Notes added again on 7/18, 2011 after meetings with Mike. Yellow highlight indicates issue reolved. Orange highlight means resolved for present but need to be checked in interveiws This doc was saved in pdf and SVN'd on July 24, 2011

July 18, 2011: We are going to deploy without further interviews. The things that may come up sometime in the future are:

Masses going behind platform
More masses to start with?
Greater force coming from the middle than on the outsides?.

Mike and I have started a sample lesson, but won't have time to complete it until after Aug 1. I put up a HS version

ToDo July 18th:

check color with Kathy (approved)
Go over goals, abstract, Tips, and Sample lesson (only briefly reviewed)

Notes edited on Jluy 16th after meetings with Mike and Mindy.

Notes added by Trish and Mindy on July 12, 2011. Mindy talked to Mike earlier in the week and the blue highlighted items are those things that she remembered from their conversation.Mike read them and said the remarks were ok.

Bugs:

Version 00.00.18 (July 13) If the driver is on (light is blue and button says off) when you Reset the light goes to black, the driver is off, but the button says "off" ; the button should say "on"
Summary of Resonance Interviews

Interviews done 6/9/11 – 6/21/11 by Mindy Gratny Four students, all enrolled in summer term Phys1110 The content below are from her notes, but include remarks from team discussions

BUGS (already fixed by Mike):

- Text box for typing in the number of which resonator you are changing acts funny if you push "backspace" or "delete". Out of four interviews, three of the students had this problem. If you just highlight the number and enter another number, it works fine, but if you highlight the number, push backspace, then enter a number and push "Enter", other numbers (usually 9) appear. Mike said fixed TL: resolved
- When you have typed in a number for which resonator you are controlling with multiple resonators, then you go back to one resonator, the number stays the same. So then if you go to change something about the single resonator, you are still changing a property of a resonator that is not there. Mike said fixed TL: resolved

Possible problems/issues:

- **Delayed effects** when you change properties of a resonator. If you change the spring constant or mass, which results in a change in the resonant frequency, you don't see the change for several seconds. This seemed to confuse the students because they don't always wait long enough to see the change before changing something else. I saw this problem in 3 of the 4 students. TL: I couldn't figure out how to reproduce this. Mindy: (Steps to reproduce) From start of sim, increase the number of resonators to 3. Increase the amplitude to max, and damping to minimum.

Wait until resonator 1 has very large movement (it should be moving off the screen in both directions). Change the mass of the resonator down almost to the minimum. On my computer, it takes almost 15 seconds for the resonator's amplitude to be down to a non-resonating amplitude. Students don't seem to wait around long enough to see this change happen TL: Mike and I put an addition to tips since Steve Pollock's learning goals include observation of transient behavior and his survey results show that the sim behavior was successful

- **Drop-down menu** – All students found this and went through all the possible options. The only thing that presented a little bit of a problem for students was understanding what the "custom" option meant. If they selected it from the drop down menu, two of the students said they were looking for something to come up that they could change. One of these students later figured out that the custom option was automatically selected if he changed anything. If they wanted to make changes to the resonators, 2 of the 4 students went to the drop down menu and selected "custom" and thought this would change something and make it easier for them to change properties of the resonator. When nothing happened, they seemed a little confused, but it didn't really slow them down much. Mike idea: not show custom unless something changes TL: I looked at My Solar System to see how it works.Seems like we need a discussion. TL: IT was agreed to change the word custom to "Select Preset"
- **Mass go behind stage** Three of the four students asked why the mass could go below the platform. One said this didn't make sense because she wouldn't think that the mass could physically go below where the spring was attached. Mike says might just need instructions ; Steve Pollock likes this feature for his class TL: needs discussion, but we put a note in Tips draft. Mike will think about how to address this with a visual que without changing the model.TL: after talking to Steve Pollock a second time while he was reviewing the survey results, we decided the fact that the springs oscillate below the platform is critical. His students did not have a problem with the visual cues, but we may have to watch for interviews.
- **Start with one or more masses?** One student got confused because when there was only one resonator he had changed some of the properties, but when he increased the number of resonators the things he changed about number 1 stayed the same. This confused him because as he scrolled through the resonators, he noticed that there was a consistent difference in the frequency from one resonator to the next, but since he had changed something about number 1, the difference between 1 and 2 was different than all the others. TL: Another reason that the sim needs a lesson to be effective. Mike says we can start with 3 resonators to help students see comparison immediately. This was Mike's original design.. Tl: no resolution on July 11th

Buttons/Controls

- **On/Off button** – two of the four students went straight for this button, and it was the very first thing they did. One of the four turned it on after a couple minutes, without prompt. The fourth student I prompted to turn it on because he went through almost all of the other controls and still hadn't turned it on and seemed to be wondering what to do next. TL: Needs discussion- maybe change to be a toggle, less text, and another word for "Driver" or move it's locatio nso that it is more obvious that the name refers to all the controls TL: changed to a toggle, blue light for on.
- **Driver title appears to only control on/off**
- **Frequency dial** – all of the students figured out how to use this. It seemed to be a little confusing to them that they had to turn through multiple turns of the dial to get to the full range of frequencies. One student specifically mentioned that this was confusing, and one other student seemed to not figure this out right away. Only one of the four students used the text box below the frequency dial to control the frequency. TL: discuss slider possibility. Mindy said one student didn't even go more than one rotation, so really didn't learn much TL: the reason to use the rotating dial is to enable precision that a slider would not enable; we added a note to Tips
- **Amplitude control** – All of the students figured out how to use this fine
- **Driver** – Only one student found that the driver platform was grabbable. TL: not really an essential feature just fun.
- **Sim speed slider** – All four students found this and used it. Two of the four students used it to help them make more accurate measurements using the ruler.
- **Pause and step buttons** – three of the four students used these buttons. One student at first

thought the step button was another pause button, after pushing it one time. I had to prompt her to push it again and then she knew right away what it was.

- **Sliders blend into background** TL: need to pick a different color like we did with Calculus grapher
- **Number of resonators slider** – All the students found and used this with no problems.
- **Resonator controls** – All of the students found and used the sliders for the mass and spring constant. As for the text boxes, all students found the text box to select which resonator was being controlled, and three of the students typed values into the mass and spring constant text boxes.
- **Damping constant** – All of the students found this and used it just fine. The students did seem to have a little trouble understanding what this was. All four of the students at some point near the beginning of the interview mentioned that they did not understand what it was. Three of them seemed to have it figured out by the end of the interview. TL: tips will include note use Waves on a String becaue Damping is a difficult learning goal to extract from this sim. The quantitative piece was a particular request by Steve Pollock Damping is called "Friction" in Masses and Springs, so I added a note to the tips draft
- **Gravity** – All four students found this and turned it on and off. Only one student seemed to really understand that it wasn't important and then turned it off for the remainder of the interview. The other three played with it several times throughout. One student said (after turning gravity on) that it sets a new equilibrium point for the masses.
- **Ruler** – All students found this and turned it on. Three of the four students went straight for the grabbable handles on the reference lines and figured out how to move them. Of these three, two of them actually used the reference lines and ruler to measure and compare the movement of the springs. Only one student found that the actual ruler could be moved. She also mentioned that she thought it should be flipped, because she thought of it as like a "y-axis" and thought the numbers should increase going up, rather than down. TL: use ruler like Waves on a String Mike fixed
- **Reset All Button** – Three of four students used this button. One never used it.
- **Selecting resonators** – Three of the four students figured out how to click on the masses to select which one they were controlling. The fourth student I had to prompt because she kept trying to change it in the text box, but was dealing with the bug (Mike fixed it now). Two of the four students were trying to select the masses while things were moving, and had trouble clicking.

Understanding/Comprehension of the sim concepts

greater force coming from the middle than on the outsides?.

- Two of the four students wondered at least once during the interview whether the resonance could have something to do with the location of the springs on the platform. TL: maybe make piston same size a platform to diffuse any pre-conception about torque
    - For one of these students, the problem seemed to be that when you switch between "same m" and "same k" options in the drop down menu, the resonant frequencies of the masses along the platform stay the same. She seemed to expect them to change. Mindy: She had the frequency set at the resonant frequency of one of the resonators. As she changed from one drop-down menu option to another, the resonant frequency of that particular resonator stayed the same, but the spring and/or mass changed each time. Since the resonant frequency stayed the same, the same resonator was resonating. Instead of noticing that this was dependent upon the frequency, she thought it was dependent upon the location of the resonator instead. TL: seems like we need a discussion Mike will change name of custom and see if this helps.
    - For the other student this seemed to be because he kind of stayed in the 2-3 Hz range in the frequency for quite a while, which meant that only the resonators in the middle of the platform were resonating. So he thought maybe there was a greater force coming from the middle than on the outsides.

- Understanding resonance:
    - All four of the students came to some understanding of resonance. At first they all had some struggles, but they seemed to have a better understanding by the end. They all had their own way of describing it:
        Student #1: Called it first the "optimal frequency" for the mass, and then later remembered that it was "resonant frequency"
        Student #2: "As you increase the frequency, the motion increases, but then it peaks and as you go too high it stops moving so much"
        Student #3: "The frequency of an external force matches the frequency of an object and it amplifies the motion of the object."
        Student #4: "Springs have their own frequency that they like to hang out in."
    - When asked about the resonant frequency display in the yellow box, only one of the four students was able on their own to determine what this represents. The other three I had to walk them through it.
    - Some of the students seem to be a little confused by the fact that they keep thinking that a higher frequency will mean a larger amplitude. Two students come to a similar conclusion that when the frequency is really high (and there is no resonance happening) the masses are barely moving because of the speed of the driver. One student says "there is not enough time in between pushes to absorb all the force, it's just getting a little piece of it each time". The other says "the driver is moving so fast that it is pushing and pulling it back almost at the same time, so it is keeping it at equilibrium."
- One student mentioned how he really liked how the way the spring looks changes as you change the spring constant. He said it makes it a good visual representation of what is going on because it is obvious that the thicker material will be more resistant to stretching.
- One struggle I had with this simulation was that the students seem to always move through everything so fast. So with two of the four students, as they were playing, they turned the frequency dial so fast that they didn't really see the resonance move down the line of resonators. I had to prompt both of these students to scroll through the frequency very slowly. TL: added a note to tips.