After reading sections from White and Wilson’s *Bicycle Science* (1974 Colorado Press, USA) and Prior Dodge’s *The Bicycle* (1996 Flammerson, New York), I decided that the best aspect in the history of the bicycle that would help me design teaching activities was the “evolution” of the bicycle wheel. Upon reading the sections on the pneumatic tire, rubber tires and introduction of wire spoke wheels. It became quite clear to me that these simple changes could allow for a person to use the different types of bicycle wheel as props to teach physics. The premise of this argument is that the students have most likely at some point in time ridden or have come into close proximity of a bicycle. Hopefully these activities will cause some students to walk away from the experience realizing that in fact physics surrounds them, and that the bicycle is pretty cool.

**Project 1**

**Introduction of the Wire Spoke Wheel and Rotational Inertia**

Dodge’s *The Bicycle* discussed the introduction of the wire spoke wheel, this did several things for bicyclists, it lessened the mass of the wheel allowing for quicker acceleration, and the hub of the wheel was suspended from above by the wire spokes which are attached to the rim. By hanging from the wire the wheel transmitted less vibration from the road to the rider. The new wire wheels were held together by tension, instead of compression like their wooden “wagon wheel” predecessors.

This would be a good time discuss rotational inertia, start off with one concept as not to confuse the students or make them feel that there is too much to do right away. For
this activity they would need a reproduction compression based bicycle wheel and a same
diameter new style wire spoke wheel. After reading the section in Dodge’s book and the
section on (rotational) inertia of course, they would be presented with the wheels and the
question: “Which one would you like to have on your bicycle? And Why?” It would also
be a good idea to include the incline plane and several round objects to roll down it, a
sphere, metal hoop and of course a solid disk. From the section in the physics text, they
could find the necessary mathematical equations to determine which one go will go faster
down the incline and why.

**Project 2 Compression vs. Suspension**

In the previous project I mentioned how the wire while was held together by the
tension in the spokes, and the wagon wheel was held together by compression. Dodge’s
book mentions the old style wagon wheels are held together by a metal band it
compresses the rim to the spokes and into the hub. The tension in the wire spokes can be
used to show how the wheels absorb vibrations from the road and damp them out. Also
the addition of the rubber wheel worked further to do this and the pneumatic tire did so as
well. All of the materials have spring like qualities so we could introduce springs to the
students. Also the question as to why this occurs should be asked, as usual Dodge’s book
and a physics text on spring should be referenced to get a better understanding of what is
going on here.

The tension in the spokes can be proven to the students by plucking on of the
spokes and hearing the sound it makes. Probably the best concept to introduce here
would be springs and oscillators. The best way to get across the concept would be to look
at the section in a physics text on springs and do a conventional based spring lab, with
different masses, and spring tensions. Questioning why the spokes are good as opposed to wooden spokes in a compression based wheel at this time would be good to see if they have picked up on the concept.

**Project 3 Friction**

The section in Dodge’s book on the introduction of the rubber tire should be referenced as well as the section in a physics text discussing friction. In this exercise the students should be equipped with an incline plane, and several blocks of wood with different materials on the bottom surfaces: one plain block of wood, one with a plastic material, one with rubber, and of course one with metal. The idea here is that the compression based “wagon wheel” was held together by a metal band that came into contact with the road, the bands contact surface was all the rider was dependant upon for his or her forward motion.

The students equipped with the incline plane and the blocks of wood are now set loose and instructed to find the angle where the block begins to slide down the plane. After finding that the rubber equipped block slid at the angle closest to the vertical, it would be quite evident as to why rubber wheels are better than metal wheels. To prove why this is important it should also be brought to their attention again the discussion in Dodge’s book about how the rubber tire prevented injury since it was less likely to hurt a person than a metal band. Also the students should be encourage to discuss among themselves the advantages of a rubber tire compared to metal one on surfaces such as pavement, and loose surfaces gravel and dirt. As a further suggestion student could be encourage to read the section in *Bicycle Science* on the effectiveness of wheels on surfaces other than pavement sand and such.
Analysis

The learning activities I came up with were an attempt to teach physics and some history of the bicycle. I found concepts that I found to be interesting and entertaining and tried to use them to explain the physical phenomenon embodied by each aspect of the bicycle. Module 8 served as the basis for the theme I followed throughout each activity, following the learning cycles concept introduction, exploration, and application through “hands on,” “eyes on” activities. Individuals can do these activities, although groups would make better use of the activities since they take advantage of peer learning.

The constructivist method was also implemented since students will have to answer questions about why the innovations implemented on the bicycle work, or how they are an improvement over previous technology. “Constructivism, which stands in contrast to mechanical conception of thinking and action, emphasizes the learning role in constructing meaning—as opposed to simple transmission from teacher to student (Duffy & Cunningham, 1996). Learners do more than process information—they build an understanding with their environments.” (Constructivist Learning on the Web, Brent Wilson, Mary Lowry) Hopefully the hypothetical students working through the activities I designed will be able to construct meaning from stimuli in their environment, and learn to apply the physical concepts introduced with each activity. The lab activities will also follow Module 4 Conceptual Understanding and the development of reasoning, since they have both a concrete—hands on experiments, and formal—mathematical explanations as well as textual explanations.

From the paper “Teaching for Conceptual Change: A Review of Strategies” (located at http://www.physics.ohio-state.edu/~jossem/ICPE/C5.htm) the four factors that
should be taken into consideration when designing a lab or demonstration were applied to the activities. These are as follows:

1. **Students’ prior conceptions and attitudes**: in this case I am assuming that most everyone in our society today has ridden or come into close personal contact with a bicycle.
2. **The nature of the intended outcomes**: students should learn a little more about the bicycle while learning physics, maybe they would enjoy it.
3. **An analysis of the intellectual demands involved for learners in developing or changing their conceptions**: try to keep activities on a level the students will understand and at the same time try and keep them within the allotted time.
4. **A consideration of the possible teaching strategies which might be used in helping pupils from their existing viewpoints toward the science view**: constructivism, learning cycle, “eyes on, minds on”, cognitive conflict.

These activities will use conceptual change, build upon previous knowledge, and encourage students to apply that knowledge in new ways. Hopefully they will eliminate any misconceptions the students have through experimental evidence, which the students will prove to themselves, and each other. The constructive activities will cause the “learners to do more than process information—they build upon understanding through interaction with their environments.”(Constructivist learning on the Web) It was fairly easy to come up with the activities after reading the selections from the books on the bicycle, and even easier to see what physical phenomenon tied into the innovations in the bicycle. This had me worried at first, since I thought that the experiments would be fairly simple for the students to figure out, but then I remembered that I had seen at least the physics part before.