iPad Apps Trial Test Results

World of Viruses Formative Evaluation with Middle Level and High School Students

World of VIRUSES

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Executive Summary
iPad apps Trial Test Results: World of Viruses Formative Evaluation

To provide timely and relevant feedback to developers on the World of Viruses iPad apps, we conducted formative evaluation with two groups of teens. Using iPads loaded with the Never-Ending Battle (Ocean Virus comic) and the Frozen Horror (Flu Virus comic) and the related interactive apps (beta versions), students read the comics on the iPad and worked with the different apps. Researchers observed students as they interacted with the apps, students provided written feedback about the comics and apps, and students discussed their impressions and experiences in a small group led by one of the evaluators.

Overall, students liked reading the comics on the iPads, and listened to the entire narrative with both comics. Most of the students had had little prior experience with iPads, so the novelty of using the devices was appealing. However, this also contributed to some of the technical difficulties that the students encountered, such as tapping too hard or too quickly, or not recognizing cues on the pages, and many students wanted better and/or more instructions within the apps. Students felt that having the comic on the iPad made it more appealing than a print version, and all participants said they would like to read another comic in the series. Most students said they would recommend the comic and the apps to friends to learn about viruses. The participants felt they had learned more about viruses and that the associated apps helped to clarify and expand on the ideas presented in the comics. While almost all the teens liked having the dramatized narration with the comic, some felt that it was a little "hokey." Most students felt that the narration should move faster, and some thought that the sound effects could be a bit quieter. Students liked working with the apps and spent a lot of time interacting with them. With the first comic, most students waited till the end of the comic to access the apps, and many were not sure what the "glowing spots" (indication of apps) were. Students became more adept by the second comic, and some of the high school students accessed the apps as they were reading the comic. Most students felt that the shorter apps were appropriate to access during the comic narrative, but that longer ones, such as the "So Many Strains (Tree Activity)" in the flu comic, should be placed at the end of the comic. The apps caused a few glitches with the iPads, sometimes getting stuck or closing unexpectedly.

With respect to the Never-Ending Battle specifically, most students could explain the main idea of this comic, as well as the main points of the three apps. Students really liked the way the "Explore an Algal Bloom" app worked to give them a better sense of the size and location of the bloom, and some suggested that using all "real" images would be better. The "So Many Viruses" app loaded slowly, and students found it difficult to navigate (many did not read the instructions). Students had several specific suggestions to improve this app, and once they understood how to use it, many students enjoyed dragging the objects and seeing the numbers. Students liked the straightforward, colorful "Inside EhV" app, but wanted more information included, such as definitions or functions of the virus parts.

With the Frozen Horror, some students found this comic confusing, and weren't sure if it was real or of the meaning of the pig/bird creature. Several students wanted a sequel, since they felt it ended on a cliffhanger. Most students were able to identify the main idea of this comic, although they had more difficulty understanding the concepts behind the apps. Students liked the setup of the page, pictures, and quick facts on the "So Many Strains (Dial Activity)" app, and appeared engaged and interested in the content when using it. Suggestions included making a more efficient way of searching and better instructions; some students had to be prompted on how to use the dial and did not find the tabs for the different outbreaks of the same strain. The "So Many Strains (Tree Activity)" was the most confusing of the apps for the students. Students were not sure what to do (most did not fully read the instructions), many felt the app was inconsistent with the rest of the comic, many did not understand the context or purpose of the app, and some were unsure about the meaning of the trees. Students had several suggestions to improve this app. Students found the "Inside Influenza" app informative and mostly easy to use, and liked opening the layers and the quality of the graphics and having the definitions available.

Overall, students enjoyed reading the comics and interacting with the apps, and mostly understood the content presented in the materials. The observations of students' interactions with the apps and specific suggestions for improvement should help identify changes for the current apps as well as inform the design of future World of Viruses apps.

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World of Viruses Formative Evaluation

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Purpose: Formative evaluation provides developers with feedback about instructional materials under development. It is frequently used to identify problematic aspects or areas in need of improvement, as well as to validate that the instructional goals of the materials are being met. Using the target audience during this formative phase helps ensure that the feedback provided is relevant. Formative evaluation on the iPad comics and apps was undertaken to provide information both about how to improve the specific apps that were reviewed, and also to provide information useful to the design of future apps developed for the World of Viruses comics.

Methods: Data were collected in two sessions, one with middle level students (n=8, 6 female, 2 male) and one with high school students (n=9, 6 female, 3 male). In each session, researchers provided students with iPads loaded with the two comics and the related interactive apps (two students per iPad). These were working but not fully finished versions of the apps. Students read each comic and interacted with the associated apps, while researchers observed students and provided help as needed. Students were asked to complete feedback forms with specific written comments. Then one researcher led the student group in discussion about the comic and the apps. This format was followed for each comic reviewed: Ocean Virus comic was presented first, then the Flu Comic. Each data collection session lasted about one hour and fifteen minutes (see Appendix A for more detailed information on methodology and Appendix B for a copy of the feedback forms used).

Findings: Feedback from the formative evaluation student groups sessions are summarized in three main sections: overall comments on comics and apps, feedback on the Ocean Virus comic and apps, and feedback on the Flu Comic and apps (see Appendix C for detailed student and observer comments). These notes provide specific suggestions to increase the usability and understandability of the current apps, and should also help inform development of future apps.

Overall Comments on Comics and Apps

Students liked reading the comics on the iPad, enjoyed the interactive nature of the apps, and felt it was "better than learning from a book." They felt that having the comic on the iPad made it more appealing, and all participants said they would like to read another comic in the series. Most said they would recommend the comic and the apps to others to learn about viruses. The students felt they had learned more about viruses and that the apps helped clarify and expand on the ideas in the comics. While almost all liked having the narration and thought "the sound effects were cool," there were many recommendations on how to improve them; including speeding up the narration and/or sound effects and being able to turn them off.

When asked about sharing the comic via social media, some, especially middle level students, said they might share it on Facebook (most were Facebook users), but others thought email would be a more appropriate way to share a game. Thirteen of the seventeen participants said they read comics/graphic novels, and they felt these comics "sort of" fit in with those. They said they learned something from the comics (one student "didn't know ocean viruses existed before"), and several students indicated that they wanted a sequel to the Flu comic since they wanted to know how the story continued. Some students found the Flu comic confusing, and weren't sure if it was real or of the meaning of the pig/bird creature.

While many students had had little previous experience with the iPad, they appeared to quickly catch on to the conventions used, especially with students paired together on a single device. Nonetheless, one student wrote, "I wasn't quite sure what to press in the interactive animations," and participants had some difficulties interacting with the apps (not finding cues or not getting it to work), and several indicated that more instruction at different points would be helpful. Students tended to feel that the shorter apps were appropriate to access during the comic narrative, but that longer ones such as the Tree Activity (Flu) should be placed at the end.

The apps caused a few glitches with the iPads, causing the device to get stuck or close the app unexpectedly. Some high school students commented about the apps not being well integrated with the comics; they wanted narration with the apps, similar to the comics, and more consistency between the comic and the other apps in graphic style, format, and interactive commands.

Participants suggested games to go with the comics, and one student said she had already found the Ocean Virus game (Virus Nightmare Adventure) on iTunes, by searching under "Lincoln, NE." She thought the game was "kind of hard."

The Never-ending Battle (Ocean Virus)
Suggestions for improvement
THE NEVER-ENDING BATTLE COMIC
Overall, all the students said they enjoyed the comic, most felt that the comic book format was more interesting than reading a textbook, and liked using the iPad. They all listened to the narration till the end of the comic, reading along, and indicated that they liked it ("narration was great"). However, almost all the students felt that the narration was too slow. Some high school students also thought it was kind of "cheesy," overly dramatic or outdated ("no one says 'joshing' anymore"), while others commented that they liked the style. A few suggested a little quieter or improved background music, and shorter sound effects. While students liked having the dramatized narration (it "didn't sound like it was from a textbook") and felt it "helped," they also wanted the option of turning it off.

The students liked the quality of the artwork images, and one commented positively on the character details of having the algae cells on the monster and the EhV ships looking like the actual virus. One student raved about the comic, writing that "it had everything a comic

needs to be awesome: color, awesome story, easy to understand, and cool characters and information." Some students said that they learned a lot, but one student felt that the story was confusing and suggested, "maybe explain what the algae is at first or how EhV works." Some students said they would read about viruses on their own, that the comics were "recreational" enough to be enjoyable and not too educational, and that they would recommend them to a friend. A few middle level students felt the comic format was designed for someone a little bit younger (by one or two years). One student commented on how there was a lot of information in a single speech bubble.

When asked to write the main idea of the comic, most of these students grasped the concept of the algae growing out of control and that the virus plays an important role in keeping the ocean in balance. One participant wrote, "not all viruses are bad." Another wrote, "it explains to kids that life on earth is fragile… and how small things like viruses play a huge role in the ecosystem and can be good as well as bad."

Use of the apps in the comic: Some middle level students thought that the glowing images were just an effect, not an indicator of anything. While all the high school students noticed the glowing (indication of apps), most did not tap on the glow until told to do so. A few students wrote that there should be instructions letting you know to tap on the "flashing lights" or "glowing spots" for a game. Most students waited to use the apps after they finished the comic narrative.

The comic and apps had some glitches in several cases. One iPad got stuck between pages in the comic and froze up (we had to switch to the other comic); another crashed after a few pages and had to be restarted; in another case, clicking on the last app (Inside EhV) caused it to go to the menu instead of the app.

EXPLORE AN ALGAL BLOOM
Students commented, "this is so nifty," "I like it" and "helps with [understanding the] scale," about this first app. They liked seeing where the algal bloom was located on the earth, tapping on the screen to zoom in (it "felt like Google Earth"), and getting a better sense of the size. Several high school students recommended using a "real" image of earth instead of a drawing. One student wrote, "Because of the mix of illustration and photographs it wasn't apparent how REAL it was; I'd suggest only using photos, if possible." Middle level students asked if the images were real, and commented that they liked how real they looked. Most knew what to do to move through the images, but a couple middle level students wanted more control on whether you zoomed in or out, and to be able to chose to go back to the beginning. A few noticed the scale displayed with the images, and one student stated that it "helped me understand [what an algal bloom was] better." One student thought it should be explained more.

When asked about the main idea of this app, most students explained about the "scale," "size relation" and/or "location of the algal bloom." One middle level student wrote, "I didn't really learn anything," while another remarked, "[The algal bloom] was located near England. That's very astounding. That whole thing is a growing and living organism." A

high school student wrote, "the individual algae are very small, less than a micrometer, but all of them span for miles."

SO MANY VIRUSES
This app loaded slowly, and several students initially found it difficult to navigate (many did not read the instructions). Several middle level students experienced difficulties interacting with it, having trouble getting it to work and having it freeze up, possibly from tapping too much. One student had difficulty understanding how to get out of the numbers pop-up window and suggested adding an "x" in the corner to exit it. Another student suggested using the scientific notation first, and then having to touch it to move to "show all the zeros." The high school students felt that simpler or clearer directions ("drag items"), a brief example, or an introduction where you can tap the glowing objects would improve the app. Once they were shown how to use it, many students enjoyed interacting with this, but not all. Some said this was their favorite app, and some students spent quite a bit of time dragging the different objects, reading the numbers and switching back and forth to the scientific notation and comparisons. Comments from the middle level students included, "I like how it compared how many viruses could fit in one thing," "It's really fun to play with," and "Great interactive features."

Some students described the main idea of this app was showing how many and how small viruses are, and in a "more comprehensible way." Similarly, others referred to the exploration of size relations and ratios among the different objects.

INSIDE EhV
Students liked this straightforward, colorful app, but wanted more information. They liked the quality of the graphics and looking inside the virus ("gives reader time to look at cell and not be overwhelmed," and "I thought the whole inside structure of the virus was very cool."). While they liked the simplicity of this app, almost all students wanted more, suggesting zooming in more, interacting more (being about to rotate the virus), and providing more information about the virus parts, such as definitions and functions ("there's hardly any information").

Students thought the main idea of this app was to show the cross section and parts of EhV.

The Frozen Horror (Flu)
Suggestions for improvement
THE FROZEN HORROR COMIC
Students liked the comic, and all were engaged throughout their reading/listening, but several, at both high school and middle level, were confused by the presence of the pig/bird and did not understand the connection between the shape-changing virus and the creature. Some students said they found the ending confusing, while others liked the mystery and asked, "can you catch it from different animals?" They generally liked the narration and how the "spooky" voices created a mood, though many felt it was too slow. Some thought that the dialogue was awkward and/or "hokey," although others liked the dramatic narration. Some participants felt the background sounds were too loud, and/or the

narration could have been improved (participants thought the main character should have been thinking and not have a narrator; the different voices were confusing). A few students also felt that the focus should be more on the virus than the myth. Some students wanted a sequel, since they felt it ended on a cliffhanger and they wanted to read more. Several students remarked that they liked this comic better than the Ocean Virus comic.

When asked what the main idea of this comic was, students described influenza's deadly effect on a village. Some mentioned it as an epidemic; a few talked about different strains of the flu. A few students mentioned the goal of making a vaccine, and one high school student discussed how flu is a highly adaptable virus and "changes by mingling with strains of bird and pig flu." One middle level student wrote, "I am now a little more alert of touching random animals. I would not like to start a massive epidemic."

Using the apps: Some middle level students (who read this comic first) did not find the apps. They saw the glowing images, but didn't know they should touch them. The majority of middle level participants read through to the end of the comic, and then went back explore the apps afterward. Most students appeared more comfortable with the interface since this was their second comic, and more of the high school students accessed the apps as they were reading/listening rather than waiting till the end (no prompting was needed). Some middle level students indicated that they preferred to look at the "inside the virus" app during the comic, but thought that the longer apps (dial, tree) were easier to investigate at the end.

SO MANY STRAINS (DIAL ACTIVITY)
Students said they liked the setup of the page, the pictures, and the facts that were "quick, to the point." Students appeared very engaged in this activity, and some commented that they liked the information about the affected animals and seeing so many of the different combinations of the flu. Some wanted a more efficient way of searching the different strains, a map that showed the whole world at once, better instructions on using the app (some did not understand how to spin the dial and others tapped additional areas of the screen), and more information about influenza (such as an explanatory paragraph).

Some participants had to be prompted on how to use the dial and did not find the tabs for the different outbreaks of the same strain; others knew what to do right away and also played with the tabs. They liked spinning the dial, and seemed interested in the content, with several students looking up many different combinations. This app was especially important for one student, who did not understand that the comic was about the flu until he used this app. Some students had difficulty figuring out how to spin the dial, and the dial on this app sometimes got stuck.

Students mostly identified the main concept of this app as showing when, where and what was affected by different flu strains. Some students focused on the mapping of the flu outbreaks, others identifying others focusing on the "different names of the epidemic strands and stats" and a few students indicated they were unsure about the point of the app.

SO MANY STRAINS OF INFLUENZA (TREE ACTIVITY)

This was the most confusing of the apps for the students. Students were not sure what to do (most did not fully read the directions), many felt that the app was inconsistent with the rest of the comic (different buttons, animations, type), many did not understand the context or purpose of the app ("I don't get why we do the trees"), and some were unsure about the meaning of the trees ("are the trees about the flu?"). Some middle level students had difficulty moving the trees around, and took awhile to find the appropriate buttons (tried to swipe instead of "continue" button, tried dragging cards or tried to select a character to be instead of "compare"). Students suggested improving the instructions, having the narrator read the instructions, making the objectives of the task clearer, and including a "help" button. Some students suggested that because of the length of this app, it should be placed at the end of the comic and perhaps also split into two separate apps (trees and quiz questions), so it wouldn't interrupt the narrative flow.

While several students became engaged in and enjoyed the matching game once they understood what the task was, others felt that it took too long. Some students suggested using fewer trees, since there were so many and it was a repetitive task. Some students took time to read about the different types of flu, others did not. Some students exited the app before seeing the final question section, and students who did reach the questions section appeared to spend little time with it. The app froze up for a couple groups, and for one group the trees disappeared and the app had to be restarted, with none of their matching work saved.

One student wrote, "There was so much content, I became uninterested." Others wrote, "This was very confusing," and "I had no idea what I was supposed to be doing." One student, however, wrote, "I think the idea of the game is very good."

Students took away different ideas about the main point of this app. One student identified it as "a history of diseases caused by viruses," others described comparing diagrams of viruses or different trees or charts, a couple students said it was to teach about different strains of the same virus, and one student said, "it was confusing." Only a few students identified this app as a way to learn about connections between flu strains, and it appeared that few participants understood what the trees represented.

INSIDE INFLUENZA

Students found this app informative and mostly easy to use, but a few of the middle level students did not find the definitions on their own and had to be prompted. They like having the definitions available and commented that the other comic [Never-ending Battle] with similar app should also have definitions. They liked opening the layers, and enjoyed the quality of the graphics. Some suggested making the virus rotate, and one student wanted more in-depth explanations.

They described the main idea of this app was to show the internal structure of influenza.

Appendix A
Methods

Test dates: 20 & 24 January 2011
Participants: Zoo School High school students (N=9, incl. 7 10th graders, 1 11th gr. & 1 12th gr; 6 F, 3 M);
　　　Lefler Middle School students (n=8, all 8th graders; 6 F, 2 M)
Data collectors/observers: Adam Wagler, Amanda Richardson, Nicole Bryner, Leah Carpenter, Judy
　　　Diamond, Amy Spiegel

Data Collection Plan: Data were collected in two sessions, one with a group of middle level students and one with high school students. Each session used the following methodology:

Individual Sampling:
(First 15 minutes) - Participants will be presented with iPads (two participants per iPad) loaded with the comics and related interactive iPad apps. Researchers will ask participants to read the Ocean Virus comic and interact with the related interactive applications as they read. Researchers will observe students and provide help as needed for students to access and interact with the apps.   Each student will be provided with a form on which to record their feedback on each app, with two columns for specific comments: Main ideas and Suggestions for Improvement, and also Overall Comments.   Researchers will encourage and provide help to students to complete their comments form.

(Second 15 minutes): Researchers will ask participants to read the Flu comic and interact with the related interactive applications as they read. Researchers will observe students and provide help as needed for students to access and interact with the apps.   Each student will be provided with a form on which to record their feedback on each app, with two columns for specific comments: Main ideas and Suggestions for Improvement, and also Overall Comments. Researchers will encourage and provide help to students to complete their comments form.

Group Discussion: (Next 10 minutes) - The moderator will call the group together to ask the following kinds of questions of the students, encouraging them to refer to their notes:
　　　　　What do you think of having the apps be part of the comics?
　　　　　What worked for you?
　　　　　What didn't?

Then working through each comic application, the researcher will ask the following types of questions:
　　　　　How appealing was the app?
　　　　　What was the main point?
　　　　　How could we make it better?
　　　　　Would you recommend this app to or share it with a friend?

Appendix B: *Instruments*
World of Viruses Formative Evaluation: Ocean Virus iPad Apps
Feedback

School Name: _____ Date _____

For each activity in the Ocean Virus iPad app, please describe the main ideas you learned from it and how you think it should be improved.

Main ideas	Suggestions for improvement
1. ***The Never-Ending Battle Comic***	
2. ***Explore an Algal Bloom***	
3. ***So Many Viruses***	
4. ***Inside EhV***	
Additional Comments	

World of Viruses Formative Evaluation: Flu Virus iPad Apps
Feedback

School Name: _____ Date _____

For each activity in the Flu Virus iPad app, please describe the main ideas you learned from it and how you think it should be improved.

Main ideas	Suggestions for improvement
1. *The Frozen Horror Comic*	
2. *So Many Strains (Dial Activity)*	
3. *So Many Strains of Influenza (Tree Activity)*	
4. *Inside Influenza*	
Additional Comments	

Thank you for your feedback!
For questions, please contact Amy Spiegel, aspiegel1@unl.edu

Appendix C
Student and Observer Notes[1]

The Never-ending Battle
Suggestions for improvement

COMIC
Student comments (high school):
- When there are different things talking (narrator ➔monster) change how the words are written
- Tweak dialogue so it's less cheesy
- Speed the narration a little
- narrator faster / more excited?
- The speaking felt slow during the beginning, some of the gapes between the speaking felt long.
- EHV and how it affects emilliana huxliayi was a little confusing at first. Maybe explain what the algae is at first or how EHV works.
- Quieter background noises. Joshing?
- The music or soundtrack could be improved.

Student comments (middle school):
- Maybe telling you to click on the glowing spots for more information
- If the narration was a bit faster; & on the last page, one of the last spots doesn't say whats written
- A little confused when it changed from factual to all like RAWR! But I understood it. Sometimes a lot of info in one speech bubble. Awesome pictures and sound effects.
- I like the different voices and how it read it to you. The pictures were really cool. It would be cooler if voice the fish could move and water could move.
- Making some of the sound effects shorter on the narration option.
- Thought it was cool how it's a comic and all the sound effects. The monster and broadening of the view was pretty neat.
- Some kids might not know how to flip the pages or that the flashing lights mean there is a game or something, so an explanation or indication of that would be good. (It was interesting. Liked it, the illustrations were cool.)

Observer notes (high school):
- Narration starts before first page? Had to turn narration off – then move to comic first page, then turn on, to get the timing right.
- Students said, "Liked it a lot" "Good images, liked narration, but few instructions had to try out to figure out what to do."
- "Cool sliding" – they took turns sliding to different pages at first
- Took just a second to start on cover, wasn't sure how to start
- Saw stuff glowing that is was "cool" but did not tap to see what it was
- Both participants were clearly reading along with the narration.
- Overall the comic received positive feedback.
- The male participant mentioned that at first the EHV and algae were confusing, but as the comic progressed, it made more sense. The female participant said that she had already had biology so this made more sense to her.
- Both liked the narration and sound effects, but found the pacing to be too slow.
- Overall the participants enjoyed that the comic "didn't sound like it was from a text book."
- Both students also commented that they liked the use of words like "joshing" and enjoyed that the virus was a character that also talked.
- However, both noted that the middle of the comic seemed a bit "cheesy", but they thought it was to be expected as part of the comic book format.

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[1] Note that student comments are reported here verbatim (without correction) from their written feedback.

- Did not tap on the aps while going through. Mentioned when prompted that they noticed the glowing, but did not know to tap on them.
- Female participant began the session by stating that she was an audio learner and if the comic was not narrated she would like to read aloud.
- Both participants gave each other looks and stated "this is dramatic" when the comic began.
- Overall feedback was positive but participants clearly had opinions about improvements.
- Participants commented that if the comic was used for younger kids they might not know what a lot of the words mean.
- Participants commented that they "liked it" when speaking about the comic.
- Participant comments also included "I don't know how to work this." and "I'm not a very good teenager." referring to difficulties operating the ipad (turning pages, using apps).
- Participants stated that they learned a lot, that they didn't know much about the ocean before the comic.
- Female participant commented that she liked the way the characters were drawn with attention to details; she thought it would be easy to leave out details but liked how the algae monster looked like the algae and had algae cells as details on the monster as well as the ships that fought the algae looking like the virus.
- Participants liked the artwork and specifically commented on the colors especially the green and purple.
- Female participant found the background noise distracting, she liked the effect and commented that it was "great," but stated that it was too loud at times.
- Participants commented that they hate bad illustrations and that it would have been easy to mess this up but stated that "this is good."
- Participants commented on the word "joshing" and stated that they haven't heard it since they were kids and thought "kidding" or "joking" would have been better.
- Both participants took notes/answered questions throughout the comic while reading and listening.
- Participants did not explore the apps while going through the comic. Only after prompting did participants go back and explore the apps.
- Participants stated that they thought narration should be included in the apps, that is was weird to go from sound to no sound.

Observer notes (middle school):
- Both participants were clearly reading along with the narration.
- Overall the comic received positive feedback.
- Both felt like the comic was easy to understand.
- Each felt like the comic was intended for "someone younger." When asked it was because the comic included a monster with a "bad guy" versus "good guy" theme. When probed about what age/grade they thought this was created for they thought 6th maybe 7th grade.
- Both liked the narration and sound effects, but found the pacing to be too slow.
- Each liked that they could "flip" the pages instead of just clicking "next".
- The comic book format was more interesting than reading a list or a textbook. Both thought it was a good way to blend educational information in with a comic.
- Overall this group was very quiet.
- When sound started there was immediate giggling from the female participant.
- Participants held the ipad like a book.
- Comments during the comic included:
  - That was sweet.
  - Woa.
  - Uh oh.
- They clicked on the apps right away while they read the comic
- The 2nd app about size and comparing-they said it needs more instruction
- Would rather see scientific notation
- Clicking on the last app caused it to go back to menu
- I asked if they would like apps in any other spots to clarify other ideas, they said no

- They liked the sound effects, but the narration was too slow
- They said they would read about viruses on their own
- They said that the comics are "recreational" enough to be enjoyable, not too educational
- They would recommend it to a friend
- They thought the glow was just an effect
- Didn't know ocean viruses existed
- They read as they listened to the narration
- Thought it was cool to have narration, preferred iPad app over printed comic
- Students appeared to read everything along with the narration
- This comic got stuck between pages right at the beginning and we could not get the iPad to start at the beginning of the comic again, so we had to have these two students do the Flu comic first.

After Narration (high school):
- The glow caught their attention. They were tempted to touch, but didn't
- Overall comment they made: "Balanced ecosystem. One thing can through off everything."
- Once saw glow was "clickable" it turned into a game to find the glowing objects
- Helped hearing narration but was a little slow – okay, but some were over the top or not exciting enough

Observer comments about apps (middle school):
- Participants skipped all three aps until prompted at the end of the comic.
- Did not tap on the aps while going through. Mentioned when prompted that they noticed the glowing, but did not tap on them because I didn't instruct them to. When asked if they would have if I wasn't there, they said that they would.
- App crashed hard after the first few pages, had to kill completely and restart
- The male student's uncle has an iPad. The female student has an iPod Touch
- After the session the male student went back to the Ocean Virus app and began listening to the SoundPrint doc.
- Tapping on "Inside EhV" app it went back to menu instead of app.

EXPLORE AN ALGAL BLOOM
Student comments (high school)
- Because of the mix of illustration and photographs it wasn't apparent how REAL it was; I'd suggest only using photos, if possible
- [Use a] real picture of earth
- [Use] consistent animation (change earth from drawing to real photo)
- Interesting take on the size of each compared to the cloud.
- I realy like how you can see from the big picture to the individual. Knowing to touch the glow wasn't as obvious, it had to be pointed out.
- This slide was very good.
Student comments (middle school):
- I liked it, overall
- maybe if you explained it more
- The super close up was really cool
- Really cool pictures. Could maybe just go right back to the first picture when done, instead of tapping a bunch to get back.
- I liked how you got to enlarge until you got to the algal bloom.
- Zooming in and out was a little confusing sometimes when you wanted to zoom in, it would zoom out and vice versa. What an algal bloom was (helped me to understand it better.

Observer notes (high school):
- Students said it would be better to have more clarity between what is real image and what is not. Wanted to see "real" google earth for first image, then to know where algal bloom is, photoshopped into the next image

- Students said, "That is so nifty," and "that was unexpected" (when zooming in).
- Students suggested using google earth, and use a real picture of earth.
- One of the students was surprised to find out that the electron microscope picture was a real image.
- Cool zooming – "I like it" wondered if it would go forever?
- They said it was cool to see where the bloom is located
- "helps with scale" that the bottom left scale graphic was good
- Would be cool to rotate algae
- I had to explain where to tap.
- Initial verbal reaction was "so cool".
- Male student commented that it felt like Google Earth.
- When exploring the algal bloom participants figured out to tap the screen on their own.
- Participants commented by stating "that's pretty cool."
- Participants liked how visual this app was and commented that it helped them understand the size.

Observer notes (middle school):
- Figured out what to do without prompting.
- Looked quickly at each screen and moved on.
- Very little reaction to the ap.
- Participants indicated liking this ap.
- Participants asked if the images in this ap were real and stated that they liked how real they looked.
- Participants seemed interested in where exactly the bloom was located (between which countries).
- "It's cool, if you were to go out there you would see that" referring to the algal bloom.
- Took a second to get started and they clicked through really quick
- They noticed scale and said it was cool

SO MANY VIRUSES
Student comments (high school):
- This page was rather difficult to navigate; Perhaps you should include more simple directions or brief example of what to do
- Slow(?)
- Slow load time
- Maybe include an introduction in which you can tap the glowing objects
- note: "drag items"
- I really like this one.
- I like how you can put things into other things like jellyfish into shark and the number that could fit. I didn't know to drag the object from the tool bar.
- Better (more clear) instructions.
- I like the ratios that were thought out but you could make different things for those ratios like a train instead of a subamarine.

Student comments (middle school):
- I like how it compared how many viruses could fit in one thing, and how everything can be paired/matched
- if the numbers were just written in scientific notation first and if you touched it it would show all of the zeros
- Great interactive features. Click confusion sometimes.
- it was cool, it's really fun to play with
- Giving a set of instructions, game was confusing at first.
- It was amazing the first time you saw the big numbers, but then it got boring. Maybe if you added another fact that made you realize how much it really is. Like that equals the size of 5 elephants.
- Hard to figure out how to get out of the numbers pop up an x in the corner to exit would help. It was interesting. I liked it.

Observer notes (high school):

- Students had some difficulty getting it to load; it was very slow.
- They enjoyed interacting with this one.
- "wow that is a big number" "I hate math"
- They liked and recognized the scientific notation
- What's sure what to do at first and after a sec tried dragging objects
- When dragging saw the hover state and dropped the object inside, then took a sec to tap for more info and numbers
- Didn't really mention much about the virus size, but liked many of the objects relative sizes
- Asked "can we move the person?" and tried.
- Compared quite a few objects and combinations.
- I had to explain how the app worked. The participants did not read the directions.
- Both students found the app amusing, with the male student more actively involved in moving the items and looking at the numbers.
- Female student commented on the type of jellyfish in the ap.
- The most amount of time was spent by participants on this ap and noted that it was their favorite.
- Participants liked the ratios and even commented that "ratios are cool"
- Participants had difficulty navigating through this app and thought the instructions should be better.
- Female participant commented that this was her favorite app.
- Participants also thought the number should be read aloud, so readers could comprehend the size of the number.

Observer notes (middle school):
- I had to explain how the ap worked. The participants did not read the directions.
- Each moved a few items down and into each other.
- Neither student was very engaged or enthuastic about the ap.
- Participants seemed to have a lot of difficulties with the touch features during this ap. They spent the majority of the time trying to make it work and didn't seem to process any of the information.
- Read directions and taped virus, then tried objects
- Saw the hover state and tapped and found more information
- The window with number info froze multiple times, I think from them double tapping
- They figured out why the larger items couldn't go in the smaller ones
- Compared many different objects and actually combined all of them to see all the numbers
- "scientific notation is easier to understand"
- The students naturally started tapping the glowing objects to see the app (these students had done the Flu Comic first)

INSIDE EhV

Student comments (high school):
- Zoom in farther with more information
- Very basic, not much to do or much information (zoom in)
- I like how you can look at the virus and then look inside, then the insides are labeled. Gives reader time to look at cell and not be overwhelmed.
- Definitions.
- I thought that the whole inside of the structure of the virus was very cool.

Student comments (middle school):
- I think putting the definitions in would be helpful
- if you woul give the definitions of the parts of the EhV
- it would be a good model to draw.
- Colorful! Pretty much straight forward.
- Having an option to describe what the parts of the virus were and how they function instead of just showing what they were.
- It seemed like any other organism.
- It was cool. Maybe could define what a capsid is, what the functions of proteins are.

Observer comments (high school):
- Students were eager to access the app
- Students wanted to zoom in more. "It would be more interesting to have more detail. There's hardly any information."
- Rotation
- Maybe interactiveness like rotating the virus too look at it
- This activity crashed the app
- Cool inside parts and bright colors
- Would be awesome if 3D and rotation with zooming
- Both students were curious about the inside of the virus.
- The male student looked at it more closely and commented that since he hadn't learned this information in biology yet, it was more interesting.
- Both liked they ap and thought it was informative, but wanted more information about the virus' parts.
- Both wanted the ap to "do more."
- Commented on the quality of the graphics on this ap.
- Participants were fairly silent during the Inside EhV app, the only comment was "Oh that's pretty cool."
- Female participant commented that she didn't know what a "capsid" was and that if the comic was given to younger kids they really wouldn't know what most of the words meant.
- Female participant thought definitions should be given but also commented that she could just look it up on her own.

Observer comments (middle school):
- Both students were looked at the inside of the virus.
- One participant didn't understand that it was a virus, thought it was algae.
- Participants were very quiet during this ap. They did not talk to each other about this ap nor did they comment about this ap when asked about the aps.
- Liked it and read labels
- Tried to tap for more, but nothing
- Students said they would like definitions (they saw the Flu first)

ADDITIONAL COMMENTS on NEVER-ENDING BATTLE COMIC & APPS
Student comments (high school):
- The narration was great; it exceeded my expectations; but no one says, "joshing" anymore; "kidding" might be better
- I wasn't quite sure what to press in the interactive animations
- I like the ratios. The ships and monster look like what they are representing.
- Definitions for some of the words. Overall it was very cool and good explanation.

Student comments (middle school):
- I like the sounds and graphics
- Really educational, but not something I would get for fun as an app. Fun to mess around with though.
- I absolutely loved the music and sound effects. It made the comic more lively and interesting. The extras were neat and very interesting. The comic itself was also cool. It had everything a comic needs to be awesome, color, awesome story, easy to understand, and cool characters and information.
- I liked that it spoke to you, had more time to look at the pictures. Sound effects were cool. It was a lot better than reading from a textbook.

Observer comments (high school):
- One student said she has not had a chance to work with iPad before.
- One student tried to access an app from a pink glow in the comic
- Student commented that the "spitting lightning was a bit much" (too exaggerated)

- Students easily found the apps
- One of the student's dad has an iPad and the other has an iPod Touch
- They didn't have audio for the first couple pages, until I ask and then turned on

The Never-ending Battle
Main Idea: Student Responses

COMIC
(high school):
- The algae produce a great portion of the earths oxygen; the virus EhV keeps the algae from growing out of control; too much algae wold produce a gas that in large numbers could change our planet's climate, destroying Earth's ecosystem
- Emiliania Huxleyi is an algae in the ocean that allowed for life to bein on Earth by emitting a tyupe of gas. EhV ius a virus that fights EH since EH is getting out of control
- The role of emiliania huxleyi on the earth and how it's kept I balance by the virus, EhV
- It tells the importance of balance in ecosystems even with things as small as viruses
- Balance in an ecosystem is important and not all viruses are bad
- The EhV virus is very important to the world around us.
- The danger earth faces and one of the causes that could cause damage to our society from algae.
- The first organism, talking about if this certain algea had gone wild. Viruses that have major effects on our living algea that could get out of control.

(middle school):
- The algae grows too quickly, so EhV comes to eliminate some. Too much of the algae is a bad thing
- It shows that there are a lot of underwater viruses and explains EhV
- Without virus algae it would keep on growing until it's all out of food and all the plants would die and humans.
- Ocean Algae produces ½ of oxygen we breathe and they reflect heat back to outer space if there are too many, it's bad. Some Ocean viruses kill some to make sure they don't over populate. Ocean viruses are important
Informing you of EhV and how it affects the wrold, but doing so in a way that appeals to the younger generation.
- How small things (like the algal) can become a big problem and how other organisms keep other organisms in check.
- Evh is a virus that is suppose to fight off Emiliana huxleyi. Evh keeps a balance so the ecosystem isn't completely messed up. It regulates Emiliana huxleyi's growth so it doesn't get to big.
- Explained to kids that life on Earth is fragile and a delicate balance that won't last forever. Also how small things like viruses play a huge role in the ecosystem and can be good as well as bad.

EXPLORE AN ALGAL BLOOM
(high school):
- Showed the algal bloom more up close, made it clearer
- Explaining the size relation of an algal bloom
- Shows the scale and location of algal bloom
- helps you see location and scale of algae
- The individual algae are very small, less than a micrometer, but all of them span for miles.
- Shows a closer view of the algae and what it looks like in the ocean.
- There are tons of this Emiliania Huxleyi algea in the ocean. The algea bloom is huge.
(middle school):
- shows a close up of the algal bloom
- It shows what an algal bloom is
- The image of what an Algal bloom is. How it is in the ocean
- I didn't really learn anything
- Give a visual image of EhV and where it's located in the world.
- How small an algal bloom really is.

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- I saw were it was located. It was located newar England. That's very astounding. That whole thing is a growing and living organism. The Emiliana huxleyi algal bloom are very plentiful.
- Showed us pictures of the topic so that we can understand it better.

SO MANY VIRUSES

(high school):
- Represented the massive number of algae in a more comprehensivle way
- Exploring size relation with numbers to EhV
- Very small, lots of them
- that there are so many viruses – very small. Very cool to see how much of different things
- The viruses are much smaller than the alglal cells.
- Ratio of viruses to different land masses and animals and algae then ratioed to the ocean itself.
- Lots of zeros for the virus that can fit inot Hawaii.

(middle school):
- shows number of viruses that could fit in something else
- this activity is to show you how small viruses are and how many viruses could fit in a given object
- I figured out there are a lot of those viruses
- A lot of facts about the capacity of things for things like water drops, viruses, algae, etc.
- To realize how many algal fit into something.
- Letting you compare EhV w/ known objects in the world.
- The comparisons to large and small objects helped get a mental idea of how many viruses can be in one area. Showing how many of an object can fit in the ocean and then how many viruses can fit on that object was cool.
- Comparisons helped us get a better idea of the size and scale of viruses.

INSIDE EhV

(high school):
- Showed the internal structure of EhV and what made them up
- Shows parts of virus. Interestingly and colorfully
- A EHV has 2 membranes, like a plant cell, but is missing all the organelles that cells have.
- Get to look at cross-section of EhV and labels.
- To locate all the products inside this virus.

(middle school):
- diagram of the virus cell
- It shows you the main parts of the virus
- The parts of the virus
- it has DNA wired
- The makeup of the virus.
- Showing what's inside EhV.
- It helped to see a comic and realistic version of EhV. It looks like a microscopic rock particle. The proteins are all structured and placed around the innner membrane.
- Shows what the virus was made up of, a closer view of what it looked like.

ADDITIONAL COMMENTS

Observer comments (high school):
- One student misunderstood the main idea, explaining that she thought the algae evolved and changed.

The Frozen Horror
Suggestions for improvement

THE FROZEN HORROR COMIC

Student comments (high school):

- Have different ways to show different people talking (narrator from person)
- The starting music was a little much
- When did the pig come in? (confusing)
- At start narrator character dialogue is awkwardly mixed
- Page 1 writing on cross is very poorly animated
- Voice acting for character of Hinshla is very monotone
- Liked the narration – spooky
- Female voice a bit much at times
- Some of the expressions are exaggerated too much in the comic
- Focus more on the virus
- Less focus on myth than virus
- What was the animal/creature the girl had? I kind of wish you would see what the pig/bird was, and why he had it in his car. Was he sick with the influenza?
- What was going on in the beginning? The things the first 2 apps talked about should be used on the scene after the legend, or after.
- Put a description for influenza.
- This comic was better than the last [Neverending Battle].
- Tribe name?

Student comments (middle school):

- I liked it overall. I'm a fast reader though, maybe narration could have been a little faster.
- I thought that the narration was a bit slow.
- Depressing. Good Graphics. The voice was a little weird for the lady.
- More movement, like show the snow falling. That would be cool.
- Did a good job of not using too many technical terms that were hard to follow. Speed up the narrator or cut out some sound effects.
- It was really sudden when the woman disappeared and the man got the specimen. Otherwise I liked the mystery, but it didn't conclude what the mystery was. That you could get flu from a bird or a pig?
- I liked it a lot.

Observer notes (high school):

- The two students I observed did not understand that the comic was illustrating that the flu virus is a "shapeshifter" ("Why was there a pig in the middle of the arctic? There has to be context for the pig")until they stumbled on the essay, which states this clearly. That was a eureka moment for both of them, "the creature shapeshifted!" Both thought that the information that influenza is a shapeshifter should be added.
- Students felt the narration was too slow
- Some students felt there was too much background noise
- Students remarked that some of the narration was a hokey
- Comfortable with interface since it was the second comic app
- They both liked the narration better, but one liked the Ocean Virus story more
- Both participants were clearly reading along with the narration.
- Overall the comic received positive feedback, with each participant stating that they liked this comic more than Oceans.
- Again, both liked the narration and sound effects, but found the pacing to be too slow.
- The male participant commented that the "Beware!" part was "corny", but the female participant disagreed and mentioned she liked it.
- Both participants found the goose/pig part at the end confusing, as it was difficult to tell if that was supposed to be the animal that was carrying the virus or just a hallucination brought on by the flu.

- The ending of the comic received very positive remarks. The participants felt like it made the comic more enjoyable and not just for educational purposes. The ending prompted the male to want "to read more" of that storyline.
- The participants did the apps as they appeared as they were reading/listening to the comic.
- Participants were much more quiet during this comic
- The majority of comments came at the end of the comic and they included the following:
  - "Oh, it's over?"
  - "Captivating!"
  - "Which tribe was that?"
  - "I liked that one"
- Participants commented that they liked this comic better than the previous comic.
- Participants also commented that they liked the "hanging" ending. They thought this made the comic more "relatable."
- Participants commented that they want a sequel.
- Asked them did you want to click on the glowing objects as they read?
  - They said they "Yes, we were tempted."
  - It looked like they wanted to, but waited until the end.
- Turned into a game finding the glowing objects
- Although participants clearly knew where/how to find the apps, participants waited until they had read the entire comic and then went back to explore the apps.
- While participants did not explore the apps during the comic, they did however go back at the end on their own, without prompting.

Observer notes (middle school):
- Both participants were clearly reading along with the narration.
- Both participants liked the idea for this comic more than Oceans (there were no monsters).
- Again, both liked the narration and sound effects, but found the pacing to be too slow.
- One participant commented that she found the part when the scientist has the specimen and the woman is just "gone."
- The participants like the mystery and the idea that you can get flu from different animals (like the bird and the pig).
- The participants found the ending confusing. They weren't sure if there was more to the story and felt like it didn't "wrap up."
- Participants remained relatively silent during this comic as well. There was some laughing during the comment but no feedback/speaking to each other during the comic like in the last comic.
- read in silence, did not talk about it to each other
- the first time through the comic, they noticed the glowing items, but didn't know they should click on them
- they used the word "cool"
- they prefer to look at the 'inside virus' app while reading the comic, but the longer apps (dial, tree) are easier to investigate at the end
- they knew to change the numbers (ex.H7N1) in the dial app, but that was all they knew to do
- didn't know how to move the branches of the tree…but knew it was a family tree
- overall they liked the apps…they said the apps helped clarify the idea
- they would rather read the comic than plain text
- they thought the bird and pig in the flu comic were symbols for bird flu and swine flu
- Comfortable with interface since it was the second comic app
- They tapped the glowing areas as they were listening to the audio first time through
- Turned into a game finding the glowing objects
- They said "This is intense!" as they giggled.
- Students asked, "Can you catch it from different animals?"

Comments on apps (middle school):

- The participants chose to read through the whole comic and then return to the aps in the order they appear.
- Participants did not go through the aps until the end of the comic. Participants seemed more aware of the aps (pointed to the flashing) but did not explore during the narration.
- Participants required a lot more prompting during these aps, they seemed less willing to explore.
- Participants explored the aps backwards; they started with the third ap, then continued to the second ap and had to be prompted to go to the first ap as they were almost out of time.
- Students did not find the apps (they read this comic first)

SO MANY STRAINS (DIAL ACTIVITY)
Student comments (high school):
- It was interesting to see all of them, but a more efficient way of looking [would be better]
- Search option is not the best to look through so many
- Like the layout
- Needs an intro paragraph – summary about influenza. What animals are affected?
- Dial gets stuck
- I think you should include a brief expositional paragraph about influenza beforehand
- Needs more instruction for navigation
- Love the pictures of the animals
- Should be able to zoom into the map – have it be a map of the whole world so you can see it all at once and then zoom in.
- There are so many different kinds; shorten it or have a better way to search
- The dial would stick and sometimes skip numbers
- Dial: tough to place numbers well
- I appreciated the dial and information on common name, affected animals, place, and how dangerous.
- Because of the app we know the thing that killed the people is the flu, without mentioning it in the comic.
- This one was very good.
- Explain only the #s move.
Student comments (middle school):
- I like the setup of this page
- If it would show more description, or symptoms; that would be helpful
- I wish you could click on the map
- The spinner thing locked up. The pics were cool. Quick, to the point. Facts were good.
- Dial got stuck on a #. Overall good descripton of many different viruses.
- It was interesting the first time then lost my interest.
- It is really cool and gives a lot of information. I like it a lot. It's very interesting. I like how you can spin the dial to find out about more viruses.

Observer notes (high school):
- They spun the dial so it was more random for awhile and then dialed it to ones they wanted
- Tried different combinations – dial got stuck a couple times
- They tried to tap other areas of the screen
- Saw the additional tabs in the bottom left
- Eventually found human deaths at the top – they wondered about accuracy
- Thought it would be cool to see how many combinations there were
- Thought it would be better to see combinations faster than the dial
- Male participant didn't initially catch on that the comic was about flu until he entered the app.
- Commented that they "didn't know there were so many of these" while flipping through all the strains of the flu virus.
- Participants had difficulty figuring out how to spin the dial and commented, "How do you spin it?"

- Participants seemed to enjoy all of the information provided and commented about the various animals and countries involved in the different types of flu.

Observer notes (middle school):
- Very little reaction.
- Moved the dial about 4 or 5 times and clicked 'done'.
- Participants looked at this ap last and had little time to explore.
- Participants got the general idea of the contents and seem to think it was interested.
- Participants had to be prompted of how to turn the dials.
- They played with tabs at the bottoms
- Tried to click other elements on the screen
- Played with the dial but couldn't get it to work so they clicked out of it.
- I told them how the dial worked and they looked up a bunch of combinations and liked playing with it
- Students knew what to do with the dial
- Students did not use the yellow tabs for the different outbreaks of the same strain

SO MANY STRAINS OF INFLUENZA (TREE ACTIVITY)
Student comments (high school):
- Really confusing
- Didn't like this
- Animations and type are not consistent with the rest of the app
- Not sure what was the purpose of comparing [trees]
- I had no idea what I was supposed to be doing; weird not to have page flipping (be the same as the rest of the app)
- Buttons are inconsistent with the rest of the app; whay doesn't it have the page (portrait) format?
- This is very confusing; I'm not sure what I'm supposed to do
- I don't get the context of this
- [Comparing trees is] too easy
- Simplify it, as it got kind of boring
- Very long
- It was a bit lagging at some points with the virus tree.
- There was so much content, I became uninterested.
- I think the idea of the game is very good and a great way to play with the midn (instructions).
- Better instructions!

Student comments (middle school):
- the chart comparing one was cool, and the Q&A clarified information.
- If the tree activity was explained better, it would make it easier to understand
- A little confusing to me, a lot of clicking and messing around. Got boring.
- Maybe the narrator could read instructions.
- Good job of briefly explaining the viruses. Kinda confusing and it goes on for a while (maybe only compare 5 trees instead of 9)
- This was intersesting and it kept my interest out of all of them.
- A help button that explains everything you can do on that page would be good if kids have questions.

Observer notes (high school):
- Students touched screen to get the pairs, but didn't find/use the comparison button
- Couldn't find the "compare" button
- Student commented, "I don't get the context of this, I don't get why we do the trees… I don't get what we're supposed to do – what's the point?" and, "how do the trees work? There's not enough information to understand them. I don't really like it"
- They suggested taking out the matching trees and instead create trees, draw them.

- Students suggested moving the questions at the end of the tree activity to the end, and have it in a quiz format.
- Students thought the tree and the questions should be separated, not put into a single app. Too long.
- One student said, "[comparing trees is] too easy, let's skip to questions"
- Students thought that this should be at the end, since it was such a long app
- They tried to slide screens, took a bit and then saw continue button
- First tree to a little exploring to figure out interaction
- Not sure what to do at first with the cards, finally saw compare button after tapping multiple cards
- They weren't real clear on the overall objectives
- Once they got going they seemed to get into it and eventually finished all the comparisons
- I had to explain how the ap worked. The participants did not read the directions.
- Male commented that the matching game could take forever.
- Female seemed more interested to match. Male requested to go back to reading the comic during the matching segment.
- Male didn't understand the concept of the trees until it was explained to him. Had a difficult time "trying to see how some of this is relevant."
- Both mentioned that everything in the ap was "kind of a lot".
- They suggested fewer trees to match would be okay. There just seemed to be too many.
- Participants had difficulty figuring out what to do in this app and required prompting, even after instructions the male participant asked "are the trees about flu?" and the female participants answered "yeah" but seemed unsure.
- Participants were confused about what was expected of them during this activity, comments included:
  - "Is this like memory? Like the game memory?"
  - "Is this the only one we compare to?"
  - "We need better instructions."
  - "They've managed to confuse us!"
  - "Maybe it's no" after 5+ attempts at correctly arrange one tree
  - "This is a little fun."
- Both participants took the time to read about each type of flu.
- It was only after seeing the "oops" screen three times that participants figured out how to rearrange the trees.
- While it was confusing for the participants, they commented that they did like the game and wanted to finish it
- Participants spent the most time on this app

Observer notes (middle school):
- The participants only needed a small amount of extra directions from me on how to compare the cards.
- The ap seemed to keep their interest. Each spent time comparing the trees and rotating them.
- The participants chose to exit the ap before seeing the final question section.
- Participants seemed to really enjoy the game but had difficulty figuring it out as well as difficulty with the touch screen.
- Due to the length of the ap participants only had time to make a few matches.
- Female participant seemed disinterested in moving the trees around but the male participant really seemed to want to make it work. Part of the female participants disinterest could have been from her difficulty making the trees move properly, she had great difficulty with the touch screen.
- The ap seemed to freeze a lot and seemed to respond to the participants touches inconsistently.
- Tried swiping, then found the continue button
- Instead of comparing they were trying to "Select" a character to be
- Female was reading instructions, but male just clicked through
- Tried dragging different cards and didn't see the compared button, finally found compare button
- The male asked "What are you doing?" The female said "making it look the same"
- A bug in the app, the trees disappeared and we had to restart the activity. No saving progress.

- They said it was a "little difficult"
- Landscape layout was a little weird to switch to.
- Students easily found "compare" button
- They did not click on the viruses to find out information about them
- When asked, they said the tree was "like a family tree"

INSIDE INFLUENZA

Student comments (high school):
- This was awesome
- Well labeled
- Definitions were good
- Level of writing in definitions was good
- Capsid: protein coat – what does it do?
- This explains where N & H come from better! I like the definitions and labels
- Still should maybe have some rotation/interaction
- I liked how it was layered and explained so you weren't bombarded with a lot of information to look at.
- A great job. Definitions.
- Definitions here too.
- Participants seemed to anticipate the last app, since the previous comic had a virus diagram, there comments included:
  - "This is going to be cool."
  - "This is like the last one."
- Participants really enjoyed definitions and commented that definitions need to be in the previous comic.

Student comments (middle school):
- I liked the facts that came up
- If it would go into a more in-depth explanation, that would be great
- Informative
- Good job of explaining the parts of the virus.
- Looked like any other organism and didn't learn anything new.
- I like how you can touch the words and they define them. Might not have known you could do that though.

Observer comments (high school):
- They asked again for rotation
- Didn't see extra info, but after I showed them they thought it was cool
- Both students were curious about the inside of the virus.
- The male student carefully read about the virus parts.
- Commented that they liked seeing the whole virus, followed by the inside and than the parts because that way you weren't bombarded with all that information at once.
- Commented on the quality of the graphics on this ap.

Observer notes (middle school):
- Both students clicked on the ap to see inside the virus.
- They clicked on the words for definitions, but did not read them.
- One participant commented that the virus "looks like peas."
- Participants began by exploring this ap.
- Participants did not provide much feedback or say much about this ap.
- Participants did not find the definitions on their own; they had to be prompted and then only looked a one or two definitions.
- Didn't see extra labels
- Saw what it was, similar to last one and clicked done

- Said, "it's cool"

ADDITIONAL COMMENTS on THE FROZEN HORROR COMIC & APPS
Student comments (high school):
- Pauses in the main guy's talking are too long
- Explain more that it [influenza] is a shape-shifting creature. Information about influenza being a shape shifting virus could go in one of the apps ("so many strains" or "inside influenza")
- Pulsating works
- The tree activity either needs instructions or context within the story. It is very difficult to understand
- I liked the creepiness and the voices of the comic. It created a good mood in the comic.
- I like the ending.
- Good definitions. But some more definitions.
- Cool echoy voice. Definitions are awesome :)

Student comments (middle school):
- More sad and serious, but informative.
- I liked it. Way better than a text book.
- This narration ws slower than the other one.
- Was a little difficult to rotate.

Observer notes (middle school):
- Students said they thought it was more interesting to have this in comic format than like a textbook.
- They wanted the more in-depth apps to come at the end of the comic, not in the middle

The Frozen Horror
Main Idea: Student Responses

COMIC
(high school):
- The influenza viruses effect on a village in the arctic
- Influenza is a highly adaptable virus that is very contagious and very deadly; It often changes by mingling with strains of bird and pig flu
- It told the origin of the disease
- How the influenza virus affected the village / where it came from
- Massacre of 103 native villagers. This was an epidemic. The natives caught with this epidemic and it made them see things. New strain of influenza.
- About mysterious deaths of the natives in 1918 epidemic. Trying to find the flu strain it was and making vaccines of it.

(middle school):
- The village died out 90 years ago. The scientist says it was a virus, but the old women thought it was supernatural.
- There was a deadly disease 90 years ago that killed everyone but a few in 6 days. Hinshlai told the scientist the tale of the creature that brought the disease to the village.
- Told about virus of a tribe, a guy was doing research there to create a vaccine against it.
- It was from pigs and birds. A lot of people died.
  Describes the influenza virus in Alaska.
- About the flu.
- This comic was also very cool. I am now a little more alert of touching random animals. I would not like to start a massive epidemic.
- Shows how deadly a virus can be and how quickly it can spread.

SO MANY STRAINS (DIAL ACTIVITY)

(high school):
- The mapping of flu outbreaks
- How many strains of influenza there are
- It showed when, where and what from different diseases came from
- Shows strains of flue, where they're location, what they affected, numbers of human deaths
- Not sure, there has been a lot of H#N# viruses. It only means anything to me because of the swine flue outbreak.
- This is to get to know the H1N1 and all of the different H1N1.
- To find out the different names of the epidemic strands and stats.

(middle school):
- Spin the dial to different virus names, learn facts (where, when)
- It shows you the different strains of the virus and how many people died and year discovered, severity, and where it was first isolated
- Information a lot come from ducks
  Times of outbreaks, info about it
- Tells about different H#N# viruses.
- Different types of flu.
- H: the Hemagglutinin. A protein on the influenza virus the numbers represent the outbreak and animal. N: Neuraminidose.
- Gives a lot of information about pandemics caused by viruses.

SO MANY STRAINS OF INFLUENZA (TREE ACTIVITY)

(high school):
- What the evolution of the flu viruses has been
- It showed ties and connects the flu strains
- Shows connections in influenza strains
- Getting ideas about the flu and what their thoughts about the tree diagrams.
- Mini comic about the tree diagrams of the flu then compare the trees.

(middle school):
- Teaches what different strains of the same virus are
- Its to show how different strains are linked together; and also how they change
- Different tree's of it and the comparison of them
- it was confusing.
- Interactive activity that lets you compare diagrams of viruses.
- How charts can look different but can end up being the same.
- Many influenza viruses were recorded arounded history. There have been quite a lot of influenza outbreaks in the past 100 years.
- Gives a history of diseases caused by viruses.

INSIDE INFLUENZA

(high school):
- What's in a flu virus
- Internal structure of influenza
- Shows inside of virus and parts
- The virus is full of RNA. This virus is bad, the other is good.
- Taking an inside look of the virus.
- Cross section of the virus.

(middle school):
- Diagram that explains the parts of the virus cell
- It shows you all of the parts of the influenza virus
- Showed different parts of influenza.
- Cool Good for drawing a picture

- Gives an enlarged picture of the influenza virus and explaining the parts of it.
- About the inside of a flu virus.
- The influenza virus hs Hemagglutinin or "H" that sticks out of the shell of the virus in a special shape. "H" helps the virus ener the host and reproduce. The RNA is interestingly shaped.
- Shows what the virus is. What it looks like, what the different parts did.

Group Discussion Notes
Overall Comments on Comics & Apps

High School
Group Discussion After Testing
Adam's Notes
- Liked narration, little slow
- Liked option of turning off voice
- They would recommend to others to learn about viruses
- Social Media
  - Most have Facebook
  - Couple have twitter
  - No MySpace – laughed
  - One Foursquare
  - Some would share on Facebook, but not many
  - They thought email might be cool
- Activities on Flu a little lengthy
  - Tree Long
  - Like Ocean virus activites
- Thought iPad would be cheaper than printed comics and "greener"

BOSR Zoo School Group Discussion Notes
When asked for their opinions about the apps being a part of the comics, participants provided the following feedback:
- Overall the feedback from participants was positive, the majority of participants said they liked the apps.
- It was "pretty cool."
- "You can make connections."
- Participants thought the apps helped clarify and expand on ideas.

When asked about the narration of the comics, participants provided the following feedback:
- An overall positive reaction, participants really seemed to enjoy the narration but they did see areas that need improvement.
- Thought the on/off option was good.
- "It helped me focus but it was too slow."
- "I read it way faster"
- "It pauses for way too long"
- "Background noises were too loud"

When asked if they would recommend these comics with apps to a friend some participants said yes, others no and some said it would depend on the friend. When asked if they learned from the comic there was overall agreement that they learned about viruses. Some participants even commented that they learned more than from a text book.

Participants commented that they would share the comic on Facebook and thought email would be a good way to share the comic. There were many comments about how sharing on Facebook could be annoying and that if participants were to share on Facebook it would have to be a "non-annoying" way to share such as

posting without spamming. Participants made additional comments about Facebook such as games on Facebook are "cheesy and not captivating" and sharing games on Facebook is often "spamming" and that "Facebook can be sketchy" and then stated that email would be more appropriate.

7 participants stated that they read comics/graphic novels and when asked if these comics fit in with the comics and graphic novels they read participants were on the fence stating "I suppose," "sort of," and "a little bit."

Participants stated that they would read additional comics like these ones and that they really wanted a second story to continue after the end of the Flu comic. Participants commented that the Flu comic ended as a "cliff hanger" and a sequel is needed.

When asked what could be improved overall participants provided the following feedback:
- The length of the "so many strains" tree app was way too long. Participants commented on the confusing nature of the app, how many trees there were and even went so far as stating "I'm not doing it," when they realized how long the app went on. Participants recommended that this app be divided into two apps with the matching game possibly at the end.
- The voices were "over the top" and participants specifically commented often about the "haunted" voice in the Flu comic. They thought it was "haunted" and not an echo.
- For the "so many strains" dial app participants recommended that this app be changed to a map format so that users could zoom into different sections of the world. They thought this would be a better way to view so many different types of flu.

Participants seemed to comment more on the Flu comic than the Ocean comic. Flu comments included stating that the comic was confusing at time and that they didn't know if it was real at first or not. They thought it was weird at times and even creepy. Some participants did comment that they liked how it was creepy. Additionally participants thought that the echo was confusing and that this comic would fit into the category of a movie more so than the category of a comic due to the story line and ending.

Narration of the second comic was also a topic of discussion. Participants thought the main character should have been "thinking" and not have had a narrator. There was lots of switching between voices in this comic and participants seemed to find this negative and wanted in changed.

When asked about the advantages of having the comic on the iPad participants commented that the comic sucks you in through the format. Participants commented that other formats would be nice too such as being compatible for the iTouch and mp3. Some participants did comment that they don't have an iPad. Participants also stated that having the comic on the iPad makes it seem "more accessible," that it is less expensive because it's not on paper and that it is greener.

Middle School
BOSR Lefler Group Discussion Notes
When asked if they liked the comic on the iPad participants provided the following feedback:
- Would only read the comic on the iPad.
- If it was not on the iPad it would not be interesting.
- They liked the interactive nature of the comic.
- The in depth game should be at the end (tree) but other shorter stuff is okay to have built in.
- The tree game was confusing and more explanation was needed.
- One participant commented that they read the instructions and it didn't say matching.
- Participants commented that they would all read another and tell their friends.
- Participants stated that it was "better than learning from a book."
- The narration seemed to be a big hit, participants commented that they like it and the sound effects they did however think the narration should be faster.
- 6 to 6.5 of the participants read comics.
- Participants thought the aps were helpful with learning. Participants specifically commented that the aps in the second comic helped.
- Participants were not sure if the flu story was real or not.
- Five of the participants said they were on Facebook and when asked if they would share the comic they said yes.
- Multiple participants commented that they would like to be able to share the comic via email.

- Participants also commented that they want more games to go with the comics.

When asked what they think of when they think of "scientists" they listed the following items:
- Lab
- Laboratory
- Viles
- Marine biologists
- Test tubes
- Microscopes
- pretty cool
- smart
- cool
- specialized number work
- biology
- astronomy

When asked about what words they use for cool, participants listed the following words:
- awesome
- epic
- boom-diggity
- tight
- wicked
- sick
- hip
- sweet
- groovy
- smirfy
- gravy
- bomb

Leah's Notes: Groups Q & A
- they really liked how it is interactive
- they liked to look at the short apps during the comic, and the long apps afterward
- the tree was confusing and too long, they didn't feel like there were enough instructions---maybe the instructions could be narrated
- they would recommend it to a friend
- they liked the sound effects
- 6 out of 8 normally read comics
- all students has an ipod
- 5 on facebook
- none on Myspace, Twitter
- they would share the comics through Facebook or email
- they were excited that they could get them on iTunes
- they suggested putting a game at the end
- when one girl searched 'Lincoln, NE' on iTunes, she found the ocean app
- when you hear the word 'science' what do you think of ….lab, chemicals, marine biologist
- when you hear the word 'scientist' what do you think of …cool, helping planet, smart
- other words for 'cool'….epic, sweet

Group Discussion After Testing: **Adam's Notes**
- They all thought interactivity was a plus
- Storytelling good, not just straight story – non-linear
- In-depth activities took too long

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- More info on tree, maybe narration?
- They would recommend and would read more like these
- These would make health class more interesting
- Maybe faster narration
- Wanted more info – they liked learning more
- Many on Facebook and email – No Foursquare, Twitter
- More open than high-schoolers to share on Facebook
- Also said email might be good to share