Physics and the Arts

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Preface

The physical sciences and the arts are often perceived as being antithetical. Scientists are supposed to be emotionless, detached, and concerned with objective descriptions of the physical world, while artists are passionate and unconstrained by everyday rules. In fact, many scientists are passionately involved with their subjects, and see beauty in both mathematics and nature, and artists are both influenced and constrained by the physical laws of the world around them. For example, a painter may depict scenes that are literally fantastic, but must still use physical pigments on a physical canvas to convey that message. This seminar attempted to explore the interface between physics and the arts.

We began with an exploration of musical acoustics: what are vibrations and waves, what is sound, and how are sounds produced in musical instruments and perceived by humans? This portion of the seminar was quite hands-on, and the Fellows made numerous measurements on vibrating strings, air columns, etc. We then moved on to a discussion of the visual arts, and painting in particular. How do pigments work, and how are colors described by artists and scientists respectively? What is the mathematical and optical basis for the artist's "trick" of using linear perspective to give the illusion of three-dimensional depth on a flat canvas? Our third topic was the physics of dance, and we saw how concepts such as force, acceleration, and angular momentum guide the movements of a dancer even though the dancer herself may describe what she is doing using a very different language. Finally, we examined physics in the movies, using clips from films as diverse as *Crouching Tiger, Hidden Dragon*, *Hulk*, or *Looney Tunes* cartoons. In each case, we started by asking whether the physics in the movie was "correct" or not, and if not (as was usually the case), we asked whether this was accidental or a deliberate choice (for example, for humorous or dramatic effect).

A common theme in all of our investigations was the tension between art and science. The artist often has a different language for describing what he or she does, and may even disagree vehemently with the scientist's description. Does this matter? Would a better understanding of the underlying science empower the artist to do better work, or should the scientist just get out of the way?

The Fellows in this seminar went quite different directions with their curriculum units. Three of them (Rosalind Echols and Vijayalakshmi Kari, high school physical science teachers, and Rita Sorrentino, an elementary school computer/technology teacher) chose to directly adapt the musical acoustics material from the seminar to a format appropriate for the age and grade levels they were teaching. Bonnee Breese, a high school English teacher, went further with the theme of physics and film, and developed a unit combining concepts of film, animation, and literature. Moses Jackson, a high school mathematics teacher, incorporated aspects of physics, music, and art into a unit that presented mathematical concepts with a unifying theme of "patterns". Krishan

Wadhwa and Anne Cherian, also high school mathematics teachers, developed units that taught mathematical concepts and techniques using the physics of kinematics (the description of motion) as their tools. And finally, Stuart Surrey, a high school physics and chemistry teacher, developed a unit on atomic structure, with a historical perspective.

Collectively, these units will provide a valuable resource for teachers wishing to present these topics in their own schools. In addition to detailed lesson plans, the Fellows were also in many cases able to identify valuable teacher and student resources, both in printed form and on the web, which could be used both in development of new curricular units or in enhancing existing units.

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