions that selected disciplines make to a problem, not concerned with integration.
>
> **Cross-disciplinary** – one discipline having hegemony over the other, such that one becomes a passive object of study rather than an active system of thought.
>
> **Interdisciplinary** – integration of the contributions of several disciplines to a problem, as necessary, more comprehensive and self-conscious perspective for addressing complexity.

I am more interested in students experiencing an approach to problems and questions, at any of these supposed levels. The type of disciplinary play that is valuable depends on the problem and the goals of the practitioner. All "levels" have value for our goal in general education.

Comment on #3: Problem that our students cannot do interdisciplinary integration.

There is widely differing opinion on this one. I admit being uncertain about the level of attainment we can expect. An inevitable concern with IP in general education lies with inadequate breadth and depth of preparation in the disciplines, in particular for many of us who highly value serious interdisciplinary work. To keep general education to 38 hours means relatively little experience with any discipline. In addition, a frequent assumption is that general education courses should be open to all students, without prerequisites or expectations of

background knowledge beyond high school competency and our admissions standards.

Our Assessment in History has revealed a fairly common problem. Even advanced students in the major have difficulty integrating multiple evidences and sources, and resolving competing explanations. With our History majors, we spend much time in introductory classes talking about, and getting students to try, the posing of appropriate historical questions, the nature of evidence and sources, the varieties of explanation. We don't expect the results to be well-formed and sophisticated in the earliest courses. It takes a few years of guidance and practice.

So how can we expect sophisticated use of history in interdisciplinary courses? More generally, it raises the question of whether students have enough disciplinary background and depth to realistically engage with interdisciplinary work in their earliest studies. We need to define the level of engagement and accomplishment we expect in a general education course.

It's easy to teach my history of science course when students are mostly engineers or scientists. I can assume a solid knowledge of the relevant physics and chemistry, although they might have little background in biology and social sciences. But we have a shared foundation to draw on, deep enough in the science to be able to move to a new view of it, going through the ideas and logic of those sciences, while expanding into the social and historical constraints and conditions that interact with ideas. With students from non-STEM majors, it's harder. To achieve integration in the course forces me to teach some of the science simultaneously with the historical analysis – so that's what I do. I just can't expect to do as much complex, synthetic interdisciplinary work if we're creating disciplinary foundations in the same course.

Thus I'd want to scale back expectations for general education IP, acknowledging the degree of disciplinary work needed to do IP in the most sophisticated manner. We don't have to expect the most advanced level of interdisciplinarity in general education. We can at least envision students working through examples of how a problem might be approached, and being able to articulate an awareness of different methods and questions on a problem. Good interdisciplinary work can be modeled for students, without expecting them to have the disciplinary skills and knowledge to deeply integrate. Exposure to how a field has used interdisciplinarity, such as a survey of case studies or a readings course, is valuable. All we need require, as the Task Force has stated, is "sustained, rigorous, and substantive instruction."

But I also don't want IP-Lite, of the sort of course seen in so many examples from the literature on interdisciplinary teaching. As a historian of science, I routinely see how popular accounts of scientific development are used in science teaching or commentary, and how misleading or simply mistaken they can be. There is a field of scholarship here, revising knowledge through ongoing research, and as a research university we would hope some standard of rigor would apply when we talk about Interdisciplinarity. We don't want courses with 13 weeks of disciplinary material, with an intro week of "history" and a last week of "social impact" tacked on.

The STS Progam faculty are a model for how to address this problem. Keep in mind that STS means two distinct things on this campus. There is a field of faculty scholarship, and they are the core faculty for the undergraduate major and minor. At a broader level, STS also means a General Education category. It is intended to insure that our students graduate with an academic course that has helped them develop and understanding of the mutual relationships between technical knowledge and society, and to be able to critically evaluate such relationships. The STS steering committee includes faculty from across several departments and colleges.

For STS course criteria, CUE charged the STS Program faculty to write the standards. I suggest a similar advisory body of interdisciplinary faculty – that is, those faculty who have demonstrated such an approach to problems in their research and teaching. In the STS example, we faculty produced the definition, some guiding suggestions, and the objectives that a course should meet. We still review courses in an advisory role, but hope also to act as a resource for feedback in development of courses.

The STS Program faculty – historians, political scientists, communication scholars, philosophers, and other disciplines of Science Studies – have adopted a "bit-tent" approach to STS courses in general education. A wide range of courses fulfills the rubric, not limited by the finer definition of our scholarship. We realize that not every course includes the type of scholarly rigor and research from, say, history, or philosophy, or communication studies, or political science, that we would do. We don't expect that every course should. The primary requirement is that such courses emphasize a sustained and rigorous interaction, and how the topic of the course draws on a variety of sources and perspectives. Courses must at least seriously address social effects and critical analysis. This is the reason why 138 STS courses are going to migrate into the new Interdisciplinary Perspectives box – they supposedly all fulfill such

an approach to a topic or problem. Such rather catholic breadth, even looseness if you will, is my suggestion for IP courses.

A rubric for guiding such considerations of satisfactory IP courses must deliver the ability to ensure "sustained, rigorous and substantive instruction that focuses on the content and approaches of two or more disciplines."[7] From my experience with the STS program, I would add the language of our extra criterion. The "efforts to meet the objectives should be evident across the entire syllabus and be reflected in course lectures, discussion, readings, projects, [and] assignments."[8] That's how we hope to keep out the superficial courses. Bio Sci 181, the introductory course, does not become interdisciplinary just because I come for a class session or two to talk about the history and social implications of Darwinism. I've done that, and I hope I've added value to the biology course, but it isn't a sustained use of disciplines throughout the course.

A valid example of sustained instruction would be my teaching with Roger Powell from Zoology, about the history and structure of evolutionary theory. We treat the history and the biological concepts in concert. It's a reading course with two faculty in the room, both trained in the science, both culturally and historically aware, each of them having done the cross-readings. Rog the zoologist has read biographies and contextual studies, and engaged in much discussion with me. I'm trained in the evolutionary biology but work from the historical perspective. We have both shared and distinct views on the structure of evolutionary theory, informed by our perspectives and research. We end up posing new questions about both the origins and nature of the theory, structured through every week of readings and discussion.

Comment on # 4: Two courses are necessary to accomplish the goals of interdisciplinarity in general education.

I'll take it as a given that it's too late to argue that two courses in IP is too much in the balance of general education. But a related assumption is that we expect a *course* to integrate the disciplines, rather than a *curriculum*. To be really brief here, I suggest that we will need to tweak the GEP for some majors. Some are interdisciplinary fields by definition, such as STS or biomedical engineering or even a composite science such as genetics. They do not need more IP

courses in their general education. I suggest we substitute more "Additional Breadth" courses for the general Interdisciplinary Perspectives requirement. I would keep the wider experience of the course that must integrate the humanities/social sciences and STEM perspectives.

Comment on # 5: The 38 hours of General Education will be taken during the first and second years.

This does not need to be the design – and of course so many of our students don't track through the curriculum in this way. Our degree plans don't even structure it in this way. For years, my introductory STS course has been populated with juniors and seniors, waiting until late ed to fulfill this GER slot. It's clear that they have the best experiences in my class. In evaluations and conversation they tell me how they are glad they waited, that it makes more sense having had a range of classes, that they are ready for this broader consideration now. As freshmen, they were more focused and overwhelmed in engaging the fundamentals at the college-level. I consider this a valuable empirical result from theirs and my experience, and suggest that we encourage one or both of the IP courses to be taken later in the student's curriculum plan.

I can see two goals, and two types, for IP classes. One goal is the exposure class, designed or suitable for early in the curriculum. That is to get students to become aware of field they might want to explore further, because they've seen its application on a problem of interest. This is what Haynes call cross-disciplinary, but I think it's perfectly adequate for what we expect in general education. But advanced courses will be even better at satisfying the rationale and objectives at the fullest level of experience. This is also a way to turn a seeming problem into an opportunity. We require two courses, and some faculty feel students don't need it and others worry about lack of rigorous preparation or weak courses. If we think of the two separate goals of IP courses, it somewhat resolves the problem. Again the STS model applies. STS has intro courses open to anyone and upper level courses nonetheless on the general education list. Of course, for upper level history, there is a prereq of 3 hours of history. So we have precedent for later general education.

In the Jefferson Scholars program, this is actually what we're doing now. We start with a

first-semester seminar class in Plant Biology, taught by my colleague Bob Beckmann, on the role of plants in civilization, especially the cultural and religious and mythical uses and meanings of plants. Our biology students are immediately exposed to broader perspectives, a wider view of the meaning and place of their science. They engage again with interdisciplinary work in Spring of their junior year. They take an advanced history of biology class with me, where they examine their biological knowledge with historical and philosophical analysis. By this time, they usually have earned at least 75 credit hours. That is, by the time they take my course, they've had twice the hours required in GEP, and they bring a wide range of experiences to the class. They have more preparation in history, more analytical skills, and deep knowledge in their biology major. They are more ready to think outside their disciplinary development, ready to take a fresh look at their knowledge from other approaches. Not surprisingly, they do well with integration.

So let's avoid the notion that all Gen Ed belongs in the first one and a half semesters. We should promote interdisciplinary courses for students in their junior and senior years.

We will have to be vigilant about advising students that some GEP will be fulfilled in their senior year, and they will be expected to have had some courses that feed into what they pick. But if we want the deepest interdisciplinary engagement, we should admit that it might take more than 32 hours of general preparation to be ready. Perhaps then we can also lower our worry about their lack of preparation. I believe later courses will better suit their intellectual development and maturity, their readiness, ability, and interest in broader synthesis. And that's our goal for interdisciplinarity as a category.

Summary: The Big Tent of inclusive definition

- Resist hierarchies of interdisciplinarity and encourage a wide variety of interdisciplinary courses, driven by faculty interest in problems.
- Encourage courses from introductory to advanced levels, and scale our expectations to course level.
- The defining rubric is the evident structure of interdisiplinarity throughout the design, syllabus, readings, and student work.
- Include advanced courses in the General Education goal.

NOTES

1. 10 courses in the disciplines (32 hours), for simplicity ignoring 2 hours of Physical Education.
2 courses of Interdisciplinary Perspectives. One course must integrate disciplines from the humanities/social sciences and from math/natural sciences/engineering/technology.

2. General Education Review Task Force (GERTF), *North Carolina State University General Education Plan: Effective Summer II 2009* [Approved by the Provost, February 1, 2008], p. 6.

3. Undocumented citing of Newell and Green in Carolyn Haynes, *Designing and Teaching an Interdisciplinary Course*, Resource Manual developed for "Teaching Outside the Lines" Workshop, John Hope Franklin Humanities Institute, Duke University, p. 5.

4. GERTF, p. 9.

5. GERTF, p. 6.

6. GERTF, p. 27.

7. GERTF, p. 8.

8. GERTF, p. 28.