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Senior Capstone Project
*inSight*
Spring Quarter
June 2012

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**Topic Research Report**

**Research :: Narrowing Our Topic**
Before fall quarter began, we spent some time brainstorming potential capstone topics. Initial ideas included children's education and field trips, museum tours, urban exploration, nutrition, and interactive storytelling. We proposed two refined capstone project directions before deciding on the final topic. The first was a historical site exploration mobile app that would guide visitors and enhance the experience with supplemental content and media. The second concept was a children's learning app that would explain complex science concepts in a way that is both interactive and easy to understand. It would utilize fun visuals and interactive elements to appeal to kids in their preferred learning style.

We chose to base our capstone on the second concept because we felt strongly about getting kids interested in their education. Technology can explain concepts in a way that is more engaging and interactive than traditional textbooks. It also provides opportunities to integrate different learning styles (visual, auditory, and kinesthetic) into the experience. To differentiate our capstone from existing educational applications, the topic evolved into a link between the science classroom and museum field trips. This interactive tour app would enhance students' experience at a local museum and include additional supporting activities once they returned to the classroom.

Existing iPad apps for children incorporate great visuals and utilize physics engines to explain complex concepts in a way that is easy to understand. The goal of a majority of these apps is to entertain and educate; however, they do not take the extra step to test the knowledge presented. This inspired us to focus on how to use modern technology to refine the testing process. Specifically, we focused our research efforts on the methods and effectiveness of standardized testing. Our final capstone topic utilizes technology to enhance the standardized testing experience, making it more engaging for students.

10.5.11
**Research :: Online Resources**
We began our research online, primarily using Google Scholar and the University of Cincinnati Library. We found sources on a range of topics, including ways students learn, how to improve science education, and organizations related to our project.

**Reading :: The Evergreen School**
*The Evergreen School* is a school in Washington that focuses on experiential learning ("Evergreen School"). They encourage curiosity and creativity to motivate students to become actively involved in their education. The school participated in an educational project sponsored by Valve Corporation called "Learn with Portals". Students learned about physics and game building by visiting Valve Studios and designing their own levels for the physics based puzzle game Portal.

*We based the educational goals of our project on the principles and philosophy of "Learn with Portals" and* The Evergreen School.

***right:*** Evergreen students learn physics concepts in *Learn with Portals* at Valve Studios. These screenshots are taken from a short documentary about the project ("Learn With Portals").

**Reading :: Digital Promise**
*Digital Promise* is a government initiative that promotes the use of technology in the classroom to transform the way teachers teach and students learn (Duncan, Hastings). This goal is increasingly important as technology becomes more prominent in the lives and futures of young students.

*Digital Promise encouraged us to pursue technology-based learning tools by demonstrating that there are people who believe this goal is important.*

10.7.11
**Reading :: Startl**
A philanthropic venture called Startl promotes low-cost digital media learning products (Kamenetz). Co-founder Phoenix Wang believes that existing children's educational technology is too focused on either entertainment or trying to sugar coat dry subjects without really enhancing the experience. The company wants to improve education by putting the students and their needs at the center of the learning experience.

*These ideas influenced the goals of our project. We focused the experience on the interests of students because we want them to be actively engaged in the learning experience.*

**Reading :: Ohio Achievement Assessment**
Because our project focuses on standardized testing, we researched the methods utilized by existing tests. The Ohio Achievement Assessment (OAA) is a series of standardized tests taken by Ohio students every year from third to eighth grade. They cover multiple subjects including math, science, and reading. Students must pass these exams to advance to the next grade level.

*The core topics of our capstone project are based on the standards outlined by the OAA. We narrowed the scope to focus on science, a portion of the OAA taken in fifth and eighth grades. Students tend to lose interest in science early on when they don't see how it applies to the real world. This project focuses on the fifth grade test because we wanted to appeal to young students before they lose interest in science.*

**Market Research :: Bobo Explores Light**
*Bobo Explores Light* is an educational iPad app for children ages 8 to 10 that explains science topics related to light. It features interactive simulations, videos, and diagrams in a fun and interesting way. A robot mascot, Bobo, guides the user through the app and helps to explain the concepts presented.

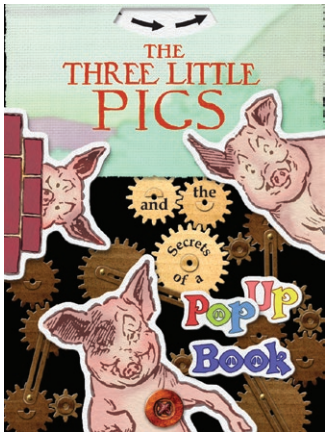
Bobo Explores Light *inspired the format and content of our project. We felt that the interactive format and graphic style would appeal to our target audience. Although this app and others like it did a good job of explaining concepts, they did not take the extra step of testing users on knowledge gained. This pushed our project to focus specifically on testing rather than simply on children's education.*


***above:*** The *Bobo Explores Light* iPad app explains complex concepts about the physics of light in a simple and interactive format.

**Market Research :: The Three Little Pigs and the Secrets of the Pop Up Book**
The developer of *Bobo Explores Light* created another iPad app called *The Three Little Pigs and the Secrets of the Pop Up Book*. It is an interactive storybook that uses traditional pop up book themes. It also features an X-ray mode that allows users to see the physics behind each pop up interaction.

*The physics-based interactions influence the case studies used in our project my highlighting the capabilities of existing technologies like the iPad.*

***right:*** The *Three Little Pigs* iPad app utilizes traditional pop up book interactions. It adds physics based interactions and x-ray views that are not possible in paper books.




10.11.11
**Site Visit :: The Cincinnati Museum Center**
We visited the Cincinnati Museum Center to see how local museums presented content directed at young audiences. We explored the *Nature's Trading Post* and *Duke Energy Children's Museum*. We observed how kids interacted with the exhibits. Some built bridges across streams or observed sand erosion. Small details of bugs, leaves, and rocks could be viewed under magnifying glasses. Flippable panels posed questions and then revealed more information once opened. Backlit displays revealed increasingly detailed levels of content when specific buttons were pushed.

*Viewing real world examples of fun, interactive exhibits inspired us to think about ways to create similar experiences in a digital realm. Though some of the exhibits seemed a bit outdated, it was helpful to see the way in which the museum presented content from an information architecture standpoint. We considered translating these museum-style elements into our project because children seem already understand these types of interactions.*




***above:*** Photos from the *Nature's Trading Post* and *Duke Energy Children's Museum* at the Cincinnati Museum Center.

10.12.11

**Research :: Libraries**

We visited the College of Education, Criminal Justice, and Human Services and Langsam libraries at the University of Cincinnati to find resources. We researched best practices in science education, the use of technology in the classroom, and sample curriculums used in middle schools. Students learn best when they are at the center of the learning experience (Cervone). They respond best to projects that emphasize the real-world scientific application. Oftentimes schools fall back on lecturing because hands-on learning takes too much time to prepare (Stone). Technology can provide students with an interactive, hands-on learning environment that allows them to cover more content in a shorter amount of time.

*This student-centered, hands on approach inspired the format and concept of this project.*

**Research :: Ohio Achievement Assessment**

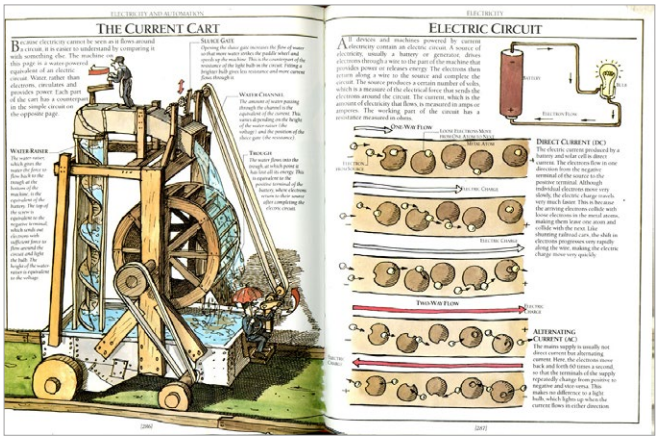
Workbooks based on the *Ohio Achievement Assessment* outlined content used in the fifth grade science test. We felt that these tests did not align with the rest of our research claiming that the most effective education is student-centered and hands-on.

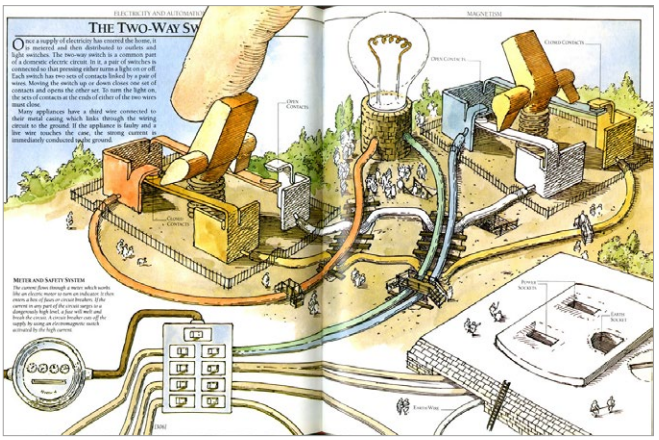
*The standards and existing test questions outlined potential case study topics for our project.*

**Reading :: The Way Things Work**

*The Way Things Work* is a book by David Macaulay that uses creative, larger than life diagrams to explain a wide range of science topics and appeals to both children and adults. The cartoon-based artistic style explains complicated concepts in a way that is straightforward and easy to understand.

*This book influenced our decision to go with a fun graphic style to appeal to a young audience, as well as to make the content of our project consistent and easy to understand.*




***above:*** Excerpts from *The Way Things Work*. Left to right: "Current Cart"; "Electric Circuit"; "Two-Way Switch"

10.16.11

**Readings :: Top Secret Adventures**

A print subscription titled *Top Secret Adventures* teaches kids about various countries and cultures Presents them with a fun mystery to solve and clues set in the country in which the mystery is based. Kids explore maps, fill in workbook activities, and read guide books on the culture, geography, and economy of the specified country.

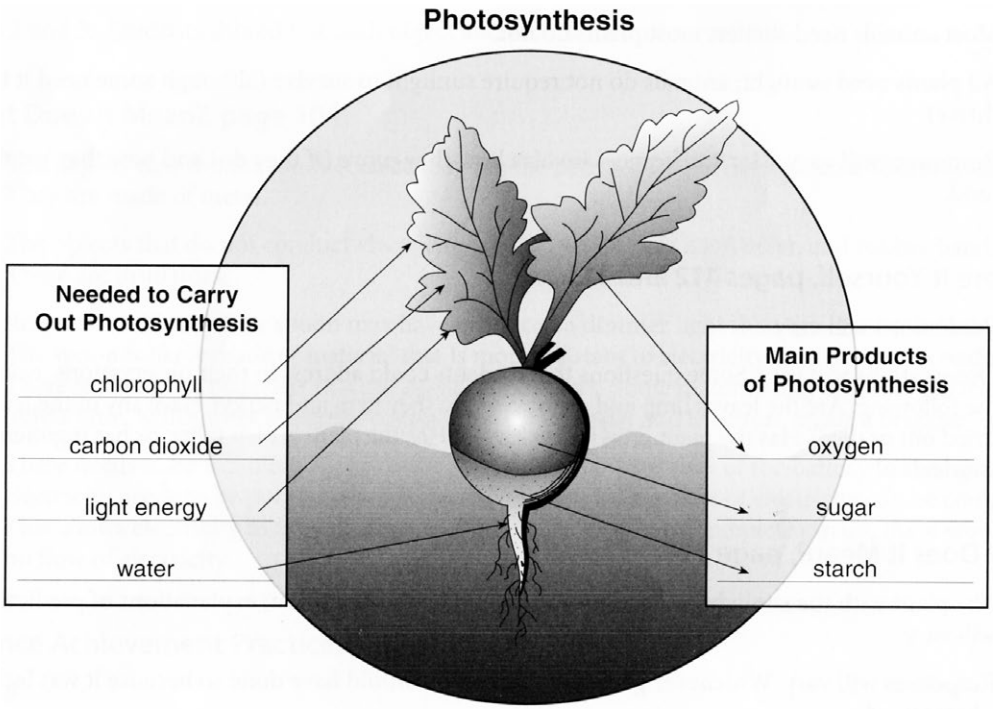
*We wanted to incorporate the game-like elements and comprehension level used by Top Secret Adventures to make our test application more interesting for a young audience.*

**Videos :: Physical Science**
The library had a variety of DVDs for teachers to use in the classroom to better explain science topics. The Physical Science series by Schlessinger Media provided us with good examples of ways to present the same topic to different grade levels. Each topic covered by the series has two versions: one for elementary students and one for junior high students. Although the content and footage were similar for each age group, the series used shorter segments and more concise, simplified language in the version aimed at elementary students.

*This was important in helping us develop the language used in our project and the appropriate level of detail for each case study.*

10.28.11
**Research :: Ohio Achievement Assessment**
The *Ohio Achievement Assessment* website provided information on required core topics, sample questions from past tests, and resources to help students prepare for the exam.

*Based on examples of the ways in which these topics were tested, we began thinking of ways to integrate the same concepts in a more interactive and engaging way. We took existing content from multiple questions and linked them together to create interactive case study that tested students on a range of topics simultaneously.*




***right:*** Sample diagram and answer key from the *Ohio Achievement Assessment* practice book for fifth grade science.

11.7.11

**Interview :: Kayla Trusty**

We interviewed Kayla Trusty, an elementary school student teacher at Oyler School in Cincinnati, Ohio. She was able to provide insight into current science education practices and the ways in which schools currently prepare for standardized tests. She believes that while the core testing standards are good, the tests focus on memorization and don't apply to the students' lives or appeal to their interests. Test preparation takes away from classroom time that could otherwise be devoted to true learning through hands on experiences.

*We used this as inspiration to use the existing standards of the Ohio Achievement Assessment as a basis for the content of our project while drastically rethinking the way in which it is presented. She also provided us with the names of people who would be helpful to our research.*

11.8.11

**Market Research:**

We looked at educational children's games that were memorable and quite successful in the past. We played these and other titles in elementary school, and the content and educational style was effective at getting us and our peers interested in the content. We looked to computer based series including *The Incredible Machine, Zoombinis Logical Journey, Carmen Sandiego*, and *The Oregon Trail* to see what made them fun and effective learning tools for kids.

*All of these games had humor, interesting characters, and a fun visual style. They presented the content in a way that was easy for children to comprehend. Player actions and choices influenced the game, getting kids actively involved in the storyline and encouraging them to continue learning. We felt that it was important to incorporate these elements into our design because they made these games memorable and effective learning tools.*

***right:*** *Clockwise from top left: The Incredible Machine; Zoombinis Logical Journey; Where in the World is Carmen Sandiego?; The Oregon Trail*

11.15.11

**Visual Inspiration Research:**

We researched visuals for the style of the simulations, questions, and user interface. Below is a sample of the cartoon and character styles we liked best. Based on our research, this style is popular with educational media that appeals to our target demographic. We looked to examples such as *Bobo Explores Light*, the Carmen Sandiego series, and *The Way Things Work*.

*We felt that stylized graphics looked contemporary and appealed to our audience while being simple enough to convey the concepts of our case studies in a straightforward, unified format.*









***sidebar:*** Interface and font inspiration from designs aimed at our target demographic.
***right:*** Visual style inspiration.

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**Project Definition**

This project rethinks standardized testing through a streamlined tablet and web based approach. In our research, we found that science classes are primarily focused on the memorization of science facts required for standardized testing. As a result, "students no longer see science as connected to the real world, and lose interest in the subject, especially as they move from elementary to middle school" (Honey 6). By moving the format of these tests away from rote memorization, educators will be able to take a more creative approach to their students' education. Our interactive testing platform requires students to demonstrate knowledge through goal-oriented, creative problem solving instead of through fact memorization.

Sir Ken Robinson, a professor and advisor on creativity in education, gave a TED Talk titled *Ken Robinson Says Schools Kill Creativity*. In it he states that "intelligence is wonderfully interactive. The brain isn't divided into compartments. In fact, creativity… more often than not comes about through the interaction of different disciplinary ways of seeing things." As technology becomes more prominent in everyday life, children are able to grasp complex technical interactions at a younger age. Technologies such as the iPad utilize physics engines to create realistic scenarios and simulations that incorporate sound, visuals, and movement. This project was inspired by apps, websites, and books with unique approaches to science education targeted at younger audiences. *The Way Things Work* by David Macaulay presents scientific diagrams in a fun and approachable way that appeals to both children and adults; however, as a book it is not an exploratory or interactive experience. In the iPad app *Bobo Explores Light*, a robot mascot (Bobo) guides the user through exploratory, interactive experiences on the science of light. The theme of the app is cohesive but without an overarching narrative, the content lacks context. The app provides users with a chance to gain knowledge, but does not test them on what they have learned. By rethinking the testing process we intend to nurture innate curiosity and conceptual understanding of science topics.

Our project, *inSight,* utilizes the existing education standards provided by the Ohio Department of Education and the Ohio Achievement Assessment. Students are required to pass this test to move on to the next grade level. We chose to focus on students in the fifth grade, the first year they are tested on scientific knowledge. In our research, we found that while the testing standards provide good benchmarks for education, the test itself does not allow students to demonstrate true knowledge or creative problem-solving. Ideally, this testing platform would function as a replacement for existing paper-based standardized tests and would be used in a classroom setting. Teachers would be present to assist students as needed, but the platform will have a simple, intuitive interface targeted at the students' comprehension level. Test assessors will be able to easily access students' answers and grade them in a way similar to the existing grading methods.

*inSight* allows students to demonstrate conceptual knowledge and creative problem solving in an goal based, exploratory format. Questions and concepts provide context and real world examples. The prototype has two in-depth case studies that highlight features of the platform. We narrowed these topics down from an extensive list of potential question formats and scenarios due to time constraints. Ideally, every part of each case study would be completely interactive, but within the 20 weeks we were given it made sense to use motion tests to demonstrate the more complex interactions. The goal of this project is to allow students to be more actively involved in their education and engaged in the testing process. Though we had difficulty gaining access to schools and teachers, user testing has proven that a strong level of interest surrounds our approach.

**Project Schedule**

*Autumn Quarter: September - December 2011*

**Week 1**
Topic research.
**Week 2**
Topic exploration, Concept mapping.
**Week 3**
Online article research, First draft of project brief, Market research on existing iPad apps.
**Week 4**
Visit Cincinnati Museum Center, Library research, Finalize topic, Revise project brief.
**Week 5**
Set up interview, Read and watch library resources, Midterm presentation.
**Week 6**
Prepare first draft of written report, Define deliverables.
**Week 7**
Wireframing, Visual user interface concept.
**Week 8**
Case study design, Begin prototyping, Present capstone project to class.
**Week 9**
UI development, Graphic design, Finalized written report.
**Week 10**
Final deliverables.

*Spring Quarter: March - June 2012*

**Week 1**
Graphic design revisions, Research prototyping methods.
**Week 2**
Refine case study flows, Begin protoyping.
**Week 3**
Finish basic interface prototype, Begin case study animations, Report: section 5.
**Week 4**
Continue work on prototype, Midterm presentation, Finish prototyping section for user testing.
**Week 5**
User testing, Refinements based on UT, Capstone poster draft.
**Week 6**
User testing analysis, Refinements based on UT, Paper: Section 6, Capstone poster draft due.
**Week 7**
Continue protoyping, Report: User testing analysis, Capstone poster revisions.
**Week 8**
Paper: project analysis, Capstone poster.
**Week 9**
Finish prototype, Capstone poster due.
**Week 10**
DAAPWorks inclusion presentation.

## Design Process

### Final Capstone Topic & Format

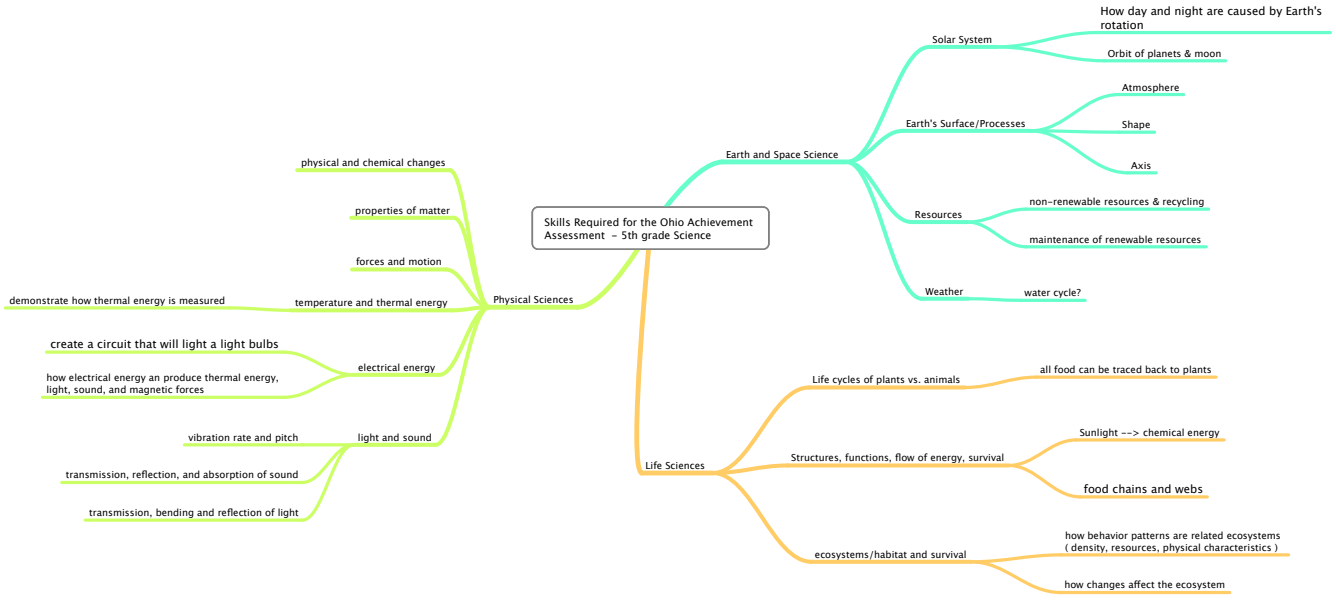
Based on our research, we narrowed our topic to children's education. Although there are many projects on the market that function as engaging learning tools, none focused on improving the testing experience. *inSight* is an interactive standardized testing solution aimed at getting students more interested and engaged in the testing process.

When science classes use fact memorization to prepare for standardized tests, students lose interest and fail to see the connection to the real word. inSight is an interactive standardized testing solution based on the core science standards of the fifth grade *Ohio Achievement Assessment*. This project rethinks the standardized testing process though a tablet and web based approach. It allows students to demonstrate conceptual knowledge and creative problem solving in an engaging, exploratory format.

Students view a simulation, interactive diagram, or experiment and then analyze what they experienced to demonstrate true knowledge and understanding of science concepts. To make it accessible with schools' existing technology, the final product is an HTML5 and jQuery based web app that can be viewed on any device.

### Case Study Topics

Using an *Ohio Achievement Assessment (OAA)* workbook as a guide, we reviewed existing science questions as a basis for our case study topics. The OAA is divided into four sections: Physical Sciences, Life Sciences, Earth and Space Science, and Safety. We translated these along with the core science standards into a mind map to help visualize areas of focus.



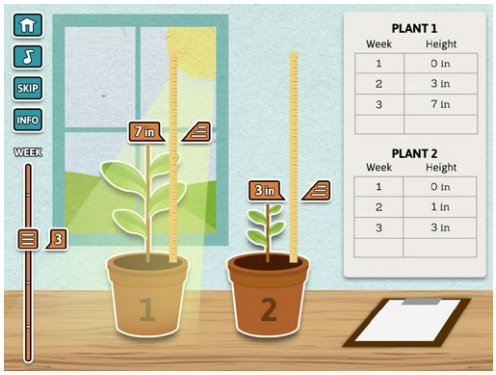

***above:*** Mind map of potential case study topics based on the core standards of the Ohio Achievement Assessment for Fifth Grade Science.

This helped us to formulate an extensive list of potential case study questions. One of our original case study concepts had students organizing animals in a food chain by pulling them out of their environment and arranging them in the proper order. Another concept dealt with animal adaptations, and required students to place animals in their proper environment based on physical adaptations. After compiling a list of possible options, we arrived at two case studies that we felt demonstrated all of the features of our testing interface.

Case Study 1 is based in Earth and Space Science and asks students to demonstrate their knowledge of erosion through scientific observation. The test presents the question 'How do these plants slow erosion caused by heavy rains?' and then plays a simulation of two hills in the rain: one with plants and one without. The simulation shows that the growth of the plants and their roots help to slow erosion. At the end of the simulation, students are asked to write a short essay demonstrating that they have true understanding of the effects of plants on erosion.



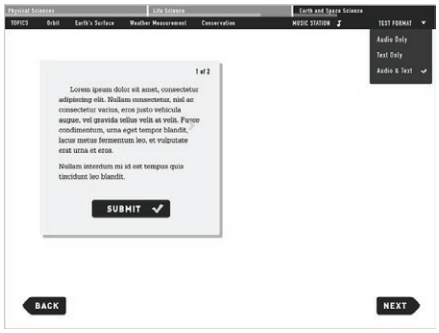
Case Study 2 is based in Life Science and asks about the flow of energy in an ecosystem along with data recording and analysis. In a simulated experiment, students observe the effect of light on plant growth over time. Two plants are arranged on a table, one in front of a window with direct sunlight and one without much light. Students begin by filling in the headers on a data chart with the correct labels. They gather the rest of the data by using the week slider to move through time, and the ruler slider to measure the plants. They are then asked to write a short paragraph explaining the data, utilizing knowledge of how plants convert light into energy.

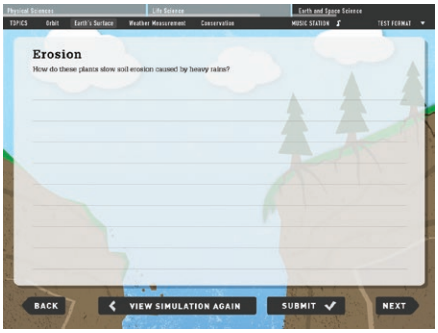
**Graphic Design**

The design of this project occurred in five stages: one wireframe and four rounds of graphic design. The first round of graphic design occurred at the end of Fall Quarter and was based on our initial wireframes. The second round occurred at the beginning of Spring Quarter, streamling and expanding on the interface and interactions. The goal of the third revision was to unify the elements and ensure that they would be easy to implement in the working demo. The fourth and final round of graphic design was based on user testing and included improvements to the functionality and ease of use as well as refining the user interface to ensure that it was consistent.

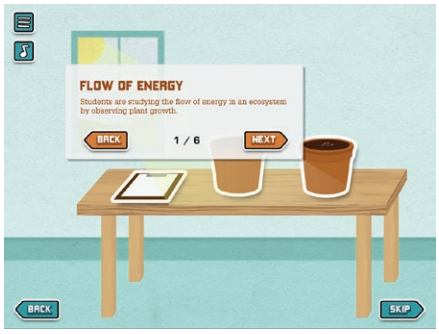
The initial wireframe highlighted the dynamic features of the concept that improve upon the existing paper based tests. The interface consisted of a navigation bar that allowed the user to easily switch between sections and topics and view their overall progress. It also included audio and narration options, allowing the test to be tailored to each student's preferred learning style. We had not yet chosen the topics of our case study questions, but we knew we wanted to begin each question with a pop up explaining what the student was expected to do. At the bottom of each screen, back and next buttons allowed for quick navigation within the test.





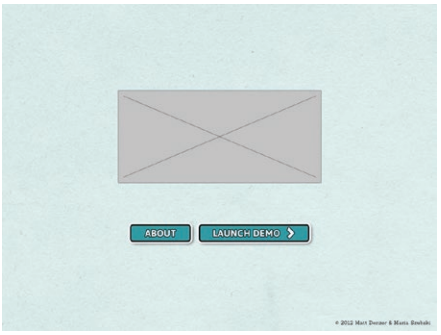


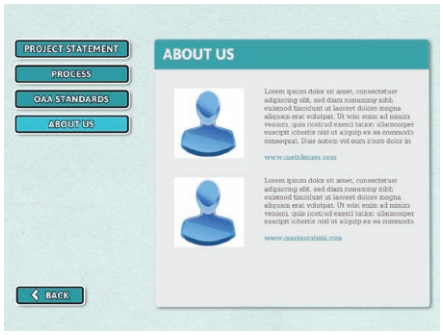

The first round of graphic design began at the end of Fall Quarter. We focused on the main menu and overall flow of the case studies. The section tabs, progress bars, and question navigation were moved to the main menu, eliminating the need for a navigation bar within each question. We chose a visual style that is fun and playful to appeal to kids and make the test more approachable. It features bright, saturated colors, and a mix of serif (*Kimberly*) and sans-serif (*Glypha*) fonts to improve legibility at larger and smaller type sizes. Simple vector graphics with and color hierarchy for case study and background elements provide a straightforward, uncluttered interface. Clickable interface elements are called out with a fun, sticker-like style and a drop shadow.

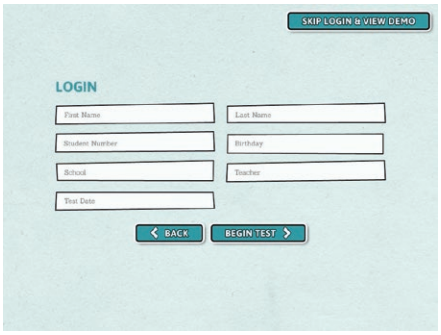




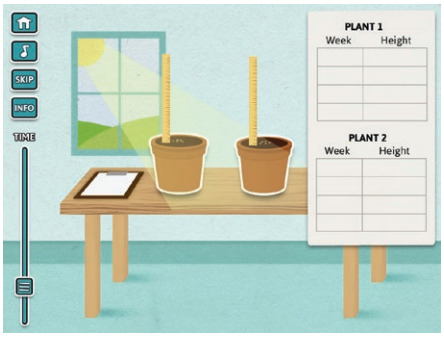
Round two of graphic design began in the third week of spring quarter and focused on refining the interface and expanding the overall flow of the app in preparation for a working prototype. We added a launch screen to feature the project's logo and tagline as well as an 'about' section. This section provides information about us, the project, and the Ohio Achievement Assessment standards on which our project is based. To make the prototype as realistic as possible, a login screen simulates the form students would fill out if they were taking the real test.



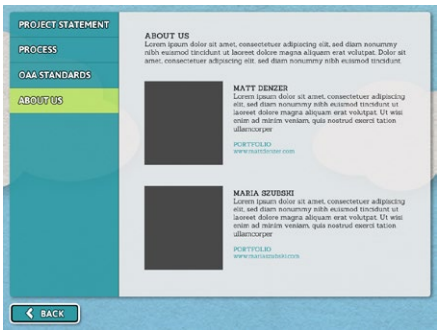

There were major revisions to the layout of the buttons within the case studies. In an effort to keep the button layout organized, global and question-specific questions were originally separated by different styles and colors. Buttons were grouped into separate corners of the screen for the sake of organization. This layout had become very cluttered instead of simple and easy to use. In round two of graphic design, all buttons became the same color and style. The global navigation buttons are stacked on the left side of the screen, making it easier for users to find that they're looking for. Buttons related to beginning or completing the question are centered at the bottom of the screen.



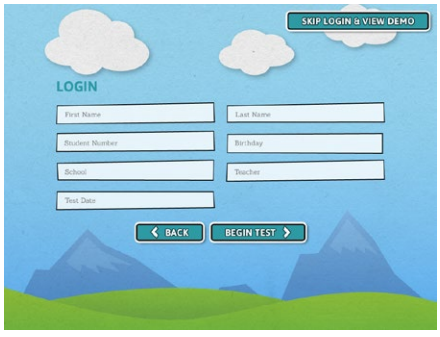


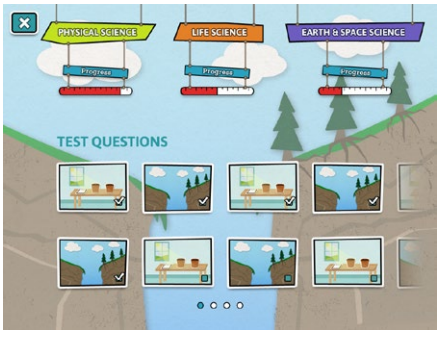
This round of design also focused on the panel that provides information about the question. In the first interface, students had to click through a series of panels, each outlining a step of the question. It was difficult to remember all the steps and the panel wasn't accessible once students began answering the question. A revised, unified panel provides all information about the question and is accessible at any time during the test. The left column outlines the topic, question, skills tested, and overall test progress. The right column lists every step to complete the question, each of which gets checked off as the student completes it. The layout and type styles of this panel set a style that would unify other elements of the interface including the essay question, popovers, case study charts, and "About Our Project" section.

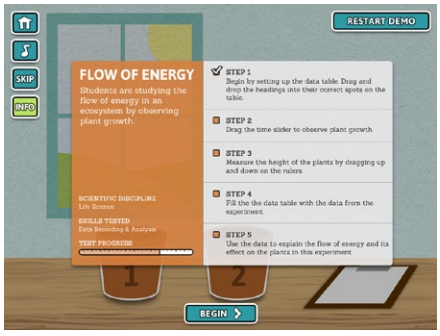


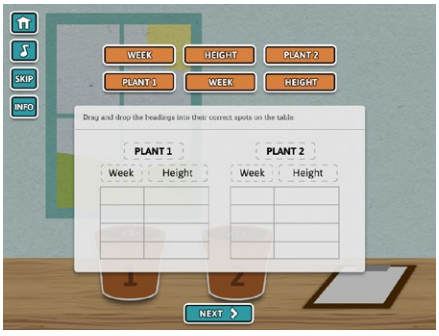


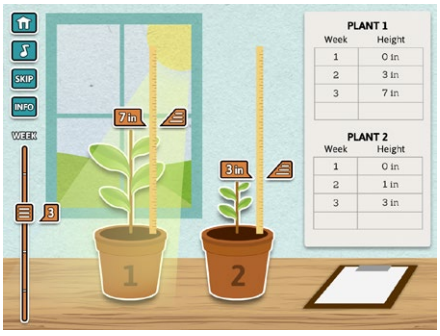

The third round of graphic design began in week four and focused on streamlining elements in preparation for the working demo. We refined the colors to be accurate on the iPad, created a new background for the launch and menu screens, and changed the fonts to open-source web-safe fonts (*ASAP* for headers and *Sanchez for* body copy). We chose final colors for the standard, hover, active, and inactive button states. A test progress bar appears on the info panel of every question, so students always know how much of the test they have left to complete. The revised phrasing of questions and instructions align with the Flesch-Kincaid standard for fifth grade readability.



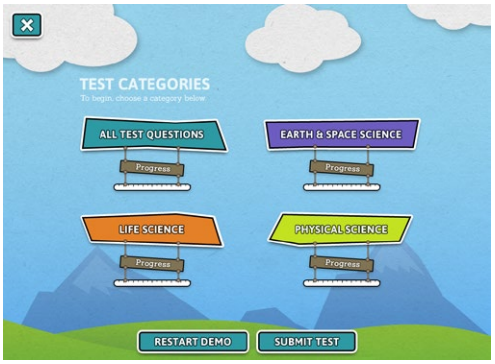



The flow of each case study became more detailed, while the interactions were simplified to make them easier to understand. Originally the case study one visualization was quite simple and showed a single vantage point. We wanted to take advantage of dynamic and exaggerated camera moves and increase the amount the hill eroded. The new storyboard incorporates a zoomed in camera view that details the growth of root structures through soil layers.

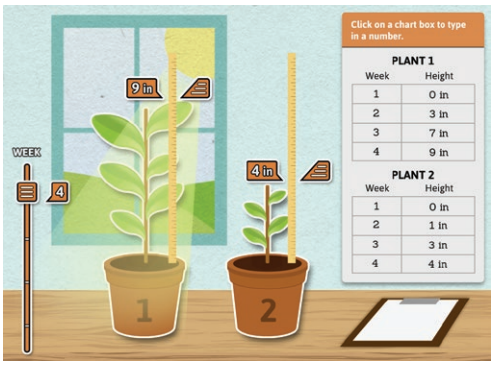
In the case study two, the increased the size of the interactive elements removes unused space and focuses on the plant growth. The experiment-specific interactive elements (week and ruler sliders) are orange to separate them from the global interface elements. The reformatted layout of the data chart and essay question fit cleanly on the screen so that students can access their data as they answer the question.

The fourth and final round of graphic design was based on the results of our user testing analysis and began in week eight. Our previous menu design confused almost all of our test subjects. Many stated that they did not know what section they were in and did not know how to find additional test questions. The flow of the main menu was completely revised to be a two step process where students first select a question category and then select the question they wish to view. Numbers help to call out thumbnails as questions, and scroll arrows indicate that there are additional questions off screen. We considered replacing the pagination with a horizontal scrollbar or adding faded thumbnails to indicate additional questions but both of these solutions made the screen busy without enhancing usability.





Many students were also confused by the case study two screen asking them to fill in the data chart headers. They did not realize right away that they were supposed to drag the headers. To fix this, more prominent instructions are at the top of the chart with large text and a bright orange background. The headers are now below the chart instead of above so that students don't have to drag them over the instructions to place them in the chart. We considered adding the draggable indicator to the chart headers, but this turned out to be busy and distracting.

In addition, the updated type layout of the 'About This Project' section matches the rest of the interface. We included brief explanations of the goal of each case study and our backgrounds as designers. Although this section is not directly tied to the functionality of our app, we wanted to include this to help viewers of our demo better understand the purpose of this project.



The animation for the first case study was revised to include plant roots that are more detailed than the previous style to highlight their importance. The overall animation was shortened to less than 20 seconds to make it as concise as possible. More dirt falls off the hill without plants, and only the top layer of dirt is erodes instead of the entire hill. The rain clouds are larger to better reflect the difference between the stormy and sunny skies.

The second case study animation was shortened to be under 30 seconds long and made less redundant by speeding up the representation of weeks two to four. The transition between steps one and two is now smoother than the initial animation. Because it is a motion test of the interface interactions, a text callout at the beginning of the animation explains to viewers that it is a simulation of how the fully functional interface would work.

**Testing the Application**

In preparation for testing our concept with our target demographic, we sent out emails to several local schools to find test subjects within our particular age range (around the fifth grade level). We also prepared a full color paper prototype to use during testing. The feedback from the test helped us to further refine our concept, particularly the navigation and basic interactions. For a more detailed analysis of our user testing process, see page 23.

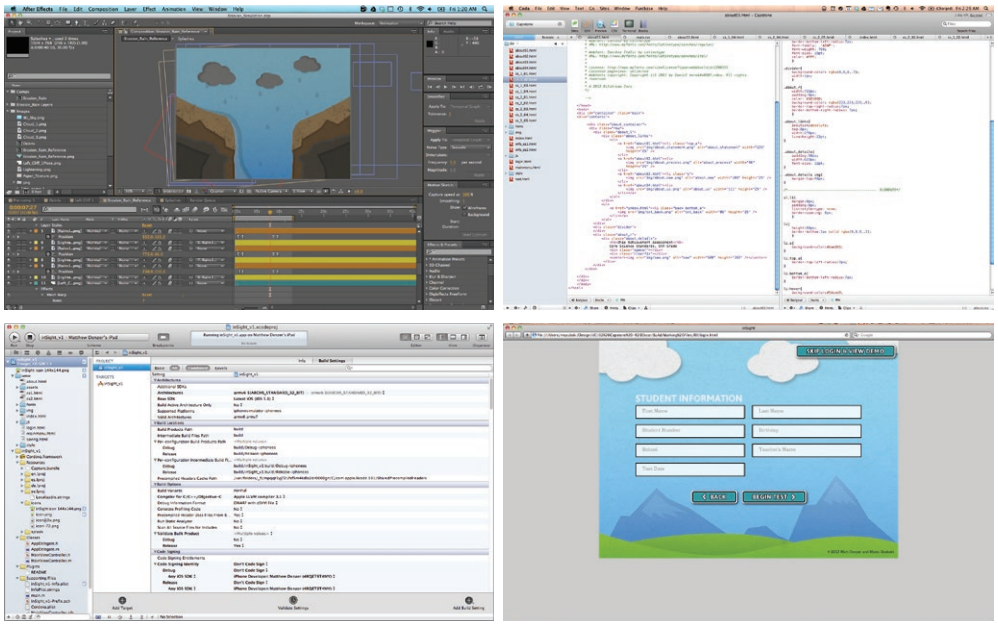
**Prototype**

The prototype is a working web app built in HTML5, CSS3, and jQuery. Using an HTML5 app platform called PhoneGap we are able to export it as a downloadable app across all mobile platforms. It is also accessible through a web browser on any computer. Based on the finalized graphic design, the prototype is broken up into two categories: features to implement as a functional interactive demo, and features to demonstrate through a motion test due to time constraints and technical complexity. The launch screen as well as basic navigation and interaction features of the app are part of the working demo. The simulation in case study one and the interaction experiment in case study two are motion tests that will play when the user reaches that point in the demo.

To further develop case study one, the initial animation storyboards were turned into a short animated simulation in After Effects.  Animated elements included rain drops, debris, water ripples, eroding cliff faces, and lightning elements. This animation was seamlessly integrated into our prototype. In case study two, interface elements such as date and measurement sliders and growing plants were animated  to represent the intended interactions.

We began building the prototype in the third week of spring quarter and refined it throughout. The first weeks were primarily devoted to building the basic HTML and CSS to create a click through. The jQuery was implemented beginning in week 7, starting with the simple functionality before moving on the more complex interactions such as the drag and drop and video playback.

The prototype was close to being completely functional at the end of week nine. Using an HTML5 app platform called PhoneGap, we were able to convert the web app into a native iOS application. We acquired an academic version of Apple's iOS Developer License through the University of Cincinnati to compile the application in Xcode and view test it on an iPad. The initial PhoneGap set up took about a day, but we had to make some changes to the prototype to get everything to function correctly on the iPad. Initially, the videos would not display at all or would display after a long delay. We also had to make adjustments within PhoneGap to get non-system fonts to display correctly. The drag and drop needed an additional jQuery plugin to respond to touch screen gestures correctly. The working prototype was completed at the end of week ten in time for inclusion in the DAAPWorks 2012 end of quarter show.



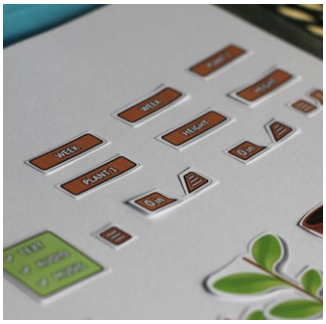

***right:*** Working files from the prototype. *Clockwise from top left:* Case study one motion test in After Effects; HTML and CSS files edited in Coda; Phonegap Build of the app in Xcode; Working prototype in Safari

**Capstone Poster**

As we began to develop the look and feel of our poster, we tried to incorporate elements from our interface such as vector artwork, textures, and a similar color palette. The initial design had a lot of body copy and thumbnails with a generic background. We developed two different concepts for our first revision. One design incorporated a "hanging title" element similar to our interface, while the second concept focused on a strong grid layout of the text and thumbnails.

After receiving feedback on both designs, we decided to combine elements from each into our final layout. In the second revision we cut down on the amount of text and thumbnails. The graphic elements, and especially the background didn't accurately reflect the educational focus of our project, so we incorporated traditional test imagery into the design. The top of the poster features our app on iPad on top of an older bubble sheet and pencil used in existing standardized tests to better reflect the theme of our app. The content of our poster uses less text and a simplified background. We used fewer thumbnails while still calling out the important features of our concept.


***above:*** Capstone poster revisions. The final poster is on the far right.




***above:*** Photos of the paper prototype. Interactive elements are cut out so that user testers can interact with the design.

## User Testing

### Overview

Although we had already developed parts of our interface, our prototype was not completely functional at the time of user testing. We decided to test with full color paper prototypes using our existing graphics to allow for consistency and ease of understanding during the testing process. Movable elements such as sliders and draggable items were cut out and placed on top of screen backgrounds sized to the specs of the iPad display.

Our goal was to make inSight engaging and simple to understand. We went through several rounds of graphic design to refine the interface and make it as straightforward as possible. Consistent colors and button styles are used throughout the app, with icons grouped by function to separate general test elements from question-specific elements. We created a information panel that provides students with everything they might need to know about each test question. This panel, as well as the main menu, includes a progress bar to indicate amount of completed test questions.

### User/Audience Profile

The primary users of this project are fifth grade students taking science portion of the Ohio Achievement Assessment. Students must demonstrate knowledge of required topics to move on to the next grade level. They must understand what the test is asking them to do and how to successfully complete all aspects of the exam. They will want to know what they are being tested on including each question's subject, category, and tested skills. The test interface must be easy for fifth grade students to use.  It must clearly depict the amount of completed questions so that students are able to track their progress and finish the test on time.

We wanted to test 10- to 12-year-olds attending public and private schools in the Cincinnati, OH area. Below is the email we sent out to local schools:

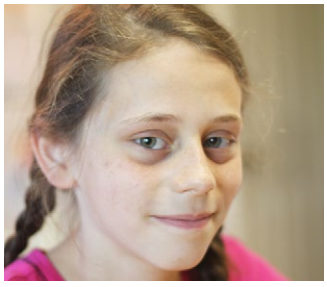
> *Hi _____:*
>
> *We are two students at the University of Cincinnati working on our Digital Design Senior Capstone Project. We're looking for some help with research from local schools.*
>
> *Our project is an interactive standardized testing solution based on the core science standards of the Ohio Achievement Assessment. This iPad app allows students to demonstrate conceptual knowledge and creative problem solving in an engaging and exploratory format.*
>
> *We would like to review our concept with fifth grade students and teachers. Would we be able to have five students participate in a short user testing session? We will not be testing the students' knowledge, but rather certain aspects of our design to see if it communicates effectively.*
>
> *We are also hoping to discuss our concept with some teachers to get their feedback as well. Please let us know if you know of anyone who could help us out.*
>
> *Thanks,*
> *Matt Denzer & Maria Szubski*

We sent this email to Madeira and Lakota Elementary Schools but did not receive a response. Instead we tested family members and the children of people we knew. To make it easier to find test subjects, we expanded our representative user group to students between 9 and 14 years old.

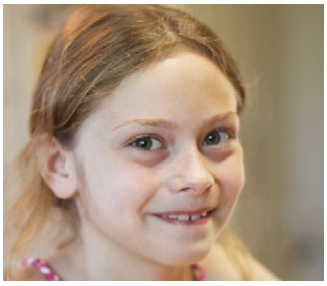
***above:*** *Test Subject 1, 10 years old*

***above:*** *Test Subject 2, 12 years old*

***above:*** *Test Subject 5, 13 years old*



***above:*** *Test Subject 6, 11 years old*



***above:*** *Test Subject 7, 9 years old*

Test subject 1 is a 10-year-old fourth grader who attends St. Ursula Villa in Cincinnati, OH. He plays all types of computer games and has used an iPad before, but hasn't used one very frequently. His favorite school subjects are math and language, and he has taken standardized tests before. His science classes usually consist of reading and taking notes, with some partner work and experiments. His teacher sometimes uses a SMART board as part of the lesson.

Test subject 2 is a 12-year-old sixth grader who attends Summit Elementary School in Anderson, OH. He plays online computer games, especially shooting games and has used an iPad before. His favorite subjects are social studies and science, and he has taken standardized tests before. His science classes usually focus on lab experiments. Each student gets an iPad to look up information during class.

Test subject 3 is a 12-year-old 5th grader who attends Fouse Elementary School in Westerville, OH. He plays computer games and uses an iPad from time to time. He has taken standardized tests in math, reading, and science. His favorite school subjects are math and social studies. In his science classes, students are provided with written instructions that they take back to their tables and work on with classmates. The teacher often uses an Elmo projector to visit web pages and show off items to the class. We tested this user over Skype by presenting screenshots and asking him to complete tasks while thinking out loud.

Test subject 4 is a 14-year-old 8th grader who attends Amherst Jr. High School in Amherst, OH. He plays computer games quite often, and plays games on the iPad from time to time. He has taken standardized tests before, and finds them quite stressful. His favorite school subject is math. In his science classes he does lots of hands on activities including building cells and working with models. In addition, his teacher uses SMART boards and projectors as part of the lessons. This test was conducted over Skype.

Test subject 5 is a 13-year-old 9th grader who attends Covington Latin Catholic High School in Covington, KY. She enjoys of goal-based computer games, but has never used an iPad or tablet. Her favorite school subjects are english and religion, and she has taken standardized tests before. Her science classes involve a lot of note taking. Her teachers use SMART Boards and Eno Boards in class.

Test subject 6 is a 11-year-old 5th grader who attends Saint Joseph's Elementary School in Crescent Springs, KY.  She likes computer-based adventure games and sometimes plays games on an iPad. Her favorite school subjects are science and social studies, and she has taken standardized tests before. Her science teacher starts out class by defining the word of the day and then reading through the textbook. Her teachers use videos to supplement class topics.

Test subject 7 is a 9-year-old 3rd grader who attends Saint Joseph's Elementary School in Crescent Springs, KY. She plays a lot of computer games including Webkinz and Poptropica but has never used an iPad or tablet. Her favorite subject is math, and she has taken standardized tests before. Her science classes often teach through games or experiments and her teachers use SMART Boards and computers in the classroom.

**Testing Methods & Conditions**
It was our goal to test students in a realistic environment to see if our interface could be easily understood by the fifth grade age level. The test subjects sat at a table with the prototype in front of them as though they were using an iPad. We chose to test within a controlled environment where a facilitator introduced the scenario to the test subject, and walked him or her through each task. A note taker was also present to record observations and responses. Testing took place in a quiet room and each user was tested individually. Both the facilitator and note taker were seated next to the test subject without hovering. Finally, a camera was placed at a distance to record a full view of the process, and photos were taken of the test subject performing the required tasks.

The facilitator concentrated on reading the script and tasks to the user while the note taker handled the paper prototype and recorded task notes. We made an effort to conceal the screens behind a folder until they were needed to avoid distracting the test subject. These tasks were followed by a series of post interview questions to help wrap up the testing session.

**Methodology**
We began the testing process by asking some simple pre-interview questions that inquired about favorite school subjects, tablet use in the classroom, and standardized testing:

- *What is your name?*
- *How old are you?*
- *What school do you go to?*
- *What are your favorite school subjects?*
- *Have you ever played a computer game? How often? What kinds?*
- *Have you ever used a tablet/iPad? How often?*
- *Can you talk me through how your teacher teaches science?*
- *Do you ever use technology in the classroom? What?*
- *Have you taken a standardized test before? Can you describe it for me?*

*For a college project, we are creating a computer and tablet - based standardized test using the same content as existing standardized tests. It would be a replacement for paper tests. We're going to ask you to do 6 simple things you would do if you were actually taking this test.*

*We're in the middle of project, so this isn't the final version. The tasks are going to be a paper version of what you would see on screen. We're not testing you on the content, we just want to see how students interact with our test. There aren't any right or wrong answers. Any comments you can provide, positive or negative, would be helpful! Also, it would be great if you could "think out loud" as you go through the tasks so we can understand your thought process (provide example of "thinking out loud").*

***right:*** Test subjects 1 and 2 complete tasks and interact with the paper prototype during the user test.

We then began the testing process by describing the scenario, and introducing the testing materials. The test subjects were required to complete a total of six tasks, each targeted at a specific interface function:

**Task 1**
Select 'skip' or go to the main menu to navigate to another question.
*"To start, imagine you're in the middle of the test you don't want to answer this question right now. How would you move to another question?"*

**Task 2**
Scroll through thumbnails to reach additional questions on the main menu.
*"Now that you've completed all 8 of these questions, how would you view additional questions?"*

**Task 3**
Bring up the info panel to see what the next steps of the question are.
*"So now, during this question you're not sure what the next step is. What would you do?"*

**Task 4**
Drag and drop data chart headers into the correct placeholders.
*"Now you're working on a testing question about plant growth. You're going to be recording the height of 2 plants in a data table. What would you do at this screen?"*

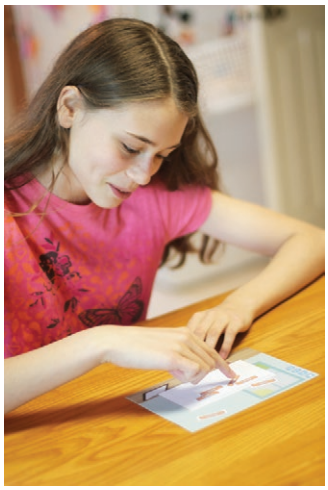
**Task 5**
Use the week slider to move through time to view plant growth.
*"Now that you've set up the data table, you're going to want to see the plants grow. How would you measure the plant growth each week and record it in the data table?"*

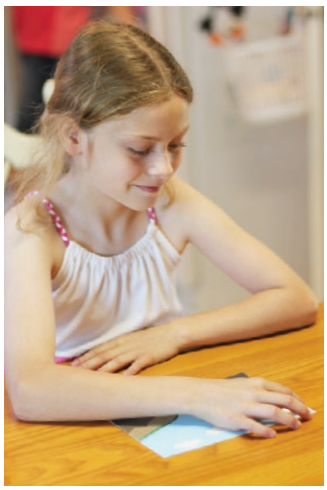
**Task 6**
View test progress on main menu or info panel.
*"The teacher announces that you have 20 minutes to complete the test. What would you do to find out how much of the test you have left to complete?"*

We followed these tasks with a series of post-interview questions:

- What are your thoughts? Any feedback good or bad?
- How was this test different from paper tests? How is it similar?
- Our testing concept covers the same content as a multiple choice test. Which type of test do you prefer? Why?

***right:*** Test subjects 5, 6, and 7 complete tasks and interact with the paper prototype during the user test.





**Results, Deficiency, & Actions**

The feedback and performance of each test subject varied from task to task with some consistent themes and deficiencies. Test subject 1 easily found the basic global navigation elements such as the "skip" button and "info" panel buttons in tasks 1 and 3. He was unable to figure out how to scroll on the main menu screen in task 2. He needed a bit of encouragement in task 4 to actually move the chart headers, but was able to fill them in correctly. When asked how to view plant growth in task 5, he found the sliders right away, and knew how to use them. In task 6, he was able to view progress by pressing the info button as opposed to the main menu button.

Test subject 2 knew to press "skip" to move on to another question in task 1 and pressed "info" to bring up the info panel in task 3. He was unable to figure out how to view additional questions in task 2 and decided to press the category header instead of scrolling (was not sure which category he was in). He was a bit confused about where to put the headers in task 4, and asked for the question to be repeated several times. When asked how to view plant growth in task 5, he was unsure what to do, and asked for help. In task 6, he suggested flipping back through his packet and looking at the clock to view progress (forgot that he was viewing a digital format).

Test subject 3 found the "skip" button easily in task 1, but had difficulty locating the "info" panel in task 3. In task 2, he completely missed the pagination at the bottom of the page, but guessed that scrolling would reveal more questions. He successfully found the "drop zones" in task 4, and understood how to drag the chart elements. When asked how to view plant growth in task 5, he found the sliders right away. In task 6, he had to be reminded that he was taking digital test format, and could not view his progress in a traditional manner.

Test subject 4 easily found the basic global navigation elements such as the "skip" button and "info" panel buttons in tasks 1 and 3. In task 2, he did not understand how to scroll, and suggested pressing the "x" to view more questions. He was not sure what to do at first in task 4, and didn't understand what the screen was for. When asked how to view plant growth in task 5, he found the sliders easily, but suggested adding an info pop-up. In task 6, he suggested pressing the "skip" button to get back to the main menu.

Test subject 5 easily found the basic global navigation elements such as the "skip" button and "info" panel buttons in tasks 1 and 3. In task 2, she suggested clicking on the page instead of scrolling to view more questions. In task 4, she knew how to drag the chart elements and put them in the correct order. When asked how to view plant growth in task 5, she found the sliders easily, but was not sure how to record the data. In task 6, she returned to the main menu to view her progress.

Test subject 6 asked a few questions when completing tasks 1 and 3 dealing with global navigation elements. She was not sure how to scroll to view additional questions in task 2, and suggested clicking on the pagination dots . She easily understood dragging and dropping in task 4. When asked how to view plant growth in task 5, she was not sure how to use the sliders, but completed the task with some guidance. In task 6, she returned to the main menu to view her progress.

Test subject 7 was not able to locate the "skip" button in task 1, and instead pressed the next button at the bottom. She was able to locate the info button with ease in task 3. In task 2 she was unsure how to view additional questions,  and had to move on. When presented with the "drag and drop" screen in task 4, she was able to complete the task, but needed a bit of guidance. When asked how to view plant growth in task 5, she understood how to move the sliders, but was unsure how to measure. In task 6, she returned to the main menu to view her progress.

In a post interview, three test subjects found that the testing format was more fun than existing tests. Several also mentioned that the lively color palette provided an engaging and less stressful environment. A majority also said that they were okay with not having to use a pencil to fill in traditional Scantron circles, and enjoyed using gestures instead. One subject in particular mentioned it was easier to see visuals as opposed to reading an explanation on paper.
Below is a list of deficiencies, in order from most to least problematic.

**Locating additional questions on the main menu :: Task 2**
When users were asked to locate more questions on the main menu screen, they were unaware that swiping to the left would bring more questions into view. We also discovered that the pagination circles at the bottom of the page were often ignored altogether. It is quite possible that this visual language is too sophisticated for a fifth grade level.

Additionally, one user was unsure which science section was active, and attempted to select a category header to bring up category specific questions. This is a detail that we overlooked when we were designing the interface elements, but we decided it made sense to break out the questions into specific categories.

**Dragging the chart headers to their correct position :: Task 4**
When presented with a chart and draggable elements, all three users understood that they needed to drag the headers, but two struggled with filling out the chart correctly. One user in particular mentioned that he was completely unsure what the screen was asking him to do.

**Plant Measurement Sliders :: Task 5**
It took users a while to figure out how to measure the plants using the sliders. A few users wanted to jump ahead and record the heights based on what they saw without realizing the sliders could be used to provide specific measurements.

**Viewing Test Progress :: Test 6**
Two users were unaware that there was not a paper test to go along with the digital test. When asked how they would check their progress, they suggested flipping back in the test and counting the remaining pages. Another suggestion was to swipe through the question screens and count the remaining screens, a functionality that we had not yet considered.

Feedback on our prototype was generally positive. The testers were interested in our project and felt that it was more fun than the traditional paper tests. They didn't have any problems understanding the basic interface. They felt that the content was similar to the content on existing standardized tests. They generally understood how to move the sliders and fill in the data charts.

Based on our findings, we plan to refine the menu screen to make it easier for students to understand how to navigate between test sections and questions. We also plan to highlight the section headers to indicate the category of the visible thumbnails.

We will refine the plant chart with a special pop-up to indicate how to drag the headers to their appropriate placeholder. The drop targets will become highlighted when the user hovers over them to indicate that they are placing each header in the correct spot. We will also refine the functionality of the of the measurement sliders used to measure the plants. When the page first loads, it will show the sliders moving along the ruler to indicate their functionality. Clicking on the ruler will cause the slider to jump to that position. We also plan to adjust the text to match a fifth grade reading level.

**Project Analysis**

A working demo of inSight was displayed at the University of Cincinnati DAAPWorks 2012 from June 5th to June 8th. The project was displayed in the mobile room on an iPad and along with a supporting poster outlining the main features and goals of the project. It is also included on the Digital Design 2012 website at: www.ucdd2012.com/12.html. The final project can be downloaded as an iPad application or viewed as a web app at http://homepages.uc.edu/~szubskma/inSight. We also created a website detailing the first quarter of our capstone process here: http://homepages.uc.edu/~szubskma/inSight/process.

Our process throughout this project was iterative. Although we set up and stuck to structured schedule, we did not have a set number of design or prototype revisions. After each stage, we evaluated or tested the project and went back to make improvements. We constantly built upon our previous designs and research, improving our concept throughout the process. The visual style was not drastically redesigned or thrown out at any stage in our process; rather, the design was constantly refined to improve the user experience. Added features and simplified interactions with expanded the motion demos helped to better visualize the case studies..

We divided the tasks equally based our skills and areas of interest. For both the project and supplemental materials we often worked separately and then compared ideas to come up with the best possible design solution. In the early stages of the process, Maria primarily focused on the user interactions and wireframe, while Matt focused on the case study graphic elements and storyboard. This carried over into the production stage where Maria worked on building the interactive prototype elements while Matt worked on the building motion demos of more complex interactions.

We met our design and production goals for the quarter and for the most part we stayed on schedule with only minor modifications. At the end of the quarter we met all of our prototype goals and had a fully functional web-based and iPad demo for the end of quarter DAAPWorks show. We successfully designed two case studies that highlighted the functionality of our concept. Although the design went through several iterations, the overall visual style stayed consistent. The biggest design challenges involved the interface and user interactions, including the flow of the main menu and the hierarchy of clickable elements. We improved ease of use and organization through each step of the design process. The resulting design appeals to our target audience, fifth grade students, and is easy for them to use and understand. inSight was well-received by our user testers who felt that our concept was an improvement over existing standardized tests. They felt that it was more fun and visually engaging and some felt that they would be more interested in taking a test in this format.

The research documentation could have been more detailed if we had recorded and photographed each phase in detail as it was happening. Approaching the process differently, we would have adjusted our schedule to better distribute the work involved each week. With more time to develop the project, we would have made all of the interactions part of the working demo instead of displaying some of them as motion tests. We had additional case study ideas that focused on other OAA core topics and highlighted additional features and interactions. We eliminated these ideas due to time constraints and the complexity involved in developing them.

Ideally we would have had more students to test our product in a more realistic setting. We would have liked to do a second round of testing with the interactive, working prototype. It would have been interesting to consult with professionals in elementary education instead of primarily referencing written resources and existing products. We would also like to get feedback on how effective and viable the final project is from people in the standardized testing and education fields.

We see this project as purely conceptual with the goal of presenting the educational possibilities of modern technologies. It would be difficult and time consuming to drastically change the existing standardized testing structure and to produce enough questions to qualify as a complete test of required topics. Although we don't plan to turn this concept into a real world product, the knowledge we have gained will affect our careers moving forward. It has reinforced the importance of designing projects with social impact over designing projects that are purely promotional. It has also opened our eyes to the importance of collaboration in design and how it can drastically affect and improve the final product.

This is the most complex and in-depth project we've worked on as designers. We got to experience the full spectrum of the design process, from choosing the initial topic to producing a working product. It's rewarding to develop something from a spark of an idea that never existed before, that looks visually appealing while having relevance and purpose. We learned about the importance of research in the design process, and how it plays a role in every element and decision. User testing helped to guide our design, bringing to light problems and solutions that we hadn't previously anticipated.