PhET Faraday's Law - Gatech Interviews Notes

Notes from Sonification Interview videos

- FL tested with #605, 606, 607 (Early Sep)
- FL tested with #603, 602, 608, 609 (Late Sep, early Oct)
- These interviews are working from v1.4.0-jump.9 build of FL (currently 1.4.0-dev.54)
    - A number of changes have been made based on feedback from the Early Sep. group which has not been tested w users.
    - The fundamental issues with the experience with text alerts remain
        - These issues can be addressed with switch to explicit grab/release interaction

#603

- PhET io sonification wrapper 1.0.0-dev.77
- Listened to most of DOM descriptions, and self initiated movement

Too many alerts and too long

Problem:

1. Users not waiting to listen to whole alert - just listening to the first part: "magnet at center of play area"
2. Lots of alerts are being fired (see #603 during exploration around coil @ ~2:00). Distracting from the sonification.
3. "Far from 4 loop coil. Very close to 2 loop coil." is too long.

Option 1:

- Text alerts only state proximity relative to coils
- Remove play area location from text alerts as they are redundant
- Put closest coil first in text alert.
- Shorten from "Far from 4 loop coil. Very close to 2 loop coil." to "2 loop coil very close, 4 loop coil far."
- Fire alerts only when thresholds are crossed, not on every stroke / key-up event.

Option 2:

- Use a grab/release interaction
    - State coil proximity on "grab"
    - State coil proximity change on release.
    - See PhET Faraday's Law - Grab and Release Interaction Sketch

Aside:

- The original design was to only fire alerts when certain thresholds were passed. In the dev version alerts are being fired regardless whether a threshold was transitioned
- Pauses between text alert messages makes people think that's all there is.

Remove Coil to the Left / Right alert when very close to the coil

Issue:

- The alert for "coil to left / right" can come across as jarring when already near the coil.
- Example, some confusion for #603 after that alert "4 loop coil to the right" (2:50 - 2:54).
- However, same user (#603) used the text cue at 36:15 and knew to move left to the coil, and again at 43:10 to find 2nd coil
    - #608 also found the prompt very helpful

Aside:

- The original intention of this alert is to help users "set up" their magnet so they know when the coil is to the left or right.

Confusion over the coil collision sound

Problem:

- Multiple users associated the "bong" sound with some sort of goal
    - #603 - interpreted the organ sound and the subsequent bong as a "bullseye"
    - #608 - interpreted the bong sound as "being in the coil".
- When coil is bumped, a "bong" sound is heard, but text alert says: "magnet at center of play area". There's a disconnect with the two.
    - Example: For #603 at 2:25, magnet inside coil and hit the top of coil. "bong" sound heard, but text alert says: "magnet at center of play area".
        - Text alert creating confusion because it's not describing what the "bong" sound means

Option 1:

- Remove text alert all together and just have the "bong" sound.

Option 2:

- When collision occurs, text alert should just say: "bumped a coil".

Aside:

- Play area edge bump and text alert is an example where this works well: edge bump sound is accompanied by an alert saying the magnet is at the edge

Sliding Cue

Problem:

- None of the surveyed users used the slide move (#603, #608)

Shorten the Play Area Edge Text Alert

Problem:

- The play area edge bump text alert is a bit too long.

Option 1:

- Change: "Magnet at middle-right edge of play area"
- To: "At edge" or "At edge of play area",

Option 2:

- Remove edge bump text alert (edge bump sound may be sufficient).

Aside:

- Alert seemed good. User immediately reversed directions (#603)

Tweak Circuit Mode Radio Button Text Alert

Problem:

- Not every user listens to the full text alert when switching modes.
- The two text alerts start off sounding the same.

Suggestion:

- Currently:
  - "Circuit now has two different coils"
  - "Circuit now has one coil"
- Change to:
  - "Two different coils now connected."
  - "One coil now connected".

Add coil location to scene summary and circuit description

Problem:

- Scene summary currently lacks any information to establish the location of the coil in the play area.
- Motivation: much of the text descriptions and alerts describe magnet and coil, and yet the coil is not mentioned at all in the scene summary.

Fix:

What	Currently	Proposed
Scene summary	"Faraday's Law is an interactive sim. It changes as you play with it. The play area has a light bulb circuit, and a moveable bar magnet. There are controls that change what is connected to the circuit, flip the bar magnet, and reset the sim. Move the magnet to play using arrow keys, W A S D, or 1 2 3 keys. If needed, check out keyboard shortcuts under Sim Resources."	"Faraday's Law is an interactive sim. It changes as you play with it. **At the centre of the play area is a coil*** connected to a light bulb circuit. There is a also moveable bar magnet. Move the magnet to play using arrow keys, W A S D, or 1 2 3 keys. Additional controls that change what is connected to the circuit, flip the bar magnet, and reset the sim. If needed, check out keyboard shortcuts under Sim Resources." *Change "is a coil" to "are two different coils" if both coils are showing.

Circuit PDOM description (1 coil)	"In circuit are a light bulb, a 4 loop coil, and a voltmeter. The coil is sideways, with openings on the left and right."	"Connected to the circuit are a 4 loop coil, light bulb, and a voltmeter. The coil is **at the centre of the play area**. The coil is sideways, with openings on the left and right."
Circuit PDOM description (2 coils)	"In a circuit are a: • Light bulb • 4 loop coil • 2 loop coil • Voltmeter The coils are sideways, with openings on the left and right."	"Connected to the circuit are a: • light bulb • 4 loop coil • 2 loop coil • volt meter The coils **are at the centre of the play area**. The coils are sideways, both with openings on the left and right."

Descriptiveness Concerns

- "In 4 loop coil." ... #603 had some confusion about what that meant. (7:40)

Add "Select magnet" to the instructions for moving it

Problem:

- Currently the scene summary and PDOM description of the magnet states they keys to move the magnet but omits the fact they need to select it first.

Suggested fix:

What	**Currently**	**Proposed**
Scene summary	"Move the magnet to play using arrow keys, W A S D, or 1 2 3 keys."	"How to play with the magnet: select magnet; move using arrow keys, W A S D, or 1 2 3 keys."
Magnet PDOM description	"Use the W A S D keys to move the magnet in four directions. Use 1 2 3 keys to slide magnet left and right."	"How to play with the magnet: Select the magnet; use the W A S D keys to move in four directions; use 1 2 3 keys to slide left and right.

Notes

- #603
    - 22:55 - figures out association of sound with being in the 4 loop coil
    - 23:11 - figures out closer you get the more intense the sound
    - 25:00 - trying to figure out what the bong sound is and why it happens.
    - 29:00 - changed rate of speech, the pause throws user off. Increasing rate helps
    - Didn't feel descriptions were enough
    - Knew there was a coil and magnet, and poles.
    - 30:00 - discovers volt meter
        - unchecks it but the volt mete is still visible. something wrong?
    - 33:50 - asked what happens when magnet moved through coil at different speeds
        - doesn't know if it does anything because it just tell him that it's in the centre of the play area.
    - 35:00
        - Wasn't sure there was more than 1 way to move the coil
        - Didn't know you can press and hold
        - Looking for a change in the description as a result of moving faster, but the text alerts remain the same (issue with text alerts disconnected w sonification)
    - 36:44
        - Prompted to switch coil modes
    - 39:00-16
        - Flipping poles, but after flipping had no way of remembering the polarity. Said: "I guess that's something you just have to remember"
        - But the description is in the PDOM. Is that enough?
    - 42:00
        - Confusion over an empty Level 2 header
    - 43:00
        - Was reminded there was already a 2nd coil. User forgot and was prompted.
    - 43:30
        - Searching for 2 loop coil.
        - Text alert said "to the right" an49d used that as a cue.
    - 44:30
        - properly describes the magnet position relative to the 2 coils and knows there's a the difference between the coils because of the different bump sounds.
    - 49:00
        - Describing the sounds. Knows the more intense organ sound is important, but admits to explore it more

- ⚠️ Text alerts are getting in the way.
- 52:12
  - Asked what happens when you move magnet quickly and said they couldn't tell the difference in sound.
- 53:00
  - Asked about the differences in coil sounds
  - Can't figure out if there's a difference. Spent so much time figuring out positioning that wasn't focusing and remembering the difference in sounds between the 2 coils.
- 56:04
  - Identifies that the sounds in the 2 loop coil are lighter and not as deep compared to the 4 loop coil
  - Says that the sounds from the 2 loop coil "all of them" are a pitch higher.
- 58:16
  - Asking to describe the sounds when flipping magnet, but magnet is inside the coil
  - can hear a difference between the different polarity.
- 1:00:00
  - Asked to describe the sim as if to a friend.
  - Described it has something to do with magnet and electricity, and differences between two coils
  - Hasn't quite figured out the purpose of the N and S poles
- 1:01:00
  - Asked whether this will help someone with impairment understand FL?
  - Answers tentatively, it's a memory thing - keep remembering what state it was previously
- 1:02:00
  - Said it would be great if there was some way to get a quick reference "this is what it is and this is where you are"
  - You have to tab or shift-tab to find out stuff and it can be confusing.
- 1:04:00
  - What do you like / dislike?
  - Dislikes not knowing what's going on.
  - Says they would like to be oriented "on my own". Feels like they will need to find a sighted person.
- 1:06:00
  - Compare to other sims used previously?
  - Said having some previous experience does help. Knows to use arrow keys, knows to more through descriptions.
  - Didn't get a good sense what is happening in FL.
  - Said this one is a more complex, says he feels stupid. Still hasn't figure out what the point of the N and S poles are.
- 1:09:00
  - ⚠️ Wasn't clear that the N and S poles are **ON** the magnet. Didn't make the association.
- 1:10:40
  - Asked about whether the sound and descriptions worked well together
  - Says they worked well, but had to get used to the presence of the pause that was throwing them off.
  - Increasing speech rate helped.
  - Doesn't like when the tones and descriptions overlap each other - not clear
    - Doesn't think there was a problem with overlapping
    - Says can hear both description and tones comfortably - one isn't louder than the other
- 1:12:20
  - Asked if there was a instance where the sounds and description really helped make something clear.
  - Tones and the dings with description let them know they hit something key.
  - Associates the presence of sound with getting to the "meat of things"
- Sim's capabilities meet my requirements - Agree.
- Using the sim is a frustrating experience - somewhat agree
- Using the sim is easy to use - somewhat disagree
- I have to spend too much time correcting things in the sim - strongly disagree
- Sound were helpful - strongly agree
- Sounds were interesting - strongly agree
- Sounds were pleasant - strongly agree
- Sounds were easy to understand - strongly agree
- Sounds were relatable to their ideas - strongly agree
- Easy to matych sounds to the meanings - strongly agree
- It was difficult to understand how the sounds changed from one variable to the next - strongly disagree (more of a memory issue
- Sounds were fun - somewhat agree
- It was boring sound - disagree
- Confusing - disagree
- Easy to understand what the sounds mean - Strongly agree
- The sim was complex - somewhat agree
- The sim is easy to use - somewhat disagree
- I need a technical support to use this - disagree
- Functions were well integrated - somewhat agree
- Too much inconsistency in the sim - disagree
- I think others will learn to use this sim quickly - somewhat agree
- I found it awkward to use - neutral
- I felt confident using this sim - somewhat disagree

#608

- 3:00 - appears to be having problems figuring out that focusing on the magnet is where you begin.
  - looking through the PDOM multiple times, and the Control Area, but can't find where to begin.
- 4:10 - comments about missing something
- 5:30
  - Asked what she was looking for, and was told to switch modes from Browse to Forms mode
  - ❓ How often does this situation come up? Should instructions be put somewhere (i.e. in the Help or scene summary?)
- 7:30
  - "I'm very confused" - can't seem to figure out how to get to magnet and move it

- 9:40
    - Still very confused. Was manipulating the coils and not getting what she wanted. Instructed to go and find the magnet.
- 9:48
    - Managed to find the magnet
    - ❓ Is the text cue not strong enough? Just says: "Bar magnet, move in 4 directions"
- 9:50
    - was moving magnet around, got it into the coil, bumped the coil
    - ❓ Is the bump sound enough?
- 14:20
    - Moved magnet around a lot. Bumped it along the edges a lot
    - Edge bump alert can be better.
- 16:02
    - User slides the magnet
    - No other audio cues because far from coil
- 18:02
    - Previously asked to turn on field lines
    - Now turns them off. Did not explore the PDOM to hear the updated description.
- 18:40
    - Asked to describe the sim
    - Describes the sim as having a coil, a circuit, magnet, and a voltmeter (although not sure what that is)
    - Not sure what the lightbulb is for
- 19:13
    - Knows the magnet can go in the coil because it's open on both ends
- 19:40
    - Asked how they navigated through the sim
    - Was using the arrow keys and getting no where
        - ❓ Possible the text description did not help either. The description says to use arrow keys but didn't say the context in which to use them.
    - Eventually was able to move magnet with WASD keys
- 20:10
    - Asked if used any other keys to move the magnet
    - Said used the 1 2 3 keys and it slid the magnet, but didn't give any additional description.
- 20:50
    - Asked about the descriptions from the screen reader
    - Said the descriptions were very specific
    - Also said didn't realize that the 1 2 3 keys wasn't sliding just inside the coil
- 21:40
    - Asked about the amount of time spent using Browse Mode
    - Didn't know they were in Browse mode. Thought they were interacting with the sim.
- 22:25
    - Asked what happens to the description as you move the magnet through the coil.
    - Says the descriptions tells the position relative to the coil
    - But still doesn't know what the voltmeter is for.
- 23:00
    - Asked which coil can generate the highest voltage
    - Was confused. Didn't really recall there were two coils.
    - Thought it was very confusing
- 24:00
    - Playing w sim again to try to better understand the two coils
    - Moving magnet around.
    - Hears the prompt for "coil to left / right" and was able to navigate to it properly.
- 25:15
    - Hits the coil and realizes it makes a different sound.
- 25:35
    - Asked again which coil generates more voltage
    - correctly identifies 4 loop coil generates more because it has a bigger and deeper sound.
- 26:00
    - Asked about the polarity
    - Responded by saying the magnet goes toward the coils different
    - Says the poles repel each other.
    - User is not clear about its purpose
- 26:30
    - Asked about the sliding
    - But said they couldn't tell the difference.
- 28:37
    - After playing some more, still couldn't answer the question
    - Couldn't tell a difference between the movement at different speeds.
    - ❓ Instructions for sliding isn't clear.
    - ❓ doesn't sound like the ticking sounds for magnet movement happens during a slide.
- 29:19
    - Asked about the sounds and what they mean.
    - Said that when the magnet is inside the coil, there's a "hitting a spring" sound.
- 30:10
    - ASked what the clicking sound means
    - just says that the magnet is moving
- 31:46
    - Has a strong association with the "spring hitting the table" sound.
- 33:10
    - associates the "humming sound" with the magnet interacting with the coils.

- 33:35
    - Asked what happens when you move the magnet through the coil
    - Says there's a "spring" sound.
- 35:51
    - Hears the organ sound, but doesn't know what is happening
- 36:45
    - Asked what happens when the magnet touches the coil
    - Thinks it might be the low humming sound
- 37:40
    - After some hints, realizes that the bong sound is when the magnet touches the coil
- 39:17
    - What happens when you flip the magnet
    - magnet makes a clicking sound and an organ sound
- Sim's capabilities meet my requirements - Agree.
- Using the sim is a frustrating experience - Agree
- Using the sim is easy to use - disagree
- I have to spend too much time correcting things in the sim - disagree
- Sound were helpful - strongly agree
- Sounds were interesting - strongly agree
- Sounds were pleasant - strongly agree
- Sounds were easy to understand - strongly agree
- Sounds were relatable to their ideas - agree
- Easy to match sounds to the meanings - agree
- It was difficult to understand how the sounds changed from one variable to the next - disagree
- Sounds were fun - strongly agree
- It was boring sound - strongly disagree
- Confusing - strongly disagree
- Easy to understand what the sounds mean - agree
- The sim was complex - somewhat disagree
- The sim is easy to use - somewhat disagree
- I need a technical support to use this - somewhat agree
- Functions were well integrated - neutral
- Too much inconsistency in the sim - strongly disagree
- I think others will learn to use this sim quickly - somewhat agree
- I found it awkward to use - strongly disagree
- I felt confident using this sim - somewhat agree
- I needed to learn new things in order to use this sim - strong disagree
- 44:55
    - How would you describe this sim to a friend
    - "I would describe it as incredibly confusing." "There were a lot of pieces and I didn't know what to do with them until you told me."
    - Didn't like how you had to go in and out of Forms mode. "Found that incredibly frustrating."
- 47:30
    - Would you see this sim as being helpful for others learning the concepts.
    - Said the descriptions were good and perhaps not use as much sounds.
- 48:40
    - How would you improve the simulation
    - Label the items so they know it is interactable.
    - Thought the checkboxes were confusing
- 49:30
    - Asked to elaborate on having more descriptions
    - Felt that the sounds and descriptions were competing with one another
    - Couldn't pay attention to both at the same time.
    - Was relying more on the description - they made more sense than the sounds did
- 50:20
    - Compared to Friction, how does this one compare?
    - Found FL more difficult because of all the pieces and playing with each one individually.
- 51:00
    - Asked to comment on overall experience
    - Said that once she figured out what was happening, everything became more clear
    - Found that 2 coils was more difficult than 1.
    - Liked knowing where everything was like "the coil was to the left."
- 51:52
    - Asked about not knowing about the voltmeter was
    - Guesses that it's somehow measuring the electricity between the magnet and the coil
    - Hadn't realized that the sound was associated with the lightbulb or voltmeter

#602

- 0:00 to 10:30
    - Exploring sim
- 0:10:33
    - Enabled field lines and wondering about whether the field lines changed
    - Wondering what they're supposed to be showing.