## MechAnimations! Designing Mechanical Linkages that Animate Stories

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**Question(s) for Discussion:** What do students learn through analysis and design of mechanical linkages; and how can teachers be prepared to support students in developing concepts of motion, force, modeling, systems, and design?

**Session Description:** The purpose of the session is to explore strategies for preparing teachers to promote mechanistic reasoning, troubleshooting, and design thinking in elementary classrooms. The strategies have been developed by the Physical Science Comes Alive project as part of its *Force & Motion* curriculum units. The unit for grades 2 and 3 is based on the analysis and design of MechAnimations. A MechAnimation is a decorated cardboard linkage that is designed to tell a story. For example, one MechAnimation shows a hand trying to catch a butterfly. As the input link is pushed towards the right, both the hand and the butterfly move to the left. Depending on the locations of the pivots, the hand may undershoot, overshoot, or actually catch the butterfly. Elementary students study existing MechAnimations and try to reproduce their mechanical movements by making pegboard models. They learn to identify inputs and outputs and determine their directions of motion. Then, they explore how to combine mechanisms in parallel, control the relative directions of input and outputs, and control the amounts of motion of each. Often, their constructions don't work as they want, so they learn to troubleshoot, for example, to correct undershooting or overshooting. Eventually, they design and build their own MechAnimations, using pegboard models to design the mechanisms.

During the first half hour of this session, participants will engage in sample MechAnimations activities from the Physical Science Comes Alive project. First, attendees will examine sample MechAnimations, whose mechanisms are hidden, and be asked to identify the relative directions of motion between the input and outputs. Then, they will be challenged to create pegboard mechanisms that model the sample MechAnimations by producing similar movements. The next half hour will focus on what students learn through these and related activities and the teacher knowledge needed to achieve these outcomes. Participants will be asked to reflect on their own experiences in learning to make the mechanisms, and the forms of support provided (or not) by the session facilitators. Attendees will use this information to discuss the knowledge of content, pedagogy, and student thinking that elementary teachers would need to support similar activities with their students. What roles should be played by printed and electronic curriculum materials, professional development workshops, and/or school-based systems of support? In the concluding 15 minutes, the presenters will share their own experiences in exploring student thinking and using research outcomes as a basis for supporting teachers. Lehrer will describe research in inner-city Nashville focusing on how children think about the kinds of mechanisms that participants will have already explored. This research has informed the design of curricula and professional development for the Physical Science Comes Alive project. Benenson will provide an overview of the strategies being used to support pilot-test teachers who are implementing the curriculum in two low-income communities in Central Brooklyn. Both presenters will use their own experiences to suggest how curriculum designers, teacher educators, and researchers might collaborate in developing strategies for supporting teachers.