**Air powered paper rocket launcher**. Students work in small groups to make paper rockets that are launched using a bicycle pump powered launcher. Students at SMS enjoyed launching rockets at a target in the gym on STEAM day last December and it is planned to be done again this year. Outdoors we can achieve 300' high launches.

You don’t need to be a rocket scientist to use the launcher, but rocket scientists would have a lot of fun modeling how it works, and optimizing its performance. We could use the launcher to discuss the forces acting on the rocket at launch, and do some engineering analysis to talk about pressures, forces, acceleration, and drag that effect the rocket’s motion.

**Prime number** demo. We discuss prime numbers and use a string of 150 independently controllable LEDs to illustrate the sieve method of finding prime numbers. All the LEDs are initially lit, and then we highlight multiples of 2, 3, 4, ... 13 and turn off the numbers that have these factors. The LEDs left on at the end are the primes, and you can easily see the dual prime pattern. Along the way we discuss the rules to determine if a number is divisible by 3, 4, 5, 6...

Who cares about prime numbers and why are they important? Mathematicians are fascinated by properties of numbers and there are countless theorems regarding primes. How many prime numbers exist? A recent mathematical development proved the “Dual prime conjecture” which says there are an infinite number of prime numbers separated by 2.

One use of prime numbers is encryption where factoring products of very large prime numbers is a job too difficult for our current computers. We could discuss this at greater length.

**Gravity is optional**. I have a lariat loop demo that shows how inertia changes the properties of a spinning bead loop. Students pick up the spinning loop using a dinner plate, and the loop shows entirely different properties when it is moving. This is a good medium for discussing equations of motion, and we could talk about how inertia and gravity are related, and how you could mathematically analyze the motion of the beads.

**Transistors**. I have a demo that starts out with a single transistor, then a bag of transistors, on up to the smart phone that has more than 9,000,000,000 transistors. Students get to look inside a single transistor, some early integrated circuits, some EPROM chips with 100,000 transistors or more, and finally look at some microprocessors. We always have a good discussion about where all this is heading. I also plan to get a silicon wafer to show a little more about how semiconductors are created.

**3D printing**. We discuss the co-ordinate plane, digitize some simple objects, and finally print out the objects on a 3D printer I bring in. The printing can take a while, but the digitizing and model creation are all subjects that have been covered in the math the students will have taken by 8th grade.

**Lenzs’** Law. This demonstration shows how a spherical magnet dropped inside a copper pipe is held back by the magnetic field created by eddy currents induced into the conductive pipe. Students can observe the diamagnetic properties of copper as the sphere remains centered in the pipe as it falls. We can also observe paramagnet and diamagnetic materials and how magnetic fields affect them.

**Sterling Heat engine**. Can a cup of coffee power an engine? What powers engines anyway, and why do we care? This demonstration runs a model engine from a cup of hot water. This is a good way to start a discussion about energy, efficiency, and perhaps the environmental effects of power generation and use.