Tuned Dampers 1883

MF Mason Friedberg · Last updated Nov 27, 2023

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Thanks, ZK Zeke for some good ideas to try out!
I've been experimenting with some different damping materials (they all weigh more or less the same)- from top to bottom:

- 3/8" ball bearings
- mineral oil
- water

- little ball bearings
- an aluminum tube

The resonators that these dampers mount to are adjustable - it's nice to try them at different lengths and see the effect. The dampers attach with velcro and seem to actually hold on and not get catapulted- yay!

There are a few key variables to get a handle on that I'm sure matter a whole lot- mass of the dampers, length of the tube, length of the resonators. It would be ideal if you could actually really completely dampen the resonators instantly. Not there yet!

WK

Dec 13, 2022

William Katzman

This looks like it could be interesting. I expect if you invert this, you would still have the same effect, but it would look a bit more like our system (hanging down). We actually DO add masses onto the tables that contain optics to make them more stable. We even have a picture of one of our staff hitting the tables to see if they ring correctly.

Dec 15, 2022

Jessica Strick

Thanks, William- I love the idea of inverting these!

At our shop show 'n' tell, this one was really engaging for people. And yes, people = our shop and TI people who are not your typical visitor.

A lot of surprise by the effectiveness of the dampening; lots of experimentation. At one point someone had managed to fix all the dampers to one resonator.

People wanted to weigh the dampers, want more variety of lengths of tubes, more materials to test (ie sand).

Edited Dec 20, 2022

Jessica Strick

Some notes from the 12/13 show 'n' tell and 12/16 meeting:

- as noted above, really engaging.
- I think the thing I've been referring to as "resonators" may actually be "pendulums"? Which makes for a clearer connection to LIGO's isolation system.
- Especially if we hang the pendulums
- would be good to include a set of pendulums that are fixed as well as adjustable ones.
- eddy currents!!! (thanks, WK William). Must try an eddy current dampener.
- we like the ability to change the angle of the dampeners on the pendulum ends. The velcro works pretty well but not great in terms of longevity and it's also kinda hard to pull pieces apart. Maybe a hex peg and magnets?
- We decided that this one's a keeper- I'll keep developing this one for visitor testing. Yay!

Edited Mar 9, 2023

Jessica Strick

IMG-1696.jpg

IMG-1697.jpg

IMG-1699.jpg

I'm back to the Tuned Dampers this week. My first order of business has been to come up with a way to attach the dampers to the pendulums without inadvertently creating a sling shot. I am really a little bit in love with the slot system- it seems pretty simple and intuitive and the dampers securely fall right into place. No video to share yet! More tweaking of the variables is in order- in other words, this current thrown together version isn't doing much dampening.

A group of us came up with a whole line up of things to try next.

- try different lengths of dampers
- materials in dampers- do noisier things make better dampers??
- eddy current damper- make it with a slot so the magnet is at least a little visible.
- how about making the pendulums articulated? This would make a better connection to LIGO's mirror pendulums
- eyes are in danger! Needs some shielding.
- release mechanism for pendulums would be ideal- want to see them go at the same time.
- add a scale or add label that indicates weight on each damper

- make the whole thing shake-able- on a shake table?
- adjustable length pendulums will come after I work out these variables.

General theme: isolate the variables. This is the driving force behind what I try next for the prototype and is also how I hope visitors will use the exhibit.

Mar 10, 2023

William Katzman

Noisier items might make better dampers since they can change the energy into sound. We can also think of this as changing one frequency vibration into another frequency vibration (one that we can hear). While in our instrument we won't use items that can roll and create this higher frequency vibration, the idea of using different elements to stop the visible motion is a good one.

Edited Mar 16, 2023

Jessica Strick

IMG-1716.jpg

IMG-1717.jpg

Met with explainers today who had lots of great observations, wonderings and ideas.
Here are some notes from today:

- change orientation of use so that people are watching from the side and the dampers aren't aimed at your face :)
- does it matter if the damper is off center?
- make one of the pendulums a "control" - maybe one without a slot
- make the slot longer so you can add more dampers
- use indicator to cue how far to pull pendulums
- labels for the fluids- it's nice to know what's in there
- try a long tube with a little fluid vs a short tube with a lot of fluid. How much does the travel time of the fluid matter?

I'm also thrilled that Desiré steered me towards an available and perfectly sized optics table that will be great to mount the pendulums to- because the 2x4 thing I scrapped together wobbles ridiculously.
Also, I've got some ideas for how to better cut the soft tubing (that covers the dampers).

👏👏

Apr 11, 2023

Jessica Strick

Current state of affairs and next steps:

IMG-1908.jpg

- pendulums are mounted to the nice, solid, heavy optics table (and don't seem to be acting as coupled pendulums anymore- yay)
- pendulums are much, much longer and the rails have an adjustable clamp that is sort of working so far

- there are two sets of pendulums- one set is 1/8" thick, the other is 1/4" thick
- got a scale (not sure if it's a red herring- may need to put it off to the side somewhere)

These are all steps in the right direction, but we're still not seeing dramatic dampening! The bar has to be high enough so that the differences are convincingly different and easy to see/

Next steps:

- Add second 1/4" thick pendulum so there's a real match and ability to compare the two pendulums. 1/4 is less floppy so it seems like the better choice.
- all the dampers need to be adjusted to work on the 1/4" pendulum
- Get those adjustable clamps to work better. They need to really clamp the pendulums.
- experiment with magnets added to rails and pendulums to boost dampening.
- We talked about adding rails/wheels to the bottom of the table so the jiggle would be less crazy/ less hard to dampen and closer to the reality of the types of movement that LIGO is dealing with. This seems like a good plan but will need to happen after the basic set up is solidified.

Lingering questions:
If I take all these steps and still don't see anything cool, I will need to rethink the dampers. Will they need to be longer? Have different material? Be heavier? Lighter?

Edited Apr 12, 2023

William Katzman

If I am correct, I think you are saying that the inverted pendulum systems damped better than the normal pendulum systems. Is that correct? If so, I could understand that as it seems that when a pendulum is inverted freely moving items might continue downwards while the stiff inverted pendulum is snapping back - causing the items to crash into the far wall, and pushing the pendulum in a manner opposite it's current motion.
With a regular pendulum that seems less likely unless the stiff material that is flexing snaps back quicker than a natural pendulum (string) would swing.
Any dampening would have to be done by eliminating the energy in the system.
Do the dampeners still allow for free flowing motion of materials inside them? Like earlier - a container partially filled with ball bearings? If so pay attention to whether the ball bearings are making similar noise to the inverted pendulums, if not they may be in sync with the typical pendulum and therefore would not dampen the motion. I'm probably stating what you already know, but perhaps these comments may help.

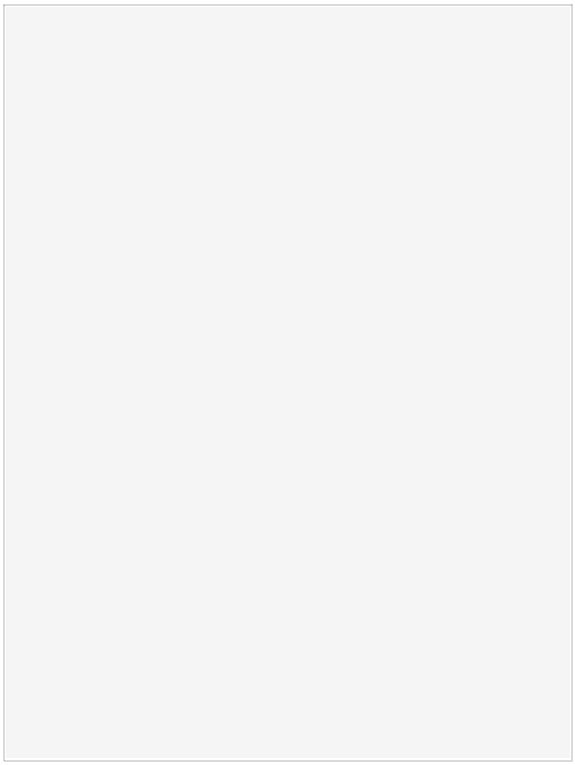
Apr 12, 2023

Jessica Strick

Thank you, William - this is helpful!
I'm hoping that the thicker pendulum material (1/4") will be more snappy, less passive string-like. We'll see how it is when I really eliminate the other factors working against the dampening (there's still some wobble in how the pendulum is attached).
The containers have the same sorts of things I used in the inverted pendulum version- tubes half full with little ball bearings, bigger bearings, water, mineral oil, etc.

Edited Apr 21, 2023

Jessica Strick



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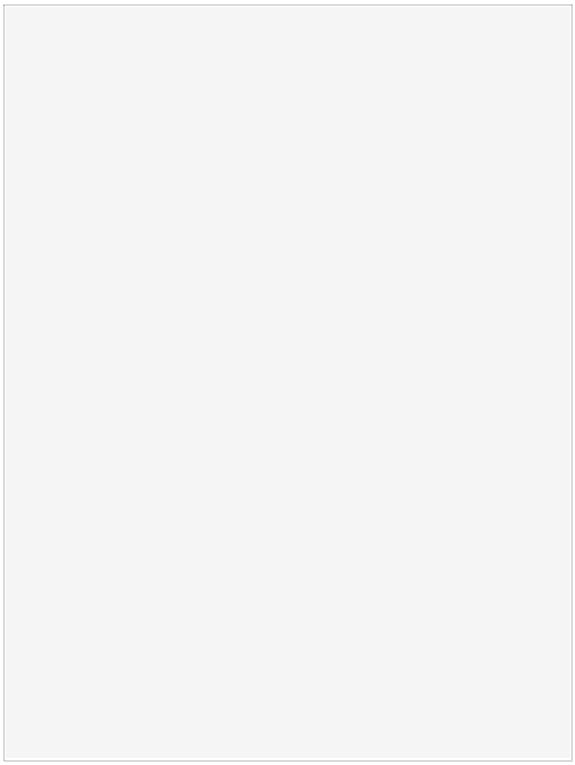

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Current state of affairs:
There's now a wide array of dampers. There are some weird things in them- lentils, rice and beans, copper dust, glass beads, an eddy current tube, mineral oil, agave nectar, plastic sand, a brass cylinder, an acrylic cylinder. And then of course, ball bearings, which I've taken off the weird spectrum, but are definitely well represented. They all move in different ways.
I thought initially that I'd be systematic with variables like weight and length of tube with the only wildcard being the stuff inside the tube. This proved proved pretty limiting, ie lentils weigh basically nothing. I can keep searching for denser materials (like tungsten dust, which is in fact readily available via Amazon) but I am eager to see how having a this variety of dampers works and if it's confusing/overwhelming for visitors.

Next steps:

- raise the pendulums so they are at a better viewing height.
- create a guard/guide so people don't over do it with the twanging
- add a place for a label
- create a shelf space for the dampers where they can be easy to see and not in the way
- add lighting
- improve labeling on dampers- something better than painters tape
- add a bumper or something to prevent the table from falling. On a foot or something.
- Next Monday- put the pendulums on the Vibrating Shapes exhibit to see what this is like with vibrations.
- Aim to get this in the prototype area by 5/2.
- I'll check in with Sal and the Explainer group to find a time to get their feedback

On hold:

- adjustable pendulum. Let's see how it goes with just the dampers first and then make a call on what to do re adjustablity

Apr 20, 2023

Mason Friedberg

Hey  Jessica, all this looks good. Some notes I took yesterday that supplement to yours:

- create a guard/guide so people don't over do it with the twanging
  - Does this include/incorporate a 'stop' that allows people to set the pendulums to the same 'input' every time?
- create a shelf space for the dampers where they can be easy to see and not in the way
  - We talked about this organizing well and also allowing visitors to see the differences of length and inside of each weight (tray, shelf, rack), maybe even something like a spice rack, or lazy susan
- One note on experience and changes in the inserted weights: A good question might be "What are we learning when able to change three parameters simultaneously?" Being able to change the volume, material (density), and weight might make it hard to pinpoint what is having the change of affect. If this is something we are desiring, full steam ahead. If trying to hone in on something more, perhaps something to think about more.

Good discussions ahead!

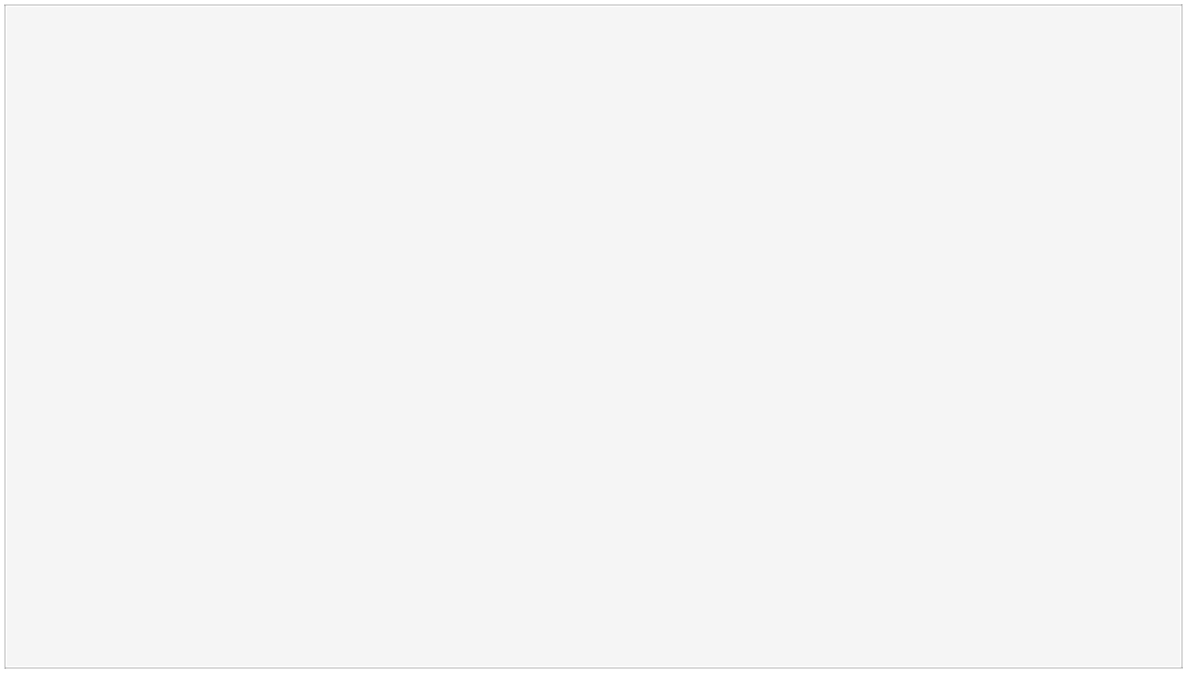
Edited Apr 26, 2023

Jessica Strick

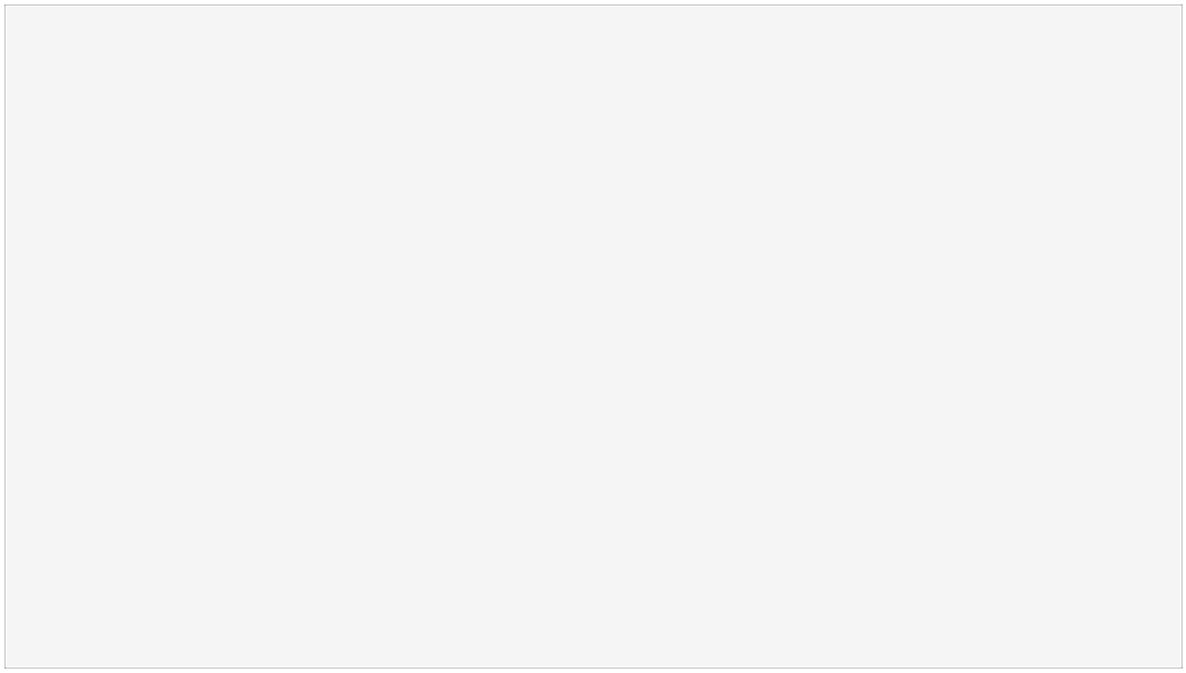
On Monday I put the dampers on the exhibit Vibrating Shapes which served as a convenient vibration bed. I found that the vibrations pretty much did nothing to the pendulums- I tried different lengths for the pendulums, different frequencies of vibration, different dampers. Nothing.

What I did find was that when I'd use the vibration PLUS twang the pendulums there was some difference. Not a ton, but some. Below are some comparisons.

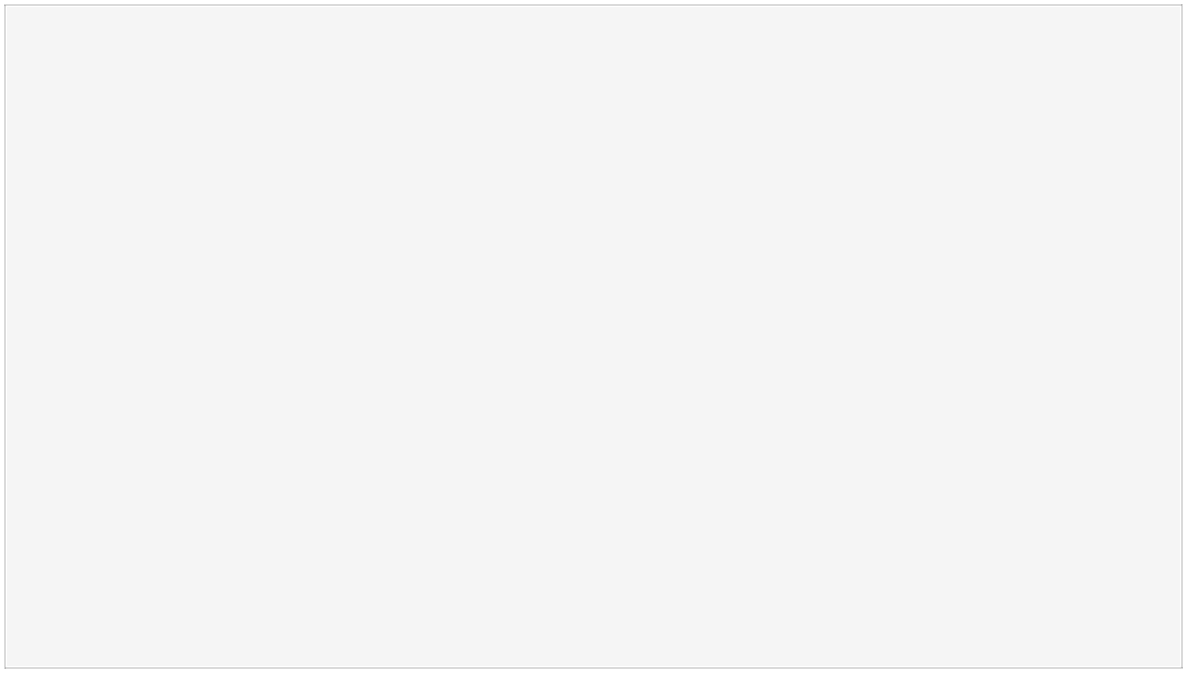
No vibration 1



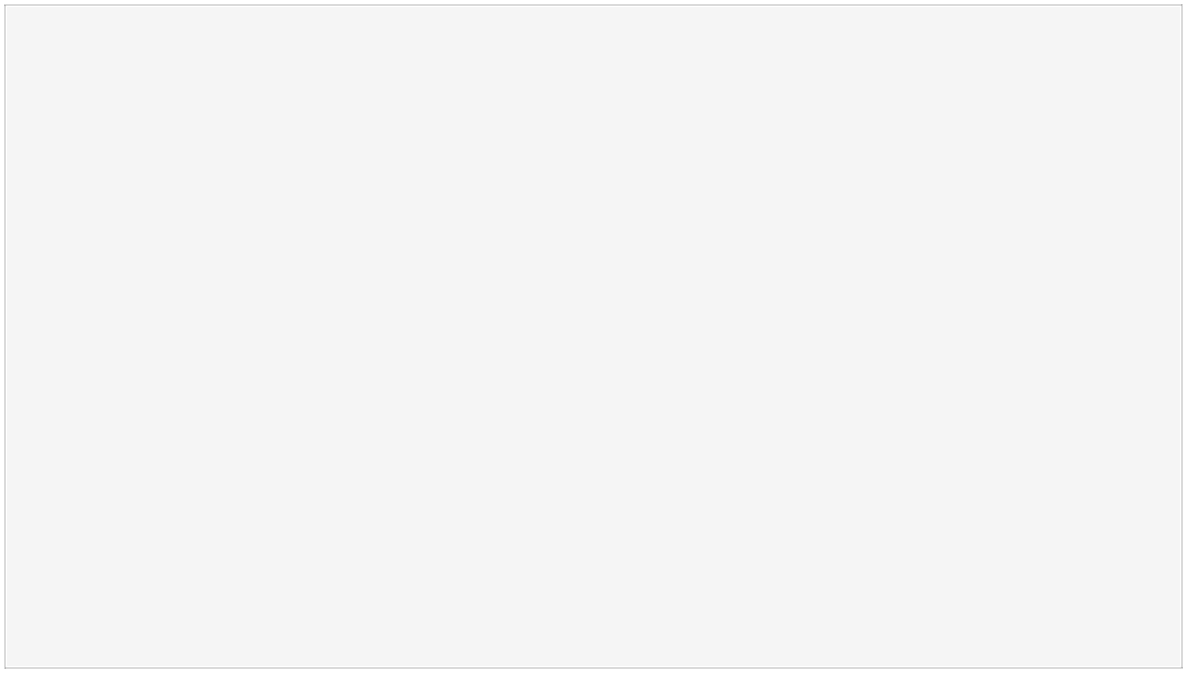
Vibration 1



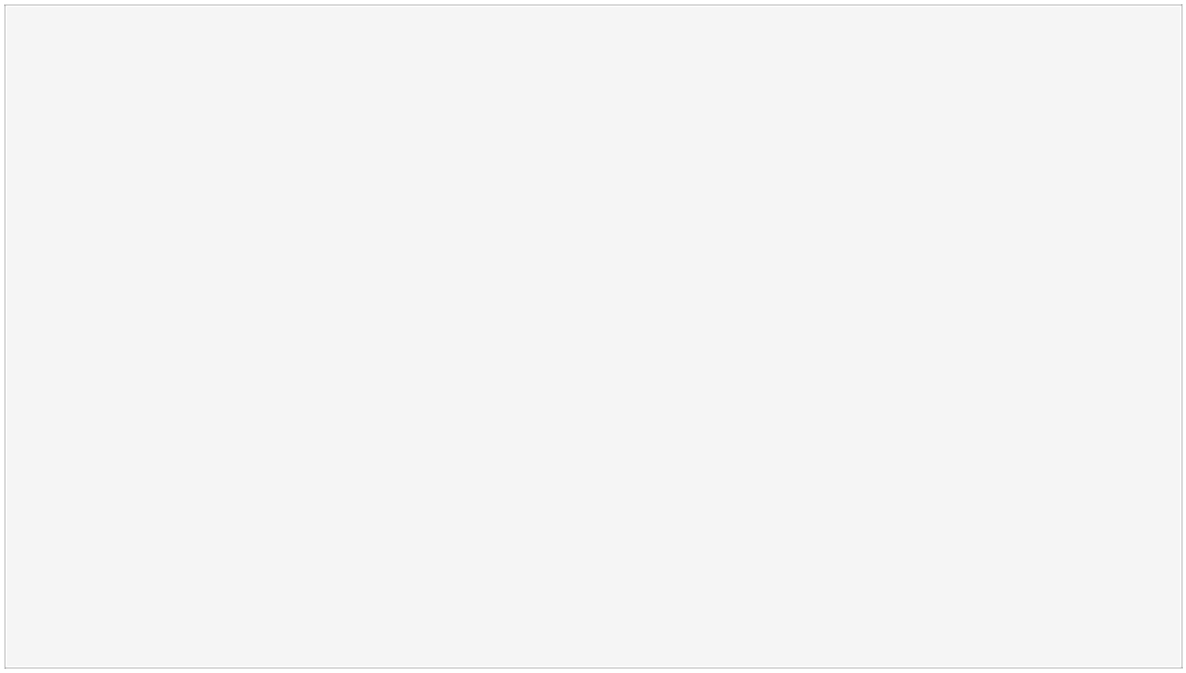
no vibration 2



vibration 2



no vibration 3



vibration 3

Apr 26, 2023

William Katzman

Pendulums are generally a good way of eliminating quick vibrations - that's why we use them for our mirrors! Of course this is slightly different in that these are semi-rigid pendulums,with a distributed mass. In a semi-rigid pendulum, essentially the shorter the pendulum the quicker the vibrational frequency that will resonate with the pendulum (conversely the longer the pendulum, the lower the vibrational frequency). To see any vibration, I'm guessing that you would also need a larger vibrational amplitude to make it visible (unless you hit resonance). I'm guessing this is a small amplitude shaker - kind of like a massager, because I cannot see movement in the table. Furthermore, if the pendulum isn't clamped down to the table, it may not even vibrate with the table. If you use three different length dry spaghetti noodles with marshmallows on the ends, hold the bottom of the noodles and shake, you will find that the longer one will start bouncing back and forth with the lowest frequency hand-shaking (until it snaps), and the shortest one will require the highest frequency hand-shaking. That's another take on an exhibit - instead of dampening a vibration out, which length pendulum vibrates with which frequency vibrating.

Apr 26, 2023

Pearl Tesler

Hi Jessica

Here's some very draft text that may be helpful for your road test next week. I tried, but could not find a way to work in "astronaut bacon".... ;-)

Looking forward to hearing how it goes!

pt

Kill the Vibe--V1.docx
11.4 KB

Apr 26, 2023

Mason Friedberg

Jessica Notes for 04.25.23:

- Pendulums raised put them at a much better height for users to engage with.
- Guard also acting as 'limit stop' for pulling back pendulums to get them started.
    - One **Question:** How might we encourage users to use the back stop so they have a better comparison from baseline start
    - **Question:** Do we want to have a baseline start, or just let users go from wherever
- Organization Rack--> **Questions:** How do we want it organized? Is there any benefit to helping organize in size, weight, material, etc?
- One main takeaway --> What is the main take away; what are the valuable parameters; If someone can determine which pendulum 'wins', what do they think made that the case?
- Interesting find: When using pods of same weight and volume, the material form factor made a difference for which pod 'won'

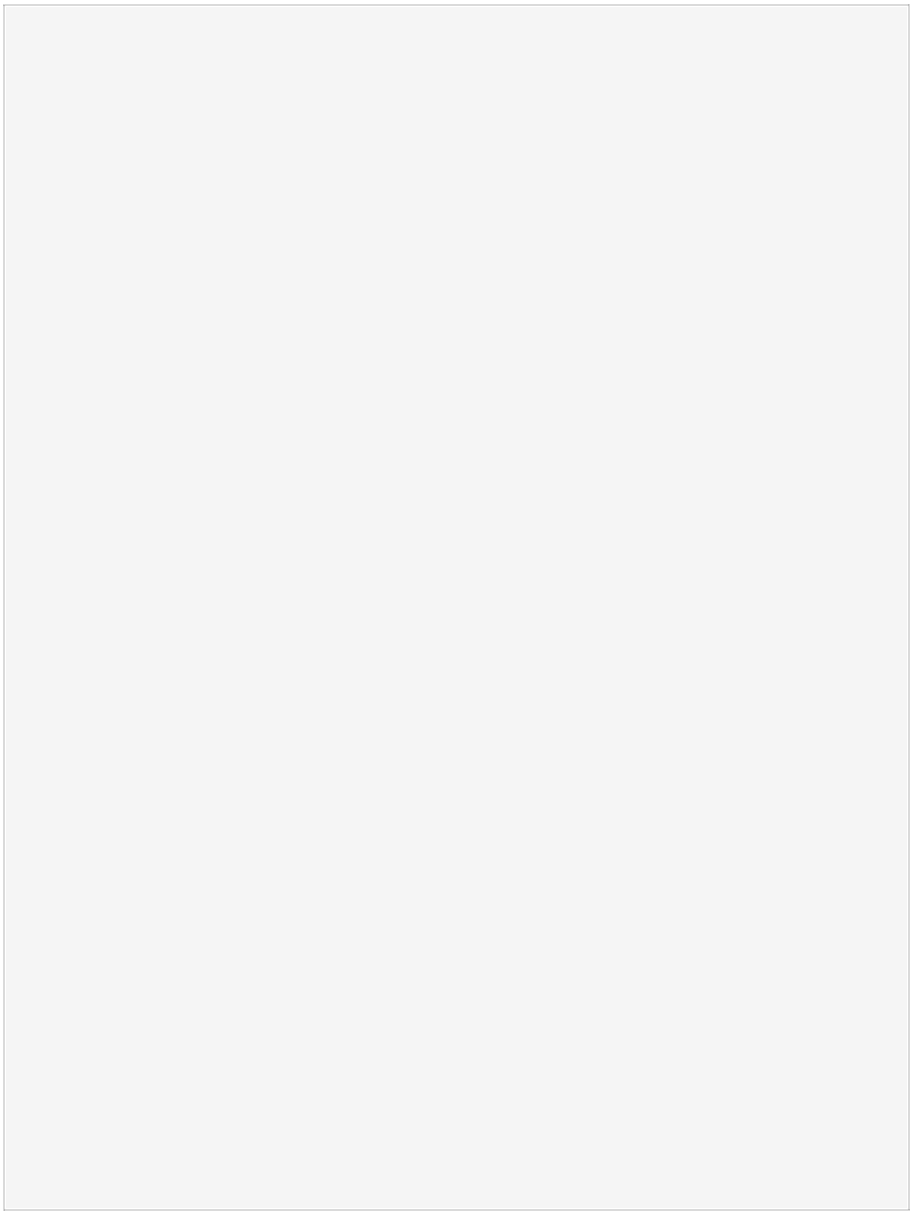
Apr 26, 2023

Jessica Strick

Thanks, WK William. This is clarifying! So it sounds like the vibration would need to be better matched for the pendulums; small amplitude vibrations with short pendulums and big amplitude shakes for longer pendulums. Given that going smaller will be less ideal as an exhibit and that going with bigger vibrations won't be that much different than what you get with twanging the pendulums, I think I will put the vibration add-on aside!

And thank you, Pearl! This is great to get things started and I love the title (which makes up for "swinging flaps!).

Some notes from our meeting today



IMG-1959.jpg

- Do we want a spot for the winning tube or some way to help people track what they've tried? Can the tray be a way to help people be systematic with their experimentation? Let's wait and see what people do. Are they experimenting? Are they comparing?
- What are we calling the pendulums...because they don't really look like pendulums and that may just be a confusing word to use here. For now, we're starting with "swinging flaps".
- We talked about the color of the pendulums. For example, if they

were red, then we could say, "put the tubes in the red pendulums". But.. we all agreed that transparency lets you see the whole damper and it's contents. So maybe the pendulums could be a transparent color- but this would be more to make them more visible and less as an aid for the instructions. (not sure if polycarbonate is available in different transparent colors??)
- the plywood sides obscure the view for people looking on the side- clear plex or brackets (without material) would be an improvement.
- it'd be good to have some identical dampers so you could see what other variables aside from weight, volume and material might effect the swinging.
- I need to include some sad balls! I'll get some for Tuesday.
- sometimes it's hard to tell which one is the winner. Would a sensor to track number of swings help? Let's table this for now in the hopes that people are able to see and get a sense for which is slowing down without getting all particular about the precise numbers.

Next steps- in preparation for floor test on Tuesday 5/2:

What are we trying to learn from this floor test?
Is it clear what you're trying to do with the dampers, ie that the "winner" slows down faster? I will be at the exhibit modeling how to twang the pendulums at the same time. But will people know why they're doing that and be interested in the results?

Success would look like people doing these thigns:
Experimenting with the different dampers. Making multiple comparisons. Comparing "winners" with different dampers. Being systematic If we're really rolling, we'd hear some evidence of people experimenting based on hypotheses.

- finish up the tray
- make a tube of sad balls
- a couple of the tubes keep blowing their lids- I'll try epoxying them

shut. Or something.

- improve the labels on the tubes

Edited May 3, 2023

Jessica Strick

I am very pleased to say that yesterday's trial was a success!
For the most part, people knew what to do with the tubes, even without a use drawing or me showing them. They were engaged in looking closely at the contents of the tubes, making comparisons. They did novel things like stacking the tubes. They stayed at it a long time. They didn't seem disappointed with the activity of killing a vibe (the title- so good) .
I saw little people (3-4 yo) as well as high school seniors engaged. People had questions and hypotheses. I talked to a chaperone who was there with a group of 8th grade boys- I asked if they were really into science, because they were really engaged with the exhibit. She said no, and that they'd just gotten into the museum, this was the first thing they were drawn to. I take that as a really good sign.
YAY!

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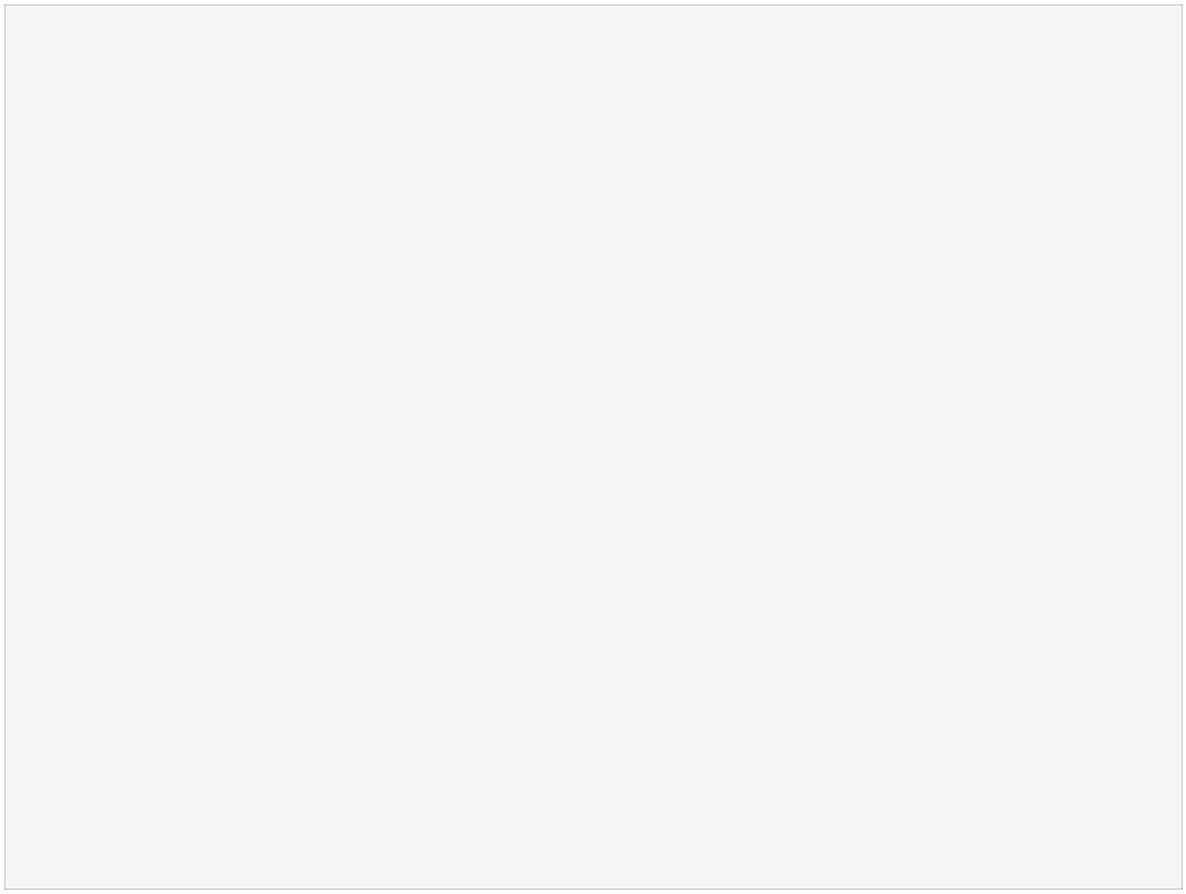

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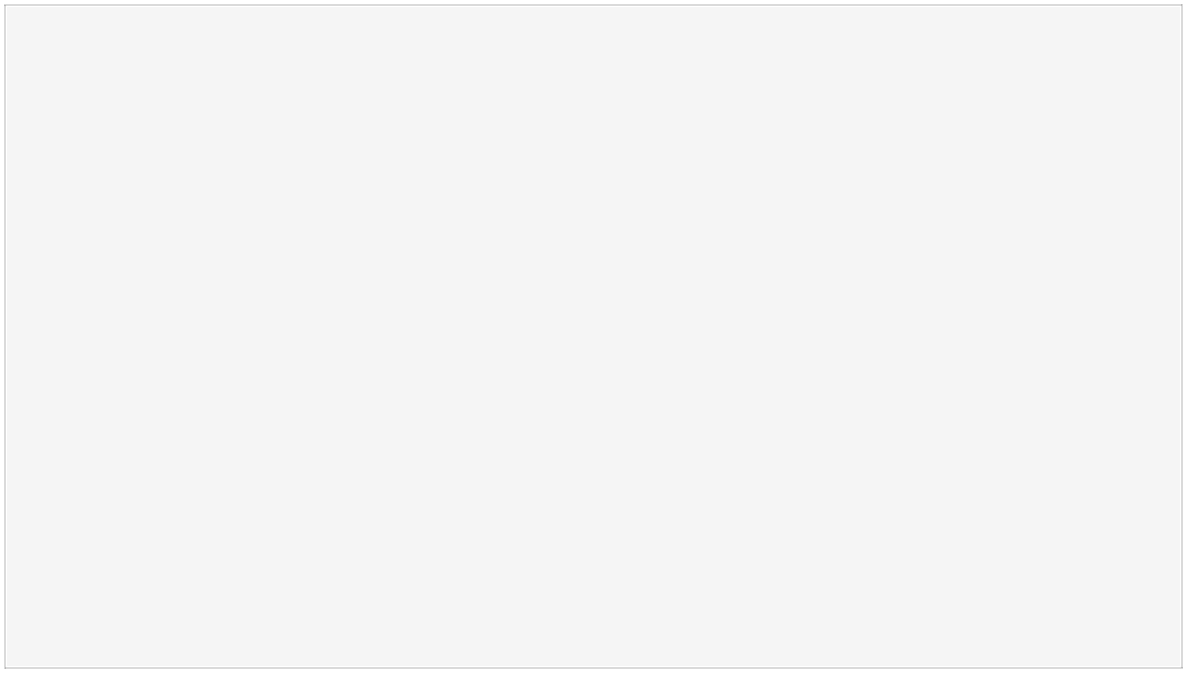

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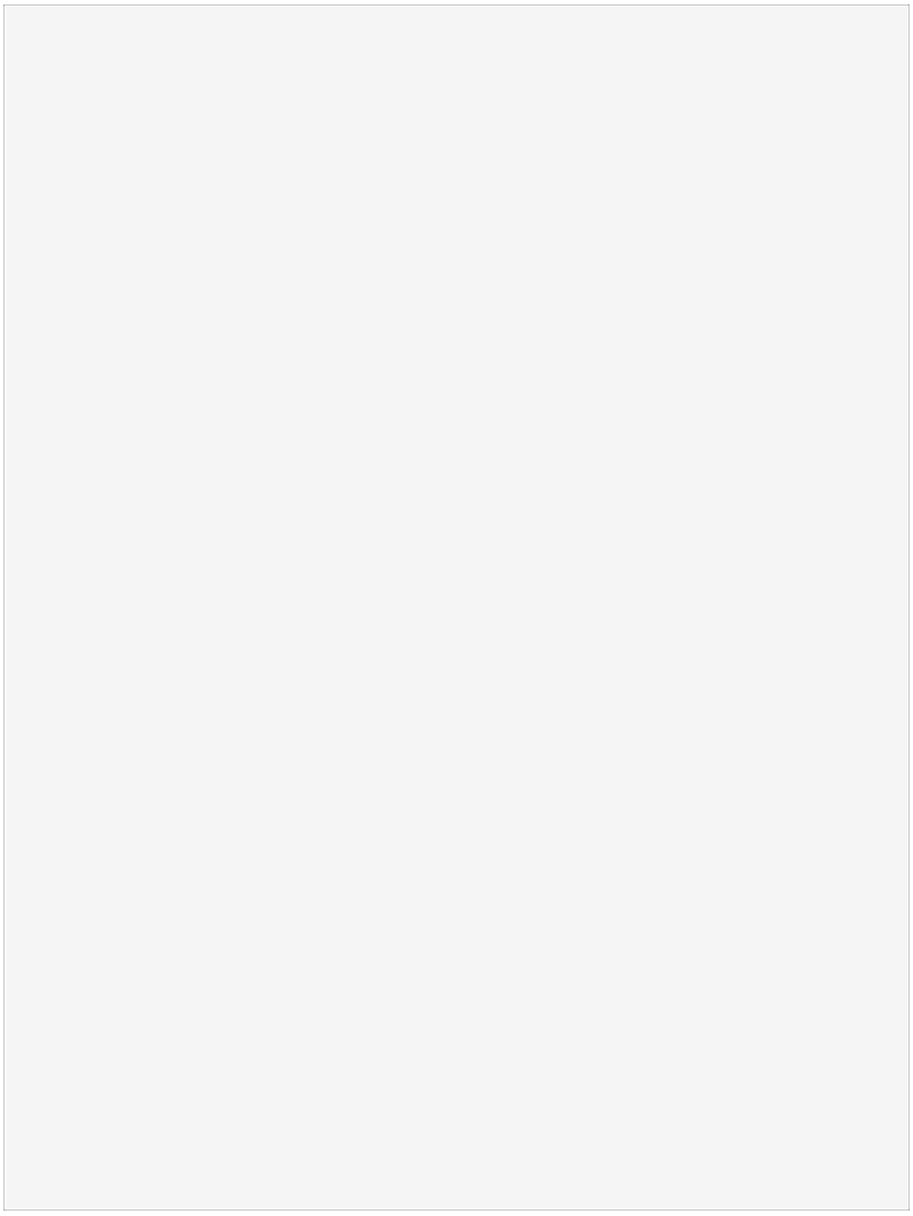


IMG-1980.jpg

Some things I noticed:

- definitely, definitely too many variables. I will probably limit the materials to a few fewer things. And I'm thinking I can make the tubes all one size (long) and have weight be a variable.
- people like the colorful things and the liquidy things
- the array of tubes attracts people (I saw one girl meticulously

organizing the tubes before she played.)

- People are doing this with their friends- it's social.
- a good use drawing is going to help
- it's really tall for little people (see photo above)

May 4, 2023

Mason Friedberg

Jessica So glad the floor testing had some promising results. Very cool to hear that people were engaging and sticking around to see the differences between each tube.

Some notes from yesterday:

- Seems like some users stack the tubes in a single flapper --> Would be good to keep an eye on this with next testing to determine if we think this will be a considerable issue
- Pulling up at the same time and distance --> BDR Barbara working on a use case drawing for this
- Too many variables --> Potential to keep all volumes (sizes) of tubes the same; Use about half as many materials (this also opens up space to put graphic lower)
- Can't see through sides --> make out of plex
- Still need to consider the tubes hitting people in the face when moving
- Potential desire for sound effect of the movement for the visually impaired

May 4, 2023

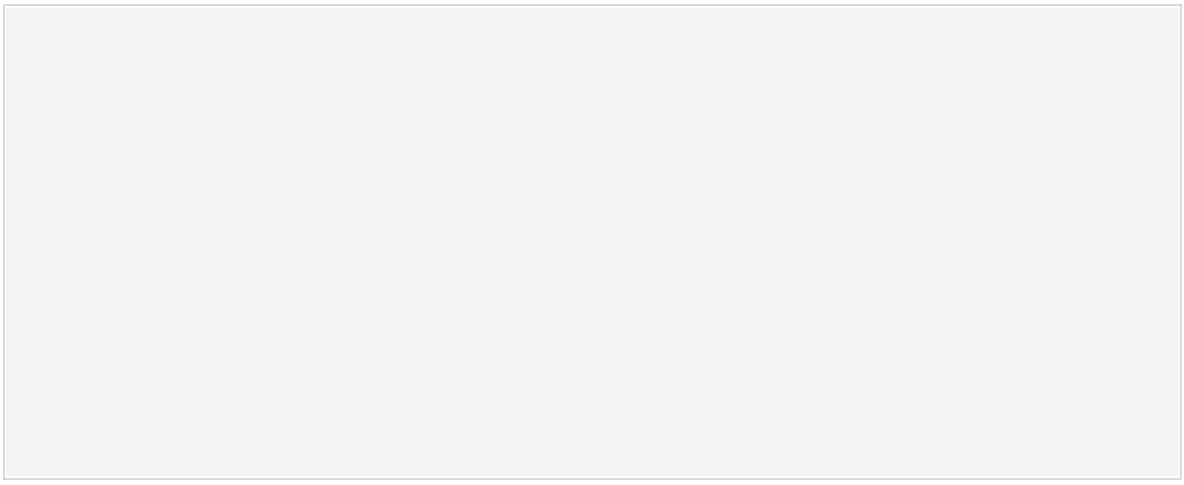
Jessica Strick

Thanks for the notes, MF Mason !
I am aiming to bring this back out on the floor next week. Does that work for you, BDR Barbara? I am looking at Wednesday or Thursday morning.

BDR May 10, 2023

Barbara del Rio

Taped onto prototype:



1883_KilltheVibe_prototype.pdf

thanks!

May 11, 2023

Jessica Strick

Barbara

Jay

Pearl

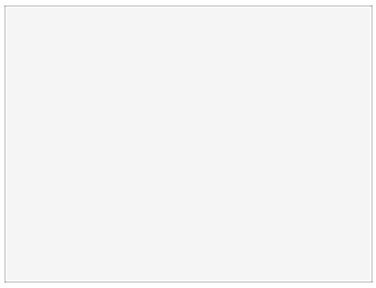
Out on the floor this morning. So far, I'm feeling all the more convinced that a use drawing is really needed! The photo isn't really helping. Unlike the last floor test, I'm holding back more to see how it goes. People are doing an assortment of not great things; pushing the flaps, touching the end of the tubes, shaking the flaps.

I also saw a couple kids trying to "open" up the tubes. This, to me, this also communicates that they didn't know what to do with the exhibit. One of these kids was so intent on getting to the beads that he put it in his mouth (gross, right?!).

Also, I'm seeing way too many people doubling up the tubes (see below). This, again, could be a matter of not knowing what to do at the exhibit and could be helped with a use drawing. But probably, the extended slot is a feature that's working against visitor use.

Some questions that are coming up for me...

- is there anything about the new tubes - they're all the same length- that is changing what I'm seeing today? Does one size make experimentation less appealing?
- Are the materials too attractive? I see a lot of kids going for the beads and the colored glycerin. Neither of these are great dampers, so maybe the low drama of the effect these have on dampening confuses things.



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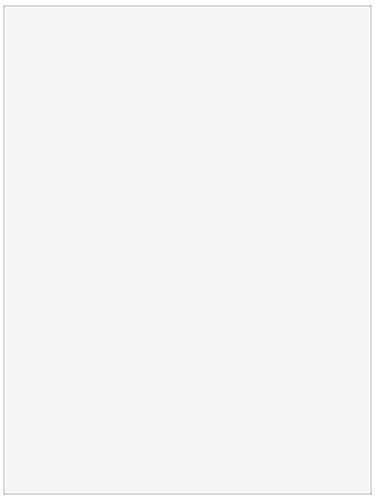

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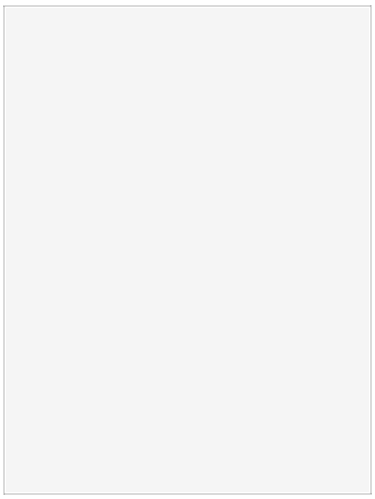


IMG_6170.jpg

IMG_6172.jpg

IMG_6173.jpg

May 11, 2023

Pearl Tesler

Hi Jessica and gang,

Those colors certainly *are* attractive. Maybe candy-colored on the balls is just too appealing...perhaps monochrome balls instead?

As for the stacking, I'm wondering if the label couldn't help with that. First, I do think a good use diagram will *really* help here, clearly showing just a single tube in each slot. That photo is visually quite hard to read.

Second, I'm looking at the text and I'm seeing we start with "Slide two different tubes..." and I'm thinking that perhaps people are just reading those first three words and not making it to the end of the sentence. I'm attaching a tweaked text version to address that possibility.

pt

Kill the Vibe--V2.docx
14.7 KB

May 11, 2023

Barbara del Rio

Great thoughts, Jessica and Pearl. I agree that adjusting the text might help, and a use drawing will certainly be clearer than the photo, which has a lot of distracting background. I commit to having a drawing ready for next week.

Let me know if you think there is a better angle to view the action from. Open to considering a different photo, as I just shot that one on the fly. Although I couldn't ask for a better model.

May 11, 2023

Pearl Tesler

Great! I think the angle is pretty good, actually. I might only suggest tightening up the frame a little bit to focus on mainly just the hands and the flaps/tubes.

May 11, 2023

Jessica Strick

Agree with Pearl- a little closer on the flaps/hands/tubes should be better for the use drawing.

Also agree that the text may be confusing people/encouraging the double stacking. Just witnessed a mom with kid, diligently reading the text and then adding a second tube to a flap.

May 11, 2023

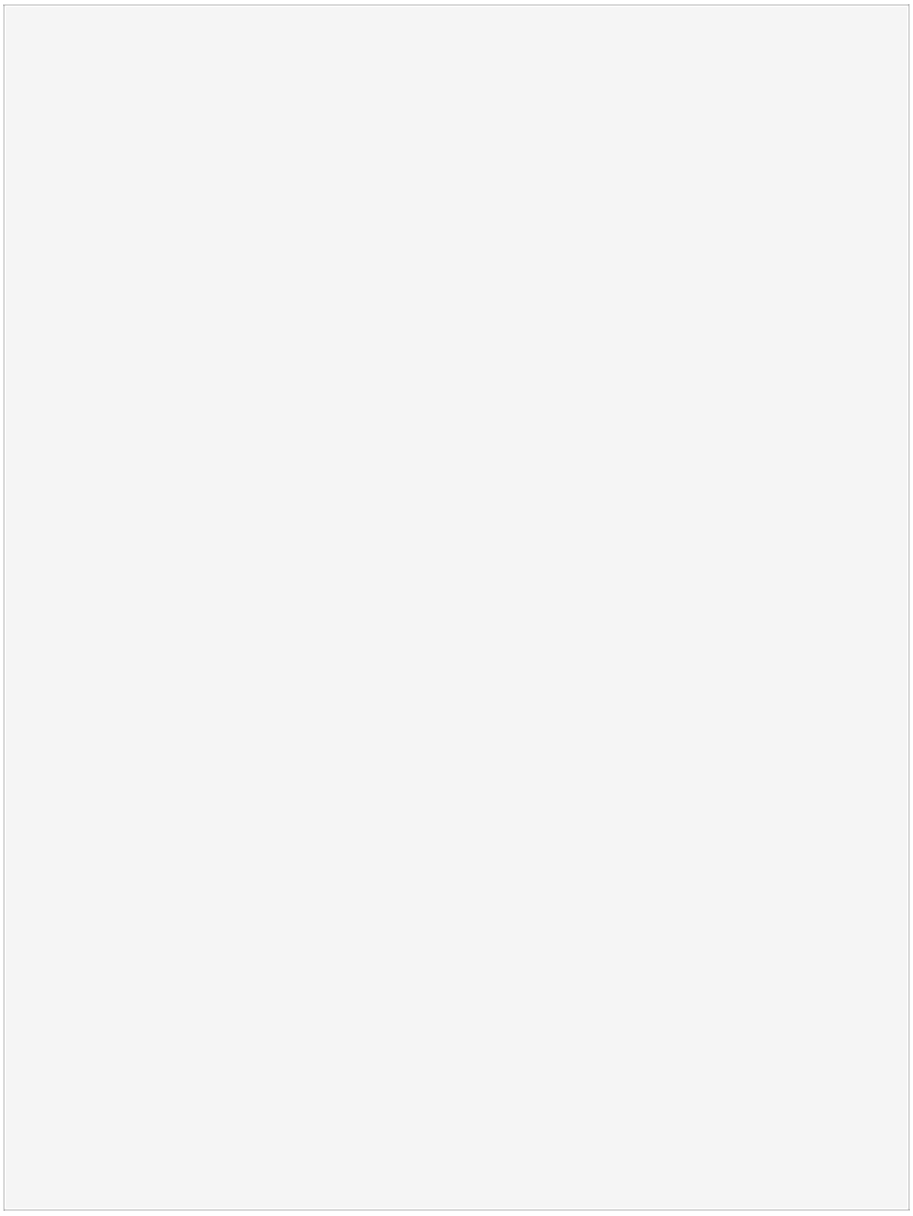
Jessica Strick

Another observation: people are pulling off the soft PVC tubing. I made it easier for people to do this by using a dab of mineral oil to get the tubing on in the first place. Easy on, easy off.

One solution is to have the end caps match the outer diameter of the soft tubing.

Additionally, because the tubing can also slip in, making the gap too tight, there may need to be some shaft collar type things sandwiching the soft tubing.

Behold, my crappy drawing of what I'm trying to express with words:



whoah- looks even crappier magnified.

Edited May 15, 2023

Jessica Strick

Notes from today's Explainer feedback meeting with a special call out to 🐓 Pearl, as the meat of what we discussed involves words:

Sal brought up the use of the word "vibrations" (and, related, "vibe"), as it's not totally clear that vibration is something that is happening at this exhibit.
While it's an important word in the context of LIGO- and is a good word to use in a What's Going On/LIGO Connections - it's too far from what people experience and see at the exhibit.
I think this is a really good point!
As much as I love the title, I think it'd be worth trying something else. One of the explainers came up with a pretty good one: "Shake it Off".
Other words besides vibrations: wiggles, shimmy.

Another point of discussion- and this may be something to explore during our test on Wednesday (so throwing in a callout to  Jay here)- the question of what is causing the dampening came up. The thing that I'd like to know is if people have enough to experiment with to get a sense of what matters. Do they want or need answers (in the label) to back up their sense of what matters?

And finally, this callout goes out to MF Mason - the height is currently comfortable for wheelchair users. The reach to the flaps is also working well. I had been inclined to lower the exhibit because it's a little high for little kids, but now think that as long as stools are around, kids will pull them over and be able to use the exhibit. Better to size it for wheelchair users. The height and reach to the flaps is also safer because it keeps faces further away from the swinging tubes.

May 15, 2023

William Katzman

I like the title "Shake it Off," but isn't that the opposite of what you want them to do? Isn't the idea to stop the shaking or maybe they won't even see it as shaking so much as swinging. So a title that suggests making the swing still might be best. Still the Swing? (not a fan yet - right idea, but not a good title).

May 15, 2023

Pearl Tesler

I fear that "Shake It Off" will make people think that the goal is to shake the flaps so violently that the tubes fly off...

May 15, 2023

Jessica Strick

Ok, very good points from both of you, Pearl and William! As much as I love a random pop culture reference/ title, this seems like it won't work.

May 17, 2023

Jay Shepard, Project Evaluator

Jessica -- I Spent a while observing school groups this morning and found some interesting patterns.

1. Visitors rarely re-set the exhibit. Most new groups approached the exhibit with tubes already in the flaps. There were only a few cases of "double stacking" and all occurred when visitors arrived at the exhibit with tubes already in the flaps.
    1. MF Mason mentioned having more space on the shelf with spaced out individual slots might encourage putting the tubes away.
2. Visitors started with lots of different combos of tubes. Some groups spent a while shaking the tubes and making their selections, others grabbed two right away.
3. A number of groups only used one of the flaps OR the group split and half used one flap, half used the other.
4. Almost all groups did the "pull towards self and release" action, but they didn't all pull to the maximum/release from the plex guard.

Since the title might be in flux, I wonder if framing it as a race would help prompt visitors to use both flaps at the same time? "Race to be still" ? Pearl what do you think of something along those lines?)

Looking forward to the meeting this afternoon to discuss more!

May 17, 2023

Pearl Tesler

Hi all,

Here's reworked text (with new title) to try for our next floor test.

Thanks,
Pearl

Kill the Vibe--V3.docx
14.9 KB

Edited May 18, 2023

Jessica Strick

Notes from yesterday's meeting:

- to deal with the regularity of people adding 2 tubes to slots, I will make the slots shorter to accommodate only 1 tube.
- I'll add some visual cues to front panel and flaps- I'd tried this with red tape (small piece on flap, small piece on front panel where the two meet) and it seemed to make a difference. I'm going to try dots and see how it is with red dots on one side, blue dots on the other side. The thinking with the different colors is that it could bring home the idea of comparison/ race.
- Some of the tubes are hard to snug into the slots. I'll work on making them less snug.
- Pearl has some new text/ title "Race to Stillness" in the hopes that this will convey that you pull both flaps equally and at the same time.
- BDR Barbara is going to work on a new use drawing that's a good close up of the hands pulling the flaps to the front panel and with the added color dots (how about red on the left and blue on the right?)
- Jay will do some observations this Sunday

Go team!
Thanks, everyone.

May 18, 2023

Mason Friedberg

Jessica moving toward production of this. This will likely be a bit behind Team Mystery, but will run in parallel as the last of the testing wraps up.

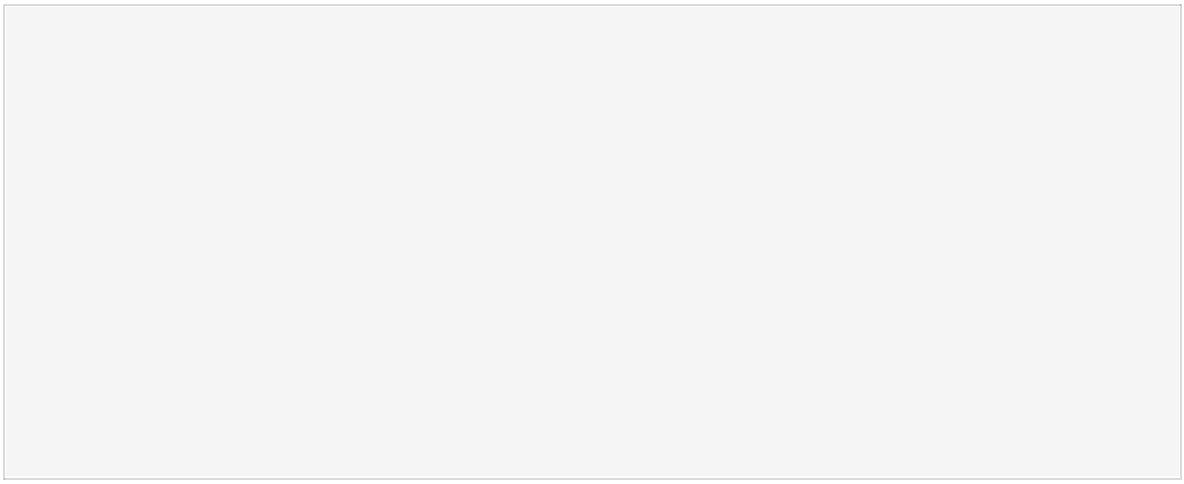
General Notes:

- Side panels currently help set the height and depth for pulling back the pendulums equally
- Height vs. Adjustability of pendulum pivot point: Do we need it as high as it is right now? If so, what is the functionality behind that reasoning?
- Rigid: This needs to be a rigid exhibit, so that no unnecessary vibration or motion is added into the flaps
- Visibility to the tube is desired (clear polycarbonate for flaps)

May 18, 2023

Barbara del Rio

Version 2 of the label—attaching PDF.

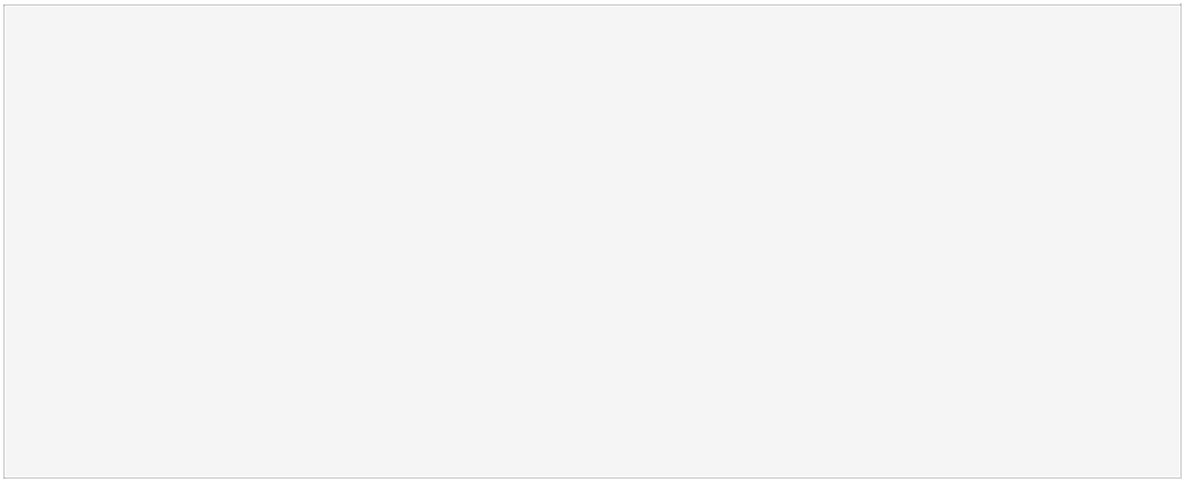


1883_KilltheVibe_prototype_v2.pdf

May 18, 2023

Barbara del Rio

Version 3 of the label—2-page PDF; two options for handling the use drawing.



1883_KilltheVibe_prototype_v3.pdf

Edited May 19, 2023

Jessica Strick

Yay!

Thanks all for the speedy turn around. Shorter slots, indicators on flaps and panel, new title, simplified image with arrows.

I put it out in the prototype area and will keep an eye on it for the remainder of the afternoon. It'll be out there ready for you on Sunday,

Jay.

Fingers crossed these tweaks will make the difference.

May 19, 2023

Desiré Whitmore, Senior Physics Educator

I checked it out last night, and I think the arrows are a helpful addition.

I also like the full vs. half-full options. I took some folks to play with it, and it was not reset, so they read the directions and automatically tried to put tubes on top of the ones that were already there. They found it kind of frustrating that they wouldn't fit and couldn't figure out why. I am not sure how to signal that folks need to reset the exhibit, but it seems like it might be a good idea.

May 19, 2023

Pearl Tesler

Hmm...I'm wondering if it might help to show a second use diagram for just the first step, showing a hand sliding a tube onto the (empty) flap.

👍

May 22, 2023

Jay Shepard, Project Evaluator

Jessica Pearl Mason

Some notes from Sunday:

- No more double stacking
  - Some visitors still attempted the double stack - especially if there were already tubes in the flaps when they arrived - BUT it was physically impossible to double stack, so they quickly got the idea.
- The arrows on the flaps/plex shield seem to be helping
  - I saw a greater proportion of people pulling them all the way back to the shield before releasing them
- 3-2-1-Go
  - With the new label and arrows on the plex, very few groups used the two flaps independently. If two visitors from a group took different sides they would usually do a count down/try to release the flaps at the same time. This solves the problem of groups using the two flaps independently, however there is still the issue of two people not always being great at releasing the flaps at the exact same time.
- Race to Stillness
  - I think the race framing likely supported the countdown/groups working to release the two flaps at the same time. I did hear one group say "you won, yours is still going" but it was an adult speaking to a ~3 year old kid. Other groups more easily figured it out. One group of two teens: "I won." "No, it's the one that slows down the fastest. See [points to label]"

Looking forward to chatting more on Wednesday

May 23, 2023

Jessica Strick

Thanks for all the observations!
I will be back tomorrow to check in on things and will pay special attention to this vestigial desire to double stack. I think Pearl's suggestion about a second use drawing showing a single tube getting slotted into the flap may be the next thing to try if we need to do something at all.

May 25, 2023

Jessica Strick

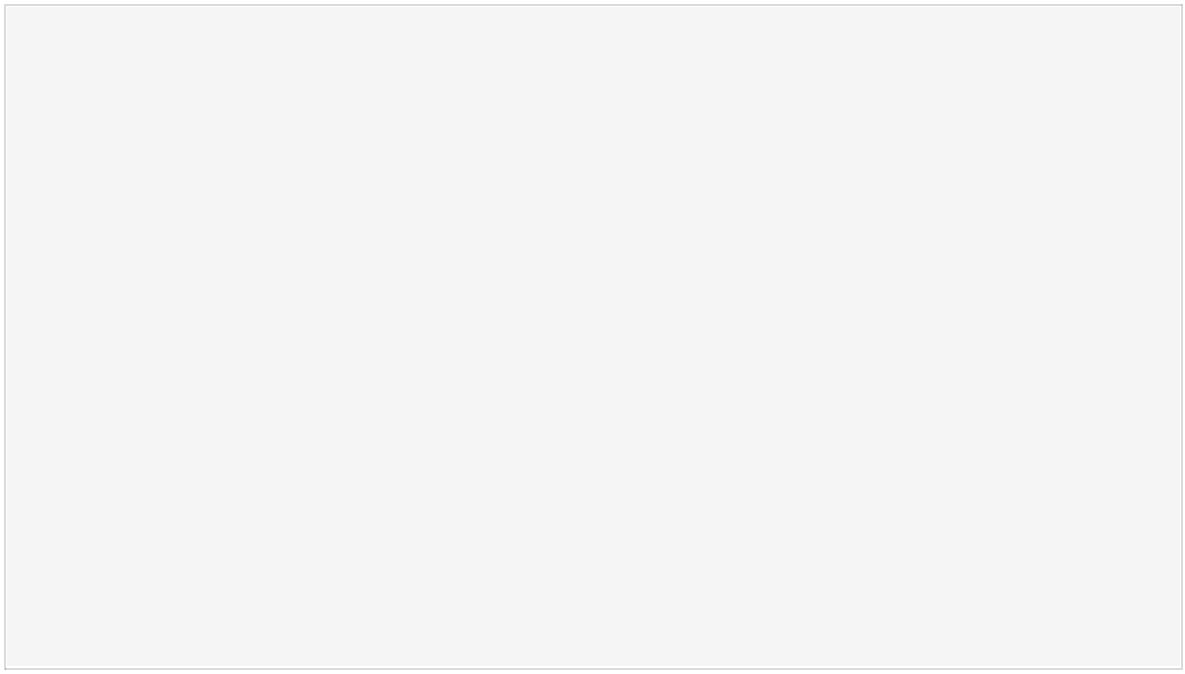
Some notes from yesterday's meeting:

- some people bop the ends of the tubes together. Do they look like magnets to people because they're black?
- what about adding some more words that encourage releasing the flaps at the same time: 3-2-1- Go (or "slow" if we want to try out Jenn's cute alternate title)
- let's try a "what's going on" as a side label that can suggest different experiments people can try and what the different types of tubes/contents there are and what might be affecting the dampening. This may help people be a little more intentional in their experimentation.

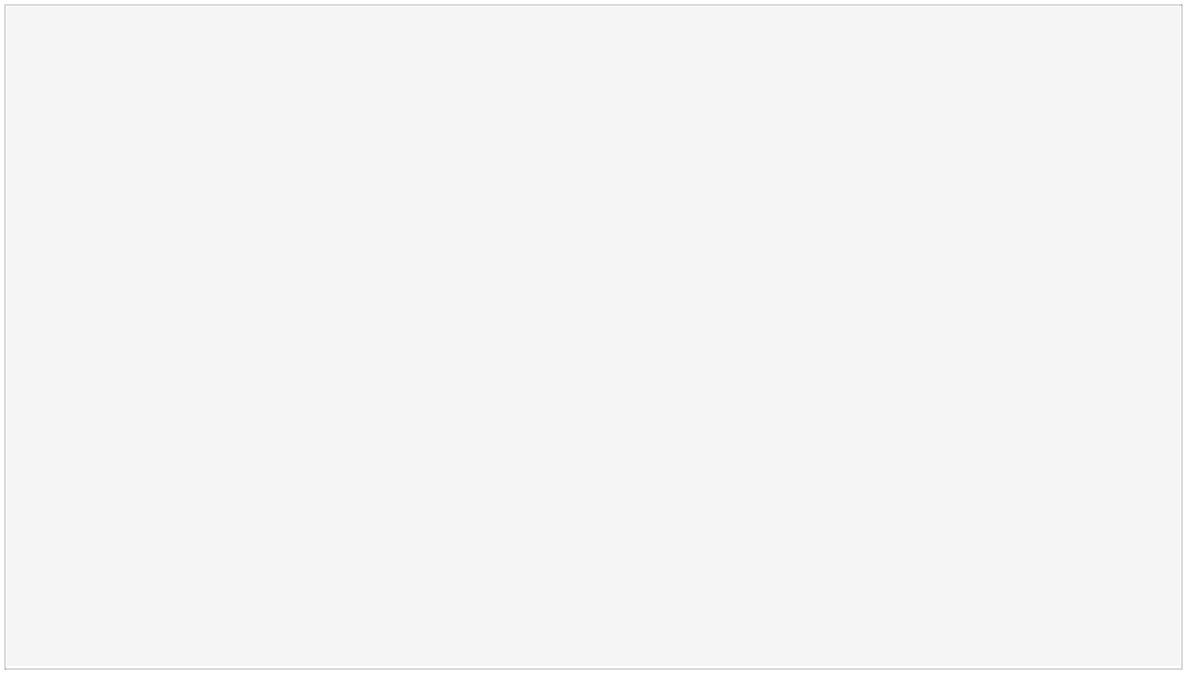
May 25, 2023

Jessica Strick

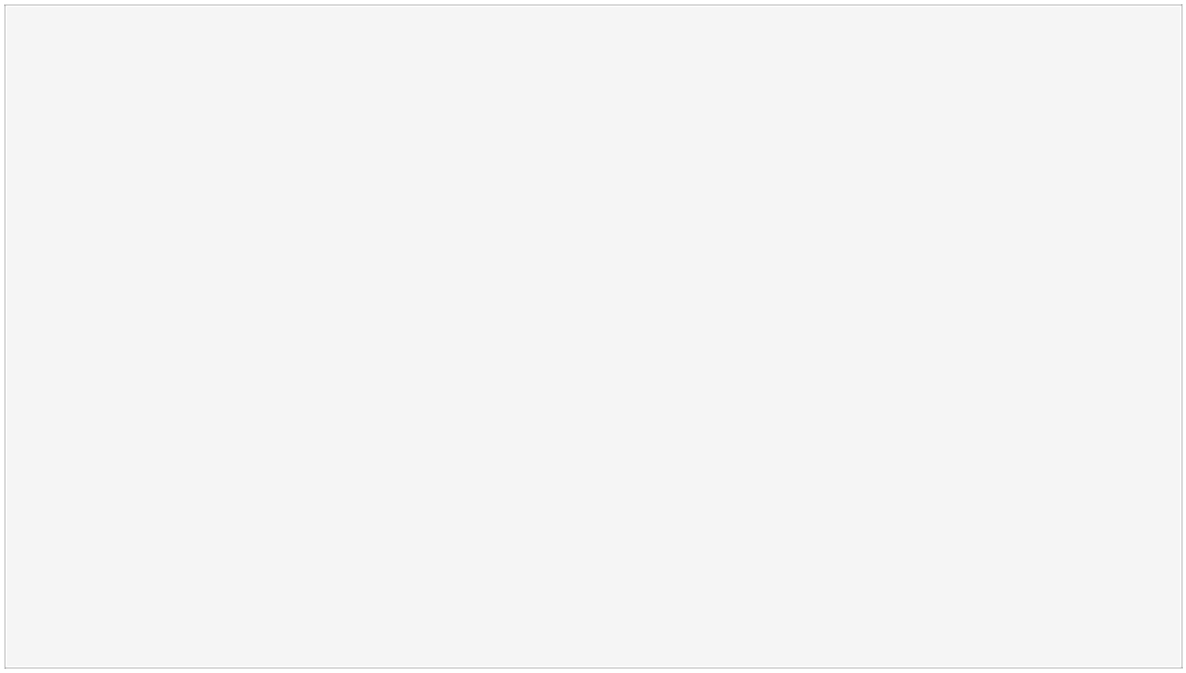
Dampers in action:



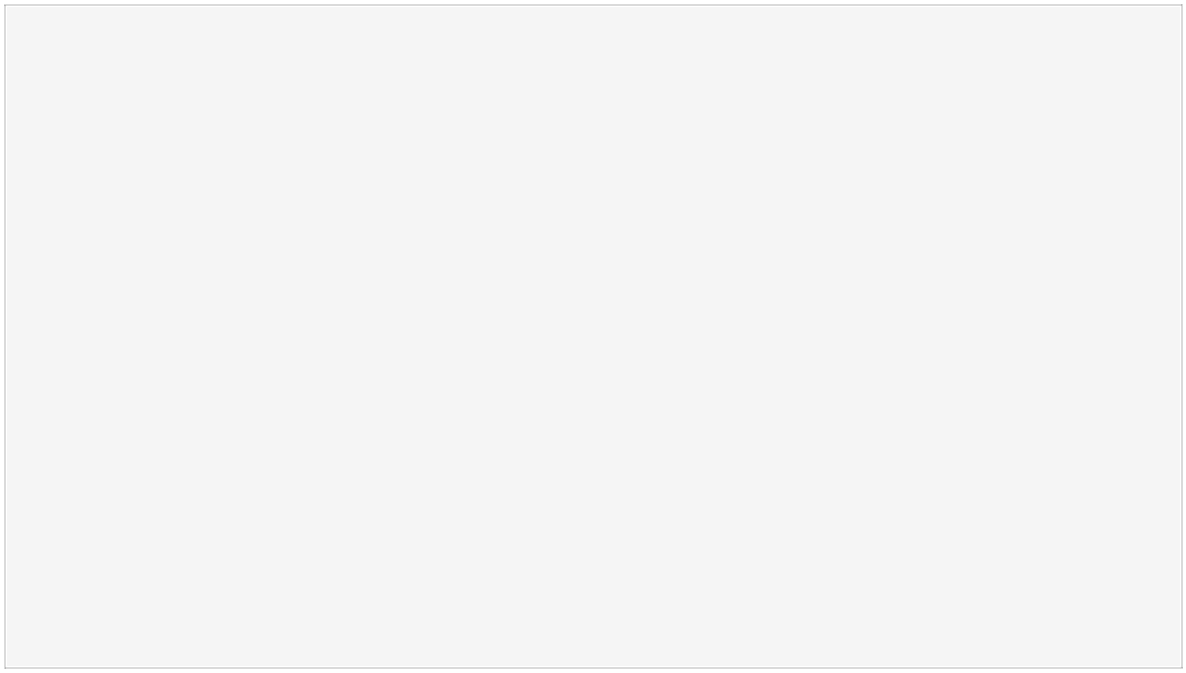
IMG-2085.MOV



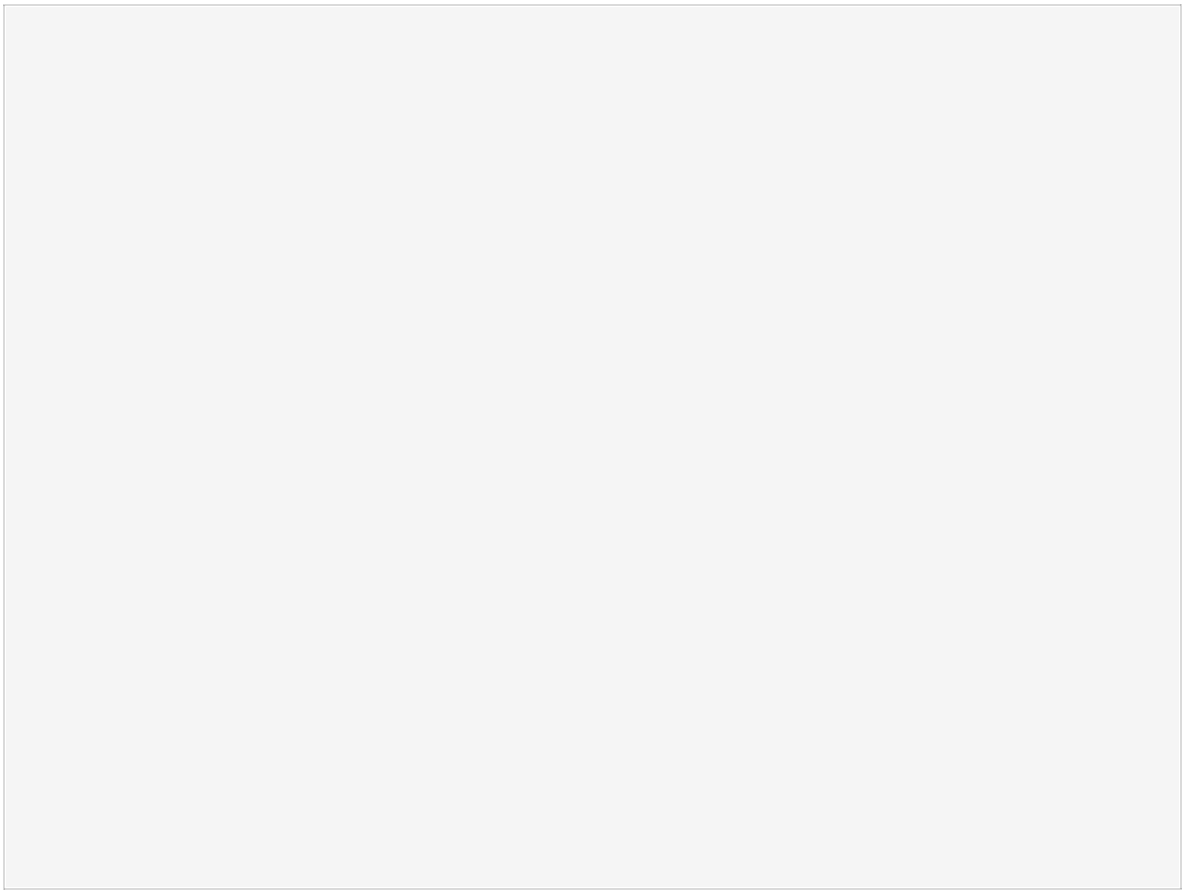
IMG-2084.MOV



IMG-2083.MOV



IMG-2082.MOV



IMG-2086.jpg

Pearl - here's the tube lineup for you.
From right to left...

- empty acrylic tube
- empty aluminum tube
- sad balls, half empty (as opposed to half full... because they're sad)
- sad balls, mostly full
- glass beads, half full
- glass beads, mostly full
- glycerin water, half full
- glycerin water, mostly full
- marbles, 1/2
- marbles, mostly
- small bbs, 1/2

- small bbs, mostly
- bigger bbs, mostly
- bigger bbs, 1/2

May 25, 2023

Pearl Tesler

Thanks Jessica! One question, okay two--is the mass/weight written on the tube? Or is there a scale? Also, is the material of the contents written on the tube? Not necessarily saying it should be, just want to know what's known and unknown.

pt

May 26, 2023

Jessica Strick

The tubes don't have any info added to them- about weight or contents- and there is no scale.
The idea of adding that info has come up a couple times (from the Explainers) but I'm inclined to go without labels and rely on people's ability to get a feel and see the differences.

Jun 5, 2023

Pearl Tesler

Hi all

Okay, here's an updated text file with the "3, 2, 1..." added and a LIGO connection made, though I believe we are still TBD on whether the countdown is really necessary.

As it stands, we're still unsure on where the WGO will go, but possibilities include a side-mounted label, a label on the back, and a lollipop or wall-mounted label. (LIGO folks say this one could easily be placed against a wall.) Maybe we should just go ahead and lay it out and decide from there...

Kill the Vibe--V5.docx
31.4 KB

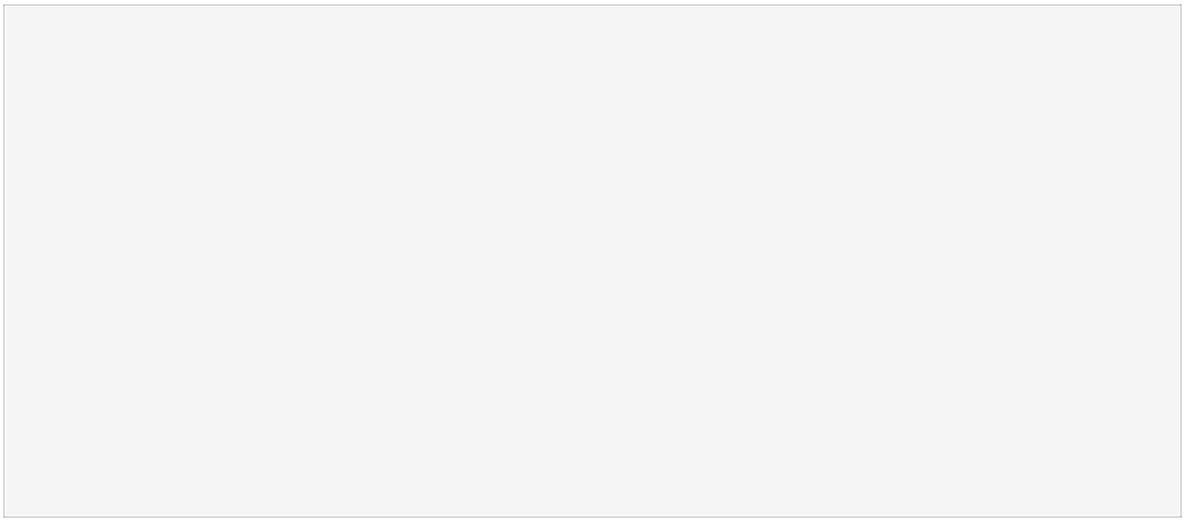
pt

Jun 6, 2023

Barbara del Rio

Label revised and attached.

Pearl Jessica Jay



1883_KilltheVibe_prototype_v4.pdf

Jun 6, 2023

Pearl Tesler

Thanks, Barbara--I was picturing the countdown in italic...bad idea?

Jun 12, 2023

Mason Friedberg

Hey All,

Back from vacation now and looking forward to getting together this week! Lots of good info, and it seems from what Jenn posted that many of the concerns we were seeing have been solved to some degree. Awesome!

Jun 16, 2023

Mason Friedberg

Jessica , just some notes from talking with engineering group about final experience and learnings we are trying to gain from this exhibit:
"Damping is hard and it takes different parameters to change the system. How the system is dampening depends on different parameters."

"Ultimately: A solution needs to be tuned for the application. There is a different optimal solution for different situations."

"One worry is still the number of parameters that are in play with the current design"

"One option: Keep two damper tubes, and have two stations; one with polycarb flaps, and the other with steel flaps. That way only one variable it changing"

I think for us at this point, it will be less about changing the exhibit and more about finalizing our change of variables and making sure we are happy with the change of variables that we currently have in our system. I think that some of this will come into play as Pearl helps us make the LIGO connection.

Looking forward to getting together when you are back!

Jun 30, 2023

Jessica Strick

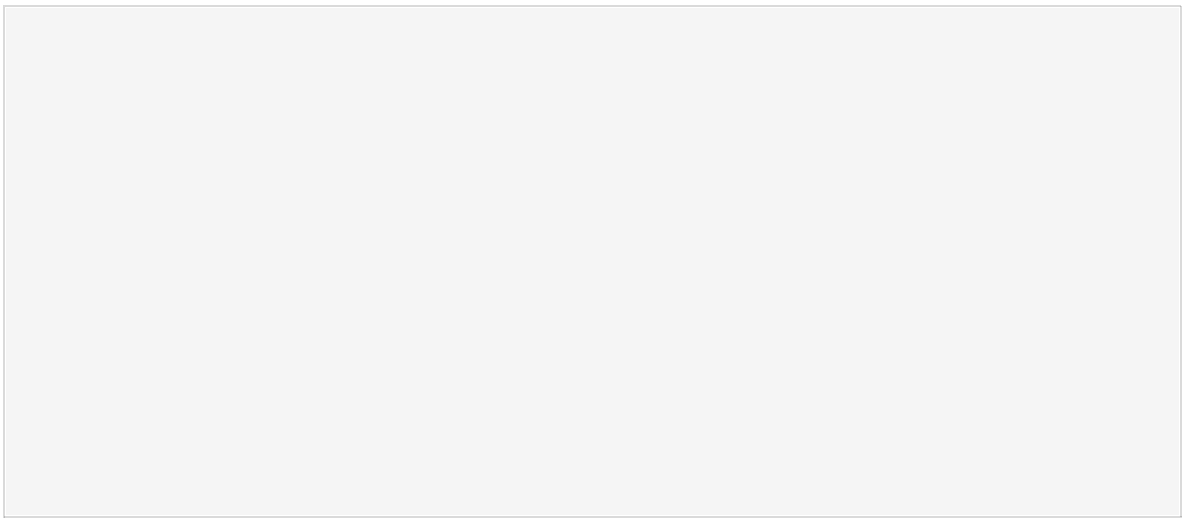
Hey there-
I am looking for a day to bring Race To Stillness back out for another look at how it does with the "3-2-1" addition and it's seeming like next Thursday and Friday would be good for me. Barbara , do you think you could do some label magic by then?

Jun 30, 2023

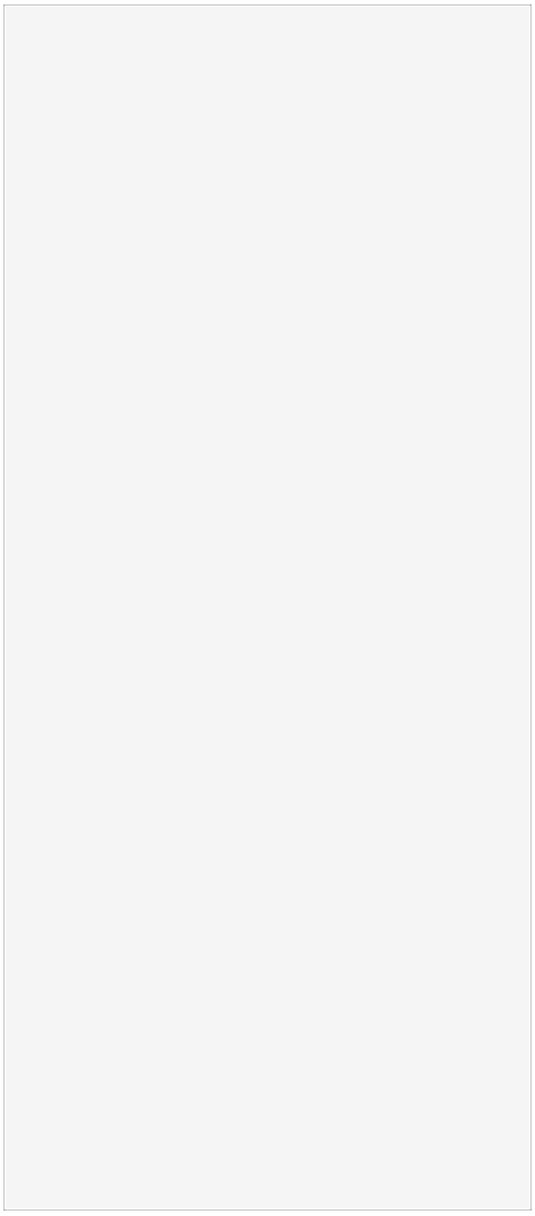
Barbara del Rio

🐓 Pearl Revised main graphic plus two versions of a "wing" label for the WGO. If these look good, I'll get them printed and trimmed next week. Thanks!

 Jessica  Jay



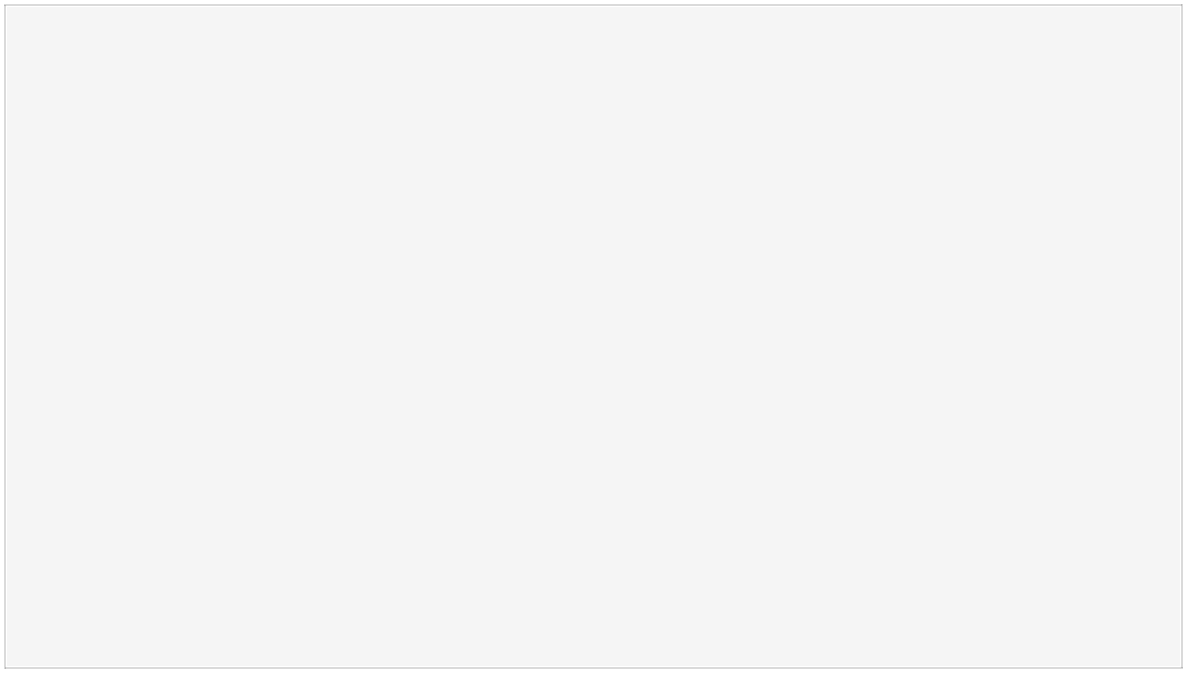
1883_KilltheVibe_prototype_v4.pdf



1883_TunedDampers_WGO.pdf

Jul 7, 2023

Jessica Strick



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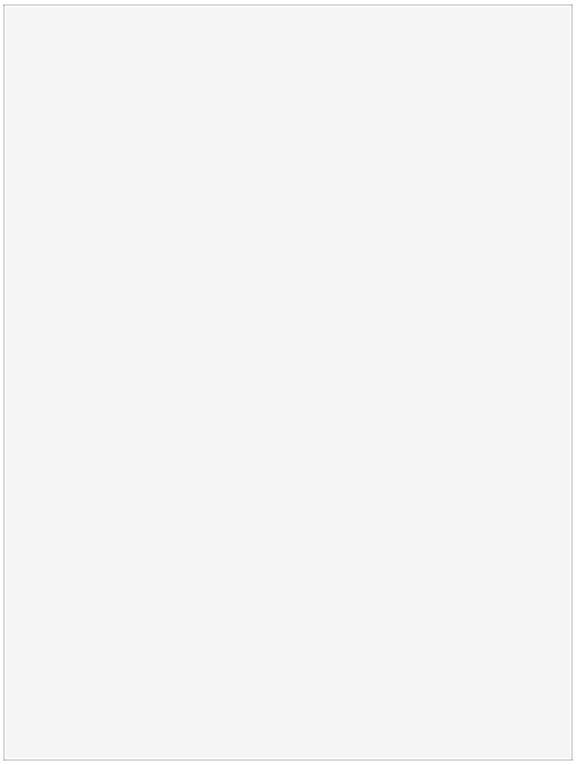
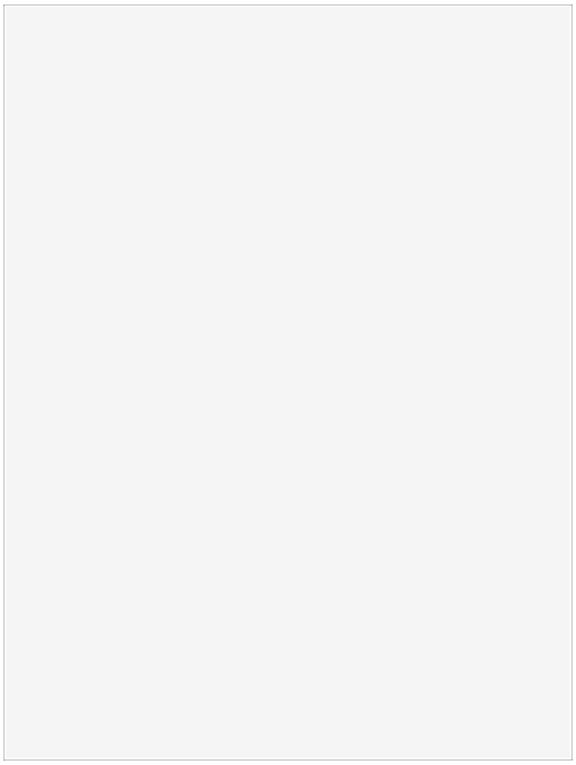


with LIGO info



w/o LIGO info

Brought this out today to see if the little tweak to the graphics and added WGO made a difference. It's hard to say if it made a difference, but I did see some good interactions at the exhibit. While some people started off moving the flaps randomly, they eventually figured it out and pulled them together- one group even said "1-2-3". Not "3-2-1" so I'm not sure if this was coincidental or if the added bullet point helped get them there.

You can see in the photo that I ended up cutting off the LIGO connection from the label- it is just too weird to include here, at Exploratorium. So the WGO is a little awkward! I also decided to have place it higher- it looked wrong as an "ear" next to the other label. Getting a good placement for this label in the actual design is going to take some figuring out. The width of the WGO is too wide to actually have hanging off the side (the way I have it now). It will need to be quite a bit lower for cane detection and to avoid toddler head bumps.

MF 🙌

MF

Jul 7, 2023

Mason Friedberg

Nice! I'll think a bit about where that graphic might fit well on the production design.

BDR

Jul 7, 2023

Barbara del Rio

I kind of like the mount with the arc at the bottom. We could produce a custom-shaped graphic like that no problem. The photo could also be smaller.

Aug 11, 2023

Jessica Strick

Pearl

BDR Barbara

I just got a message from Joe and William with a suggested edit.
I've cut and pasted the message:

I've made a suggested edit in the tuned damper text below, adding a final sentence that mentions that we also use electronic damping in the most sensitive places.

By the way, after our (William & Joe) discussion about the distinction between tuned damping, which uses resonance to disproportionately damp at certain frequencies, and what is happening in the physical exhibit, I considered adding some explanation about that here, but thought better of it. I like the exhibit the way it is and don't want to confuse people.

Joe

(top text in the shaded box)

Scientists must work very hard to reduce vibrations in the LIGO detector. Seismic waves, thunder, passing trucks, even footsteps could disturb LIGO's measurements. A variety of stabilization systems work together to isolate the detector from unwanted vibrations and to damp vibrations that do occur.

(caption text below quadruple suspension photo)

LIGO's mirrors are suspended from a system of pendulums, weights, and springs that are carefully designed to reduce unwanted vibrations. To make the main test masses extra quiet, their alignment and damping is done indirectly, from higher stages, using mostly electronic systems!

Aug 11, 2023

Jessica Strick

Pearl
WK William
BDR Barbara

Adding a note here as a reminder that we want to add a grey box- or some other visual call out- for both Tuned Damper's and Team Mystery's LIGO connection.

Aug 11, 2023

William Katzman

Thanks Jessica, also I would recommend changing from test masses to mirrors in Joe's suggestion:
LIGO's mirrors are suspended from a system of pendulums, weights, and springs that are carefully designed to reduce unwanted vibrations. **To make the mirrors extra quiet, their alignment and damping is done indirectly, from higher stages, using mostly electronic systems!**

Aug 11, 2023

Jessica Strick

Pearl - just making sure you are seeing this little tweak in the wording suggested by Joe! (see the comment above from William)

Aug 11, 2023

Desiré Whitmore, Senior Physics Educator

WK William do you think folks will know what it means for a mirror to be "quiet?" Perhaps we should instead say "**To make the mirrors extra still..."**
What do you think?

Aug 12, 2023

William Katzman

Desire I agree, still is a better word. I also have some concern with the word damping (tested with a 9th grader and he didn't know the word) and the length of the sentence. Perhaps: **To make the mirrors extra still, electronic systems stop movement and align the mirrors, indirectly from higher stages** or
Electronic systems in higher stages indirectly stop movement and align the mirrors, making the mirrors extra still. ?

Aug 14, 2023

Pearl Tesler

Hi all

Okay, here's what I'm suggesting for the caption:

LIGO's mirrors are suspended from a system of pendulums and weights that are carefully designed to reduce unwanted vibrations. Constant tiny adjustments from above help keep them extra still.

Does this work?

Pearl

Kill the Vibe--V6.docx
31.5 KB

Aug 22, 2023

Barbara del Rio

Hi MF Mason,

Have you made dielines for Tuned Dampers?

Thx,
B

Aug 24, 2023

Mason Friedberg

Hey BDR Barbara, the graphic dimensions aren't changing for this one, but I put the .DXF dieline files on Freya! Let me know if those look OK.

Aug 28, 2023

Barbara del Rio

Thank you, MF Mason ! We always like for the dielines to come from the engineer—that way we know we're both making the same size object. Jessica Pearl Please see the PDF I attached **AT THE TOP** of this thread. Note that this 4-page PDF shows two versions of the What's Going On; one which has a grey box behind the LIGO connection portion of the text. My understanding was the client wanted to see it both ways. I prefer the grey box version.

If these look all right to you, they can be shown to the client for approval. For now, I have assumed we will produce these in the embedded polycarbonate fashion we've grown accustomed to.

Thx!
B

Aug 28, 2023

Jessica Strick

BDR Barbara, I agree the grey box for the What's Going On panel is easier to read, chunks out the text.
Two questions!
1. MF Mason - does the use diagram look close enough to the final design?
2. MF Mason - is the final size going to work for the What's Going On panel? I think where we last left things, we were going to wait and see if it should be an "earlobe" on the tube tray, or hanging off the side in some non-head bumping way, or, as a last resort, on a separate stand.

Aug 29, 2023

Mason Friedberg

Jessica I think the most up-to-date label does represent the final exhibit design enough.

Additionally, I thought the 'ear-lobe' design was only a temporary configuration since we just wanted to cut off the LIGO Connection section of the label while it was on our own floor. I don't think that shape will work with the amount of text we need on there to include the WGO/ LIGO Connection text. Let me know your thoughts. We can hold off on sending that one out if needed.
BDR Barbara Pearl

Aug 29, 2023

Jessica Strick

Sorry for my poor terminology!
I realize now that the prototype used an earlobe shaped panel but I was actually referring to the idea of having that whole graphic panel hanging off the side of the tube tray (like a very big earlobe, lol)

Edited Sep 7, 2023

Mason Friedberg

BDR Barbara, wondering if it is too late to request adding 2" to width of the Main Graphic for this exhibit. So instead of 22" it would be 24" wide. Let me know if this is a possibility. If you already sent out, no sweat. The height would remain 8.5"

Sep 8, 2023

Pearl Tesler

Sorry for the long gap--big yes to grey box, BDR Barbara

Sep 11, 2023

Barbara del Rio

MF Mason , Adding 2" to the width should not be a problem.
Once that's done, do the labels need to go to the client for approval?
 Jessica , can we revisit the timeline? When are we delivering the exhibits?

Sep 11, 2023

Mason Friedberg

BDR Barbara no need to get new approval for dimension change, since content is not changing.

JP Jessica, Pearl , we are still GO on delivery for end of October.

 👍

Sep 11, 2023

Barbara del Rio

Mason If I'm interpreting the Basecamp threads correctly, the labels have not been sent to the client yet for approval. I've revised the multi-page PDF at the TOP of this thread to reflect the new size.
Pearl and Jessica , I like the WGO with the grey box as well, but did we want to show the two options to the client, or make that decision ourselves? Have they made a decision about materials for the labels?

Does end of October mean that's when it leaves the building, or do we need to allow time for shipping? We need to allow production time for these labels.

Sep 11, 2023

Mason Friedberg

Jessica can you speak toward client approval for the labels? Last I heard, you sent them samples for approval.

Barbara end of October (Tuesday 31st for arrival at LIGO) is the target, so about 1-2 weeks before that will be necessary for installing graphics on the builds here. Let us know if this sounds reasonable.

Sep 11, 2023

Barbara del Rio

Jessica , we are keeping our vendor Andresen pretty busy these days, so I'd like to give them a good lead time to produce the labels. Can we make sure to have final client approval and material decision by or before September 25?

Mason

Edited Sep 11, 2023

Jessica Strick

Yeah- sorry for the lapse. The emails have gotten tangled up and I'm seeing the response from William wasn't exactly a confirmation (but I'm kind of reading it as a confirmation). I'll double check and get back to you ASAP.

Sep 11, 2023

Pearl Tesler

Hi BDR Barbara and Jessica

Because our other exhibit (Team Mystery) does NOT need or use a "Ligo Connection" header, I'd very much prefer to follow the same (non-header) approach with Tuned Dampers, which means NO header, YES to gray box. I think that for both consistency and overall graphic clarity this is our best choice, so I'd prefer to not even offer them (or remind them of, if they've already seen it) an alternative choice at this late stage.

As far as I know, this gray box approach has in fact already been approved, but I'll wait for Jessica to reconfirm that...

pt

Sep 11, 2023

Barbara del Rio

Jessica , Will you be sending the PDFs to William again? Do you want me to delete the page showing the label without the box?
Pearl

Sep 11, 2023

Jessica Strick

Hey there-
We are all good with the wording and the grey boxes sans "LIGO connection".
The one thing that was vaguely ambiguous was whether or not we're going with embedded labels. I'm about 97% sure that we are from a previous reply from WK William but just now sent an email double checking that.

BDR Thanks!

WK

Sep 12, 2023

William Katzman

Yes, we've seen both and we're good with the more subtle grey box to indicate LIGO connection on an exhibit.

MF

Sep 26, 2023

Mason Friedberg

BDR Barbara just checking in to make sure we have ordered graphics for this. Thanks!

Sep 29, 2023

Barbara del Rio

MF Mason Yes, I placed the order September 18.

Thx,
B

MF 💪

Oct 2, 2023

Barbara del Rio

MF Mason , I just got a message from Shipping & Receiving, and the LIGO graphics are here! I may not be in until Wednesday, so if you want to pick them up, that's fine with me.

Oct 3, 2023

Mason Friedberg

BDR Barbara, these are picked up and near the LIGO production area in El Centro for your viewing and approval!

Oct 4, 2023

Barbara del Rio

MF Mason Those labels are perfection.