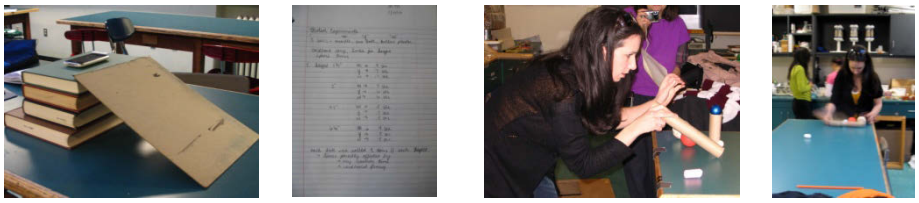
Discussion Highlights

The visit to the exhibit of historical scientific instruments at Harvard College fascinated each of us. MC describes how she is more aware of the design and function of instruments. Her awareness piqued; she is noticing more details and is checking what she thinks she knows to what she sees. Reading historical documents offered all of us an enlarged perspective of Galileo and the history of science. LJ and TA were surprised to see their diagrams in Kepler's book *Dioptrice*. MC studied sunspots. YY is thinking more about role of the craftsman and other unnamed individuals who contribute to scientific thinking and development. LJ is more curious about Galileo – what is he seeing? Who is he talking to? What is happening around him that contributes to his thinking? "It makes me want to know everything around him." "How can you teach science without situating it in the times?" JF commented on the value of hands-on exploration and the power of playing with the materials. "Everyone can take away something from hands-on; I think playing is very important." Therese speaks about teaching and using recreating experiments in history as a methodology for teaching science in public school setting. She is wondering about "How do you take episodes from people's lives and frame them so kids that are 10 can make sense of it for themselves."

Figure 1: "This was on page 19 in Dioptrice (on right)."

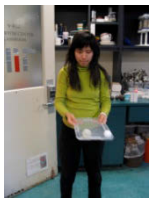
Motion Explorations

Elizabeth reads the conventional wisdom or everyday accepted way of seeing motion at Galileo's time "At beginning of his teaching he is presenting motion as dependent upon lightness and heaviness. Why would he teach this? Can you see motion as talked about in these statements? Can you see how these ideas might be challenged?" We explored inclined planes asking questions such as (1-4) "If I roll 3 different balls at different heights, how long will each take? "

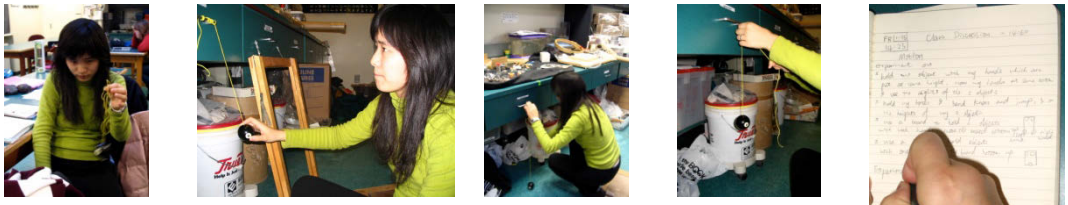


(5-8): "How far do they go?" "I'm convinced these two are the slowest." "Wouldn't they all move at the same speed? Does it have more to do with friction?" "Did Galileo talk about friction? I don't think he did." "The two that are the slowest have bumpy surfaces." "Maybe the floor is not flat."

(9-15): "I am exploring with the properties first, then I am going to decided what to do." "The solid objects roll faster than the objects that are just a shell." "It's true, the solid sphere will travel faster than the spherical shell."



(16) YY is exploring motion of two balls "How will they travel?" "Maybe I can use a board. This is better, then I don't have to worry about my hands."



(17-21) She then investigates pendulums, recreating Galileo's experiment. "Does it matter if I put the [ball] it here or pull it further?" "How can I

see that?" "How long will it take [the ball] to do 10 swings?" "I feel that if the ball is further away from where it was it took longer to swing." "Now I am trying different lengths of the rope. It moves faster if the string is shorter."

(22-27) LJ and JF move on to experimenting with balls and water. "I wonder if there is anything that would sink to the bottom of this container." "This one is heavier, but it has more surface area. That one is always floating. That one is too!" She pours water in small increments into tank, observing which balls float and when. She is puzzliing over who much of the ball is below the water when floating. In goes the baseball, it floats. "Oh that was unexpected" "I didn't expect that either", remarks Elizabeth" "Interesting… cool. See that was totally unexpected. I love things like that." "This is fun! It is hard to hold it down." LJ remarks as she pushes different balls down and quickly releases the balls. She continues experimenting wishing she had a scale to measure weight. Elizabeth later comments that the progression of activities that LJ has gone through is very similar to the investigations described by Galileo in one of his writings. "Yeah, I am turning into Galileo!!"

(28-32) YY explores motion of balls in a circular pan. She investigates how long it takes balls of various size and weight to come to a complete stop. The smaller balls (ball bearing and green marble) come to a complete stop faster than the larger balls. As the investigation progresses, Therese begins to wonder about the pattern of motion. "Does it go up the same height on each side?' The balls appear to go back and forth and then end in a circular motion before coming to a rest. "How could we track the balls path?" "Is there something we could put on it?" "Is the motion always circular?" Therese is making a connection to the ball's motion and the pendulum that drops sand as it moves. "Is this what we are seeing here?" "Maybe the colors make a difference!!" Laughter

(33-37) Motion investigations winding down, MC returns to lenses. She is investigating how light travels through various lenses. She creates various set ups for exploring light and shadow. She creates a black backdrop, puts lenses on their edge close to the black backdrop, and shines the light through the lens. A revelation – shadows and light. For one lens, a dark shadow around the perimeter with an intense white light in the middle appears on the black back drop. Why? What is going on here? LJ continues to experiment with different lenses and the effect of magnification.

(38) JF consults Galileo's work. "What should I do next?" she wonders.

Musings and Considerations: Questions abound. Thinking and planning, designing, doing, observing, and puzzling about what is seen – We are deeply engaged in uncovering properties, sorting facts, making meaning. The discovery phase unfolds.
"It's difficult to stop!"

EC.050 Recreate Experiments from History: Inform the Future from the Past: Galileo
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