Sea Change Website
Summative Evaluation Report

Submitted to:

Dan Grossman Media

Submitted by:

Rockman et al
Independent · Insightful · Informative

June 2013

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Introduction

Rockman et al (REA), a San Francisco-based research and evaluation firm, conducted the summative evaluation of the Sea Change website (http://seachange.rainbowtigerdesign.com/). Through funding from the National Science Foundation, Dan Grossman Media developed this website as part of Dr. Maureen Raymo's research. Her research looks at the Pliocene era (thought to be the most recent time in geologic history with a concentration of CO2 in the atmosphere with levels as high as today). The aim of the Sea Change website is to raise awareness about global-warming-induced sea level rise and how scientists study it. This report follows a formative evaluation report produced by REA in March 2013.

Rockman's summative evaluation was designed to: (1) gather users' feedback about the website, as well as (2) assess the impact of the site on users' knowledge and attitudes about sea level rise and climate change.

To meet these goals, researchers recruited four adults to interact with the website and provide feedback through guided think-aloud interviews.

Methodology

Participants

In June 2013, REA recruited adults from the San Francisco Bay Area to participate in the Sea Change summative evaluation study. Researchers asked potential participants to complete an online screener to gather information on their: (a) views on climate change, (b) knowledge about science, (c) interest in and engagement with science and the environment, and (d) typical activity online. From the thirty-five people who completed the online survey, REA selected four people to participate in the study (Table 1). Based on survey responses, REA selected a "high" engagement male and female (ID 1 and 3) and a "medium" engagement male and female (ID 2 and 4). Specifically, "high" engagement participants had at least some degree of knowledge about sea level rise and were past members of environmental groups. All selected participants: (a) rated their level of general science knowledge as a 4 on a 5-point scale (1: Not Knowledge – 5: Very Knowledgeable), (b) believed that human activity contributes to global warming, and (c) were interested in science and climate change issues. They also typically spend at least four hours online per day, use the Internet to find out information on science issues, and listen to public radio 2-3 times per week.

Table 1: Overview of Study Participants

ID	Gen-der	Age	Occupa-tion	Environ-mental Group Member?	Familiar with "Sea Level Rise"?	Topics of Most Interest*	Science Topics of Most Interest	Online Science Activity
1	M	60	Wireless Network Consultant / Computer Repair	Past Member (WWF)	Yes	Science, environment, public affairs, sustainability, energy, climate change	Engineering/ building, space	Daily for sci. issues (e.g., NASA, National Geo)
2	M	54	Executive Admin Assistant (Insurance)	No	No	Science, environment, public affairs, sustainability, energy, climate change	Anatomy, medicine, chemistry	Daily for sci. issues (e.g., Wikipedia)
3	F	28	Medical Social Worker	Past Member (Sierra Club)	Yes	Science, environment energy, climate change	Health, climate change	Daily for sci. issues (e.g., WebMD, National Geo)
4	F	45	Filmmaker	No	No	Science, public affairs, sustainability, climate change	Health & food sciences	1 time/month for sci. issues

*On a scale of 1 (Not at all interested) to 5 (Very interested), participants rated their interest in the following six topics: science, environmental issues, public affairs, sustainability, energy, and climate change. Topics rated as 5's are listed in the table above.

Coming into the study, the "high" engagement participants were familiar with the concept of sea level rise, though none knew how scientists study it.

> *I am familiar with the concept of sea level rise already – the increase in global climate causes the polar ice fields to melt, which in turn raises the level of the sea…but I don't know what we can really do to stop it at this point. I see these programs and stuff on the web of massive ice shelves breaking off and glaciers melting and things happening that are so peculiar and unfathomable…I'm originally from NYC…the sea level is rising, and there is a concern now, especially with what happened with Superstorm Sandy, that the lower portions of Manhattan are ill prepared to deal with this.* – "High" Engagement Male (ID I)

> *Sea level rise is the rising of the water levels in the oceans from melting glaciers and ice sheets, which has already caused people to be displaced from flooding…I watched a documentary called Chasing Ice a couple of months ago.*

> *They had this chart about the CO2 levels over the years, and since the industrial revolution, there was a huge spike…I had heard about sea level rise over the years and had read articles about the water level rising and ice caps melting. I don't know more about the science aspect of it, though.* – "High" Engagement Female (ID 3)

Before exploring the website, the "medium" engagement participants were not familiar with the concept of sea level rise, though they expressed concern about climate change.

> *I'm not familiar with the concept of sea level rise…but I'm alarmed about global warming. There's not enough money, time, attention, and caring. I don't think that we have to wait until our children are 63 to see the big problems. We're going to see it. And old men like me, and I'm 54, are going to see problems in our lifetime, and we already are.* – "Medium" Engagement Male (ID 2)

> *Maybe one of the documentaries I watched had a mention of sea level rise?...I watch a lot of documentaries on climate change and global warming. I definitely believe that we contribute a large part to it. It's dangerous, and something we need to pay attention to.* – "Medium" Engagement Female (ID 4)

Website Study

During the week of June 10th, 2013, each participant came to REA's office for an hour and a half interview that involved exploring and giving feedback about the Sea Change site and its impacts on them. For these interviews, REA used a protocol comprised of the following sections:

- Part I. Introduction: Provide an overview of the study, and give instructions for the interview.
- Part II. Background questions: Gather information about participants' Internet use regarding science issues, participants' views on global warming, and participants' familiarity with the concept of sea level rise.
- Part III. Website interaction: Examine participants' reactions to the site and how it influences them by giving them an allotted amount of time to interact with and explore each of the functional sections of the site. *(Note: Users did not explore the: (a) Resources section or (b) several subpages within the About section (Production Credits and Contact Us), since these pages were not live at the time of the study.)*
    - Homepage: [several minutes]
    - About section – Sea Change Mission & Pliomax Team subpages: [several minutes]
    - Climate Basics section – Sea Level subsection: [5 minutes]

    - Sea Change Science section:
        - Part 1: "What's Sea Change Science?" subsection and the "On the Road" page of the "Rock Wrangling" subsection [10 minutes]
        - Part 2: "All About Time" subsection and the "What's in a Number" subsection [15 minutes]
    - What Now page: [several minutes]
    - Video:
        - Video Part II: In the Lab [10 minutes], *or*
        - Video Part III: Interpreting the Results [14 minutes]
- Part V. Interview questions: Gather participants' feedback about the site (e.g., highlights and comprehension), how it influences them (e.g., in terms of learning and attitudes about climate change and sea level rise), and suggestions for improvement.

REA focused the Website Interaction portion of the summative evaluation study on the "new" portions of the site – that is, pages not reviewed by participants in REA's formative evaluation study. (Note: Besides the homepage, little to no changes were made to the pages previously investigated by participants during the formative study.) The Part II: In the Lab and Part III: Interpreting the Results videos were not available, and therefore not examined, as part of the formative study. However for the summative study, participants were guided to view only one of these 10+ minute videos due to time constraints. REA instructed the two female participants to view the Part II video and the two male participants to view the Part III video.

As previously noted, REA gave participants an allotted amount of time to interact with each section of the site during the study. Though constrained to a particular section of the site during this allotted time, participants were free to choose which subpages to explore, and in which order, for the sections of the site consisting of multiple subpages. Specifically, the sections of the site with multiple subpages were the Climate Basics section and three subsections within Sea Change Science (What's Sea Change Science?, All About Time, and What's in a Number). For the Rock Wrangling subsection of Sea Change Science, users were solely asked to view a single page (On the Road), since in the formative evaluation, participants had already given feedback on the other pages within this section (Dig It and Gear).

At the conclusion of the interview, participants received a $75 cash incentive for their participation.

REA audio-recorded and then transcribed portions of the interviews. In order to analyze the qualitative data collected, a researcher identified response themes and then organized themes by topic.

Findings

We present the data in two main sections below: Feedback and Impacts, and within each of these sections, we organize findings by sub-topics. In the Feedback section, we provide overall participant feedback, as well as feedback about comprehension, navigation, various sections of the site, and interactive site elements. We also include participant recommendations for improvements to the site. In the Impacts section, we relay findings about how the site influences users' knowledge and attitudes. In both sections, we have included extensive participant quotes in order to provide rich data for the site developers.

Feedback

Within this section, we organize participant feedback by eight subtopics: 1) Overall Feedback, 2) Comprehension, 3) Navigation, 4) Homepage, 5) the About section, 6) Interactive Site Elements, 7) What Now section, and 8) Additional Subpage-Specific Suggestions. In the Overall Feedback subtopic, we detail what participants liked most and least about the site in general. In the next two subtopics – Comprehension and Navigation – we describe participants' reactions to understanding and navigating the information on the site. In the subtopics that follow, we provide participant feedback about the strengths and weaknesses of the homepage, About section, interactive portions of the site, and the What Now section. When applicable, we incorporate participants' suggestions for improvements into each of the first seven subtopics, but in the final subtopic – Additional Subpage-Specific Suggestions – present participant recommendations about specific pages within site sections not previously discussed.

Within this portion of the report, we do not include participant feedback about the non-interactive portions of the Climate Basics and Sea Change Science site sections. Instead, we share feedback about these sections in the Impacts portion of the report by describing participant knowledge gains, since these site sections include the bulk of the site content material.

In terms of positive participant feedback about the site, an overview of highlights is as follows. Participants:

- Described the site content as easy-to-understand and accessible for adults (even though the site was highly scientific in nature);
- Particularly enjoyed the interactive portions of the site, especially the videos (which they described as extremely high quality);
- Said that the interactive site portions enhanced engagement and learning;
- Described the site navigation as straightforward and clear; and
- Enjoyed the homepage and wanted to explore the site further after seeing it.

Overall Feedback

Similar to the formative evaluation, participants described the site content as interesting and clear, and especially enjoyed the videos as a vehicle for presenting information. However, due the format of the study, participants were required to engage with the site and its content. Participants felt that the way the information was presented on the site potentially rendered it inaccessible for visitors who approach the site naturally, mostly due to the amount, format, and size of the text. One comment that illustrated this feedback was:

> *[On a five point scale in terms of how much I liked it]…in terms of the content, I'd put it as a 4.5-4.8. In terms of the presentation, the vehicle, and how it's done, I'd go down to a 2.5 or 3. Only because there's a lot of it that's inaccessible because it's so wordy or they don't have the right visuals.*

Once engaged with the content, participants described the site as extremely informative and detailed, and noted that difficult-to-grasp concepts were explained in layman's terms.

> *I'd rate it a 5 [in terms of how much I liked it]…it's fascinating…it's explained really well…It's all really, really interesting stuff…It's an adult-level educational website that uses scientific terminology, and even though it does, it explains it on an easy-to-digest level – like the thing about the carbon dating and strontium, as an example…The depth it went to in explaining it. It was a lot more than vague and general. It gave me the understanding or basic understanding of each concept they were trying to explain…It's a complete education on what causes sea level changes and how it's affecting the environment, and its direct affect of global warming. And, how it's being researched and compared to the most recent past period in time.*

> *There is a website that is very detailed but would give you information on climate change and how it's affecting sea level and what this team is doing to study it… They have a lot of research to back their studies. It's very informative…They weren't just writing the content, they were sharing the scientific process that are used to study something [strontium levels to date fossils]; so, you feel almost like you are part of their journey and that you've gotten involved in their research study.*

However, as previously mentioned, participants found the overall presentation of the content to be the biggest deterrent to engaging with it, with the most common complaint being the large amount of text. Several participants felt that, especially in this day and age, the format of Web content needs to be brief and accessible enough to hold visitors' attention, as often their time is limited. Participants

recommended streamlining the content by making it more direct and to the point. Specific suggestions included bulleting the most important content, providing several short sentences in place of lengthy paragraphs, breaking up content by adding headings and subheadings, and increasing the font size.

> *It's really interesting and useful…It's great. It's pretty clear…what they did is really fascinating, but it's lost in all these words…there's too much content, which is not broken up with sub headings…the font is very small…I find it very hard to read…on a website, there should be a simpler way to read stuff…This, to me, reads like a science paper…but even a science textbook has headers and sections…my biggest concern is that [the text on the site is] not broken up…It's just this long…All of the stuff that they are explaining should be in bullet points instead of paragraph form…people don't have much time…If they want to have paragraphs, they should at least have headers or subtitles…If they had sections, it'd be easier for me to focus and feel like I'm moving from one section to the next…It should be more like Wikipedia because they break out the content in a nice fashion…It should have separate headings for each thing because maybe you don't want to read everything or are just looking for one particular thing.*

> *The content is very interesting and good…but it is far too many words and too long…we go in sound bytes now…Hardly anybody is going to take the time to do that other than maybe a student of this…These days, nobody has the brain time to read that way…So, one or two shorter sentences per paragraph and not so many paragraphs…the bottom line is, what's the point and get to it…It could be much, much more direct…with shorter sentences…using more powerfully descriptive language. Less is more. Seven words can do it, but you gave me 32. This is tiny font.*

One participant was so displeased with the presentation that she felt that it would stop people from visiting the site:

> *Today, we are in the age where everything is about creativity and visual. Even though it's about science, you don't have to make it boring. You can make it beautiful and attractive and more appealing, and I don't think it's doing that…Right now it seems boring, and it's going to stop people from going to their site.*

However, all of the participants raved about the presentation of information through the site videos, describing the videos as a highlight of the site. An example comment is:

> *The videos are great – the music and the sound effects. The website should be like the videos. The videos pop. The website is not popping…but the videos impressed me…the videos were very professionally done. It wasn't a boring science video. It really got your attention. The short videos were just the right amount of time – less than a minute. That's usually what most people would watch for. The longer video also held my attention, though because it followed a story arc. It was edited really well. The video adds value to the website…with the videos, I think that these guys have their act together, they have all this information, they are 21st century-savvy. They add more weight to it.*

While other participants complained about how site content was presented, one participant (who happened to be the oldest) had only positive things to say about the site, expressing his extreme enthusiasm about it:

> *Is this website online yet? I want to go look at it when I get home!...I hope these guys get enough grant money that they could have a National Geographic special or a TV show about this. This is great. I'm not being melodramatic. This is really cool stuff. I'm 60, but I feel like a kid here. I love this stuff. It's just telling me these – not just concepts – they are illustrating actual ways how the sea level, which is the main theme here, rises.*

Comprehension

On the whole, participants appreciated that, even though the site was highly scientific in nature, the content itself was easy to understand and accessible for adults, even for non-scientific people.

> *The content is great…the language is simple…it was written with the layperson in mind. It explained everything very simply. Some science websites are not that easy to read and grasp. I thought it was well written and easy to follow and descriptive and informative…Though, if I were to show it to my 7.5 year old son, it would go above his head.*

> *It was very understandable, and understandable at the level of non-scientific people, though definitely for adults.*

However, they noted that What's in a Number? (within the Sea Change Science section) was the most difficult-to-understand section of the site due to the complicated concepts covered.

> *I got a little bit bogged down in the geophysics of it all [in the What's in a Number? section]...It's very thorough…It was maybe a little too much*

information. It wouldn't deter me…I would be aware that this is in the nitty gritty scientific analysis…but, it gives it more credence.

This is a little more complicated here. It's a little more complex. It's something that should require some time to read and understand.

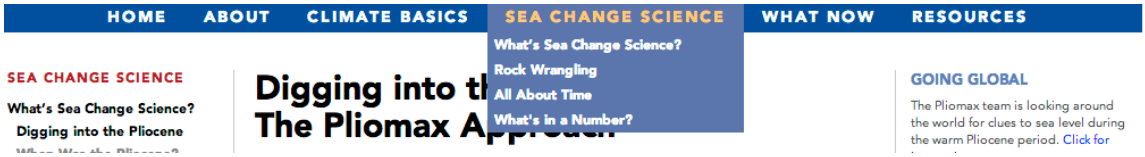
Navigation

Participants described the site navigation as straightforward and clear. Example comments about navigation included:

It was well done. It was well linked.

I like having the names of the scientists within the text link back to who they are [in the About section].

Image 1: Navigation Bar Menu



When exploring within a section of the site, participants typically navigated pages in order and read or skimmed the content, more often than engaging with the interactive site elements. (However, we cannot determine if or how navigation might change if users navigate the site outside of the study, when not constrained to exploring within a particular site section for a set period of time.)

Participants provided the following suggestions regarding navigation:

- Add information to guide users through the site (e.g., by providing a suggested order for viewing the content) and provide "prerequisite" information at the beginning of each subsection of the site to ensure comprehension.

  I think that it ought to tell you – read this first, this next, this next, etc. They ought to put an order to the tutorial of this. Have an explanation of what would make sense to read first and then next - to give you the continuity of it and building understanding of it, so you don't jump around or jump ahead to something that you don't understand because they've explained it somewhere that you haven't gone yet.

Order and prioritize things. Don't talk about Pliomax or Pliocene before I've understood what that is. The way or order of which the information is presented could be improved…Approach each section as if – in little capsule, tell me what I need to know to understand what you are writing about, assuming that I haven't read about it already because you have the freedom to go to different areas and sub-areas.

It wasn't as streamlined, and how do the pieces connect? It was a wealth of information, but I felt like I was on my own to pick [my way] through it.

- Visually clarify for users how many subpages are contained within each subsection of the site, particularly for the Sea Change Science section.

I liked it. It was very clean…However, with the navigation, you're not really certain how much info is contained within each dropdown menu selection.

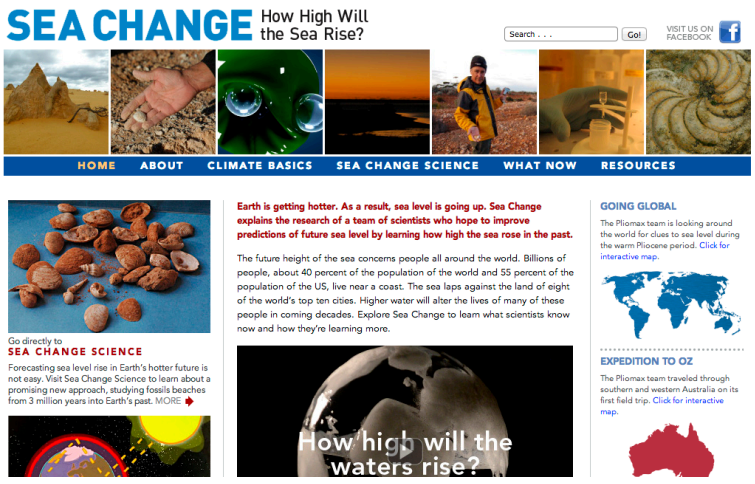
Homepage

The majority of participants enjoyed the homepage and wanted to explore the site further after seeing it.

It's very interesting. It pulls me. These are topics that I am concerned and interested in. We're approaching it from a science perspective, but it is English. At this glance, it doesn't seem political, so it's accessible…come one, come all…At first glance, this is terrific…I'm very visually oriented…I love the images and graphics.

It gives off the look of a printed magazine page. I like it – it's easy to read and put together nicely.

Image 2: Homepage - Partial Image



Several participants were especially impressed by the homepage video, describing it as motivating, powerful, and positively affecting their view of the site.

> *I liked [the homepage video] a lot…it gave a human face to it. I felt internally more fired up about the issue than I did when I landed on the website. Now, I really want to launch into it.*

> *It's great that they have the video on the homepage…I liked it. It was powerful. It's very well done and definitely has my attention.*

However, two participants noted that the amount of content on the homepage was problematic:

> *[The homepage is] not grabbing my attention…There is too much information…The homepage should have only a few bullet points, and all the other information could be on a later page.*

> *I got a little overwhelmed by the amount of content, so I didn't know where to zoom in first.*

In addition to reducing the amount of content on the page, participants recommended to:

- Add a "Contact Us" link in the footer of the page.
- Play the video automatically when a visitor loads the page.

About

One participant described the About section as clear and interesting:

> *It's really interesting. It was well written, clear, succinct, and just the right level… it's a solid explanation of what they are doing.*

Image 3: About – Pliomax Team Page (Partial Image)

However, other participants were confused by the About pages and felt that a clear explanation of the Pliomax team and its mission were lacking. They suggested including a brief overview at the top of the page(s) to clearly define Pliomax, the Pliomax team, and its mission:

> *I don't know what Pliomax is, and I didn't see it anywhere…I'm confused by who is the Pliomax team? Is Pliomax a company? Add an explanation at the top to give an overview – founded in X year, that it is a nonprofit, etc. I thought Sea Change was the name of the company. I need clarification…I'm getting [Pliomax Team here], but I don't even know what their mission is.*
>
> *Pliomax should have been explained at the beginning. Who are these people? Is it a nonprofit or are they people from other organizations? If you are investing time and reading, most people want to know about the people behind it.*
>
> *On the Sea Change Mission page, give a brief mission statement or tell me what the point is.*

Interactive Site Elements

Participants greatly enjoyed and appreciated the interactive portions of the site, often noting that these tools, particularly the videos, enhanced the site and helped solidify learning.

> *The videos are beautifully done. Whoever created the videos is very creative. I've seen science videos that are really boring – you just have someone talking. But, here, their visuals and graphics are beautifully done, powerful. It's much easier to watch the video than to read the content.*
>
> *Watching the video and then reading it, I started to have a better picture of what was going on…It was very interesting…I liked having the video and the text together…I think it helps…and gives something to choose from – if it were just the text, I'd be like, "Whoa!"*

Participants recommended to: 1) highlight the interactive site elements so that they stand out more (e.g., adding hyperlinks within the text to link to the videos or interactive elements), and 2) increase the number of interactive elements on the site. Comments included:

> *The videos definitely need to be highlighted...The video is kind of lost here...If you are not familiar with looking at videos online, the little arrow isn't enough to make you click on it. Many people may not know that this is a*

> *video…While you are reading, there should be a way to see it, or it could start playing when you get to the page…When you are reading the page, you could click on the words [hyperlink] to get to the video.*
>
> *They need to do something to bring this out and highlight it better…some people may skip the stars on the interactive map…and not know they can click them…I'd suggest having a hyperlink within each area that talks about each area. That way you can't miss it…It'd give you two ways to get there.*
>
> *I liked the interactive map of Earth [showing the ice age]. If there were more things like that, where you could click on it to see how much water is rising, etc…that would be interesting.*
>
> *Sometimes I respond better to a voice, give users the option also for the information to be narrated. I like to read it, too, but maybe some audio and text.*

One participant suggested adding interactive site elements that target youth, in order for the site to be accessible to a broader age range:

> *If they are trying to get the youth involved, it has to be more interactive...Our kids are the future of the planet. You want children to get involved…Add an interactive game to makes kids think about energy consumption. Or, add an animated video or a video with kids in it, so you are getting kids involved in science and educating them.*

Specific participant feedback follows about the four most frequently explored interactive portions of the site: 1) Video – Part II: In the Lab, 2) Video – Part III: In the Field, 3) Earth Interactive, and 4) Timeline of Earth's History Interactive.

Video – Part II: In the Lab

The two participants who viewed the Part II: In the Lab video gave mixed feedback about it – one raved about it, while the other found it overwhelming – though both noted that they preferred viewing the video to reading the content:

> *Al Gore did the documentary called Inconvenient Truth, and it was so boring. I found this a lot more interesting than his documentary. I found it very educative. Because they've used visuals and graphics, and you don't just have one person standing there and giving a lecture, it's easy to follow. I would have watched the whole thing, and I don't normally watch science videos.*

I liked the beginning of the video, and then I got bogged down in the details of the lab…It's overwhelming…I feel like I'm back in chemistry…and I'm not very good at chemistry, so I almost started getting anxious. Though, it's definitely preferable to see than reading it.

Video – Part III: In the Field

The two participants who viewed the Part III: In the Field video said that they enjoyed and learned from the video, though described it as complex or slow at times. One participant noted that, while the video would have held his interest on TV that it might not have on the Web.

Very good. Brought some very important things to simple language. Very accessible. Learned some stuff. Had other stuff re-awakened… It could be speed up a little bit and the graphics could move a bit faster, but I would be glued to it anyway if it were on my TV…but, on my laptop I don't know.

I liked it. It got pretty deep but then…they brought up some visual illustrations of what they were talking about…It might be something that you need to listen to again.

Climate Basics – Sea Level: Past, Present & Future Page – Earth Interactive

Participants liked the interactive that allowed users to view what Earth looked like during the last ice age by mousing over it. An example comment was:

I like the interactive map. Cool! I can see the ice.

Image 4: Earth Interactive

Earth from space today. Mouse over to see what Earth looked like in the depths of the last ice age, about 20,000 years ago. Millions of billions of tons more ice was frozen at the poles and sea level was 400 feet lower.

Images by Daein Ballard

Though several users were unclear at first that the image was interactive, further highlighting the previous feedback that interactive site elements should stand out more to users. One participant who stumbled upon it said:

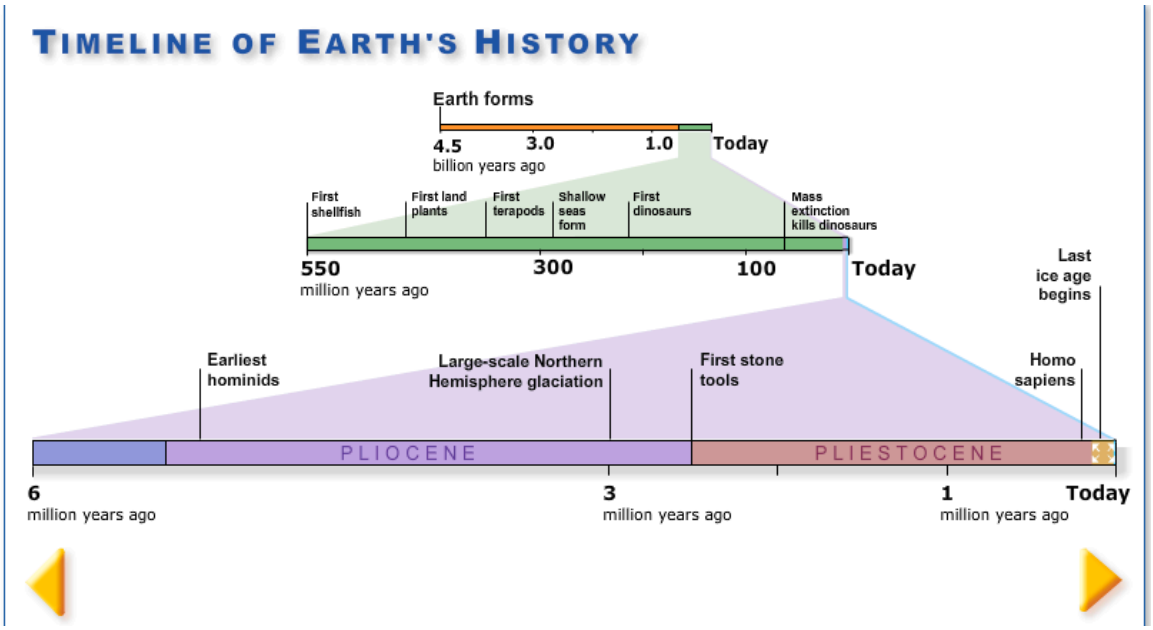
> *I found it purely by accident. I was like, "Wait did that just move?" Then, I read [the caption] under it.*

Sea Change Science – What's Sea Change Science: When Was the Pliocene – Timeline of Earth's History Interactive

Participants gave positive feedback about the Timeline of the Earth's History interactive:

> *The timeline was simply put together but at the same time, easy to visualize and factual and informative…Yes, it helped with my level of engagement and comprehension. You are reading about what the Pliocene era looked like…[The timeline] takes you into the different stages that the Earth went through. It helped to have a visual of that.*
>
> *This is really cool.*

Image 5: Timeline of Earth's History Interactive



One participant suggested moving this timeline earlier in the site in order to clarify what the Pliocene is to users upfront:

This is the first time they really make it clear what the Pliocene is. It's very good, but it should have come earlier.

What Now

On the whole, participants described the What Now page as clear and noted that it provided general resources for taking action:

It was really well written and succinct. Citizens have power to do something about it, and they give resources. I liked that it was very straightforward.

I like that they've listed the organizations that are working on the issue of the threats of climate change.

However, participants felt that the page lacked specific information about how individuals could take action or make changes in their daily lives. While the site provided a great deal of useful scientific information, participants also wanted to be able to connect with the information on a personal level. In the What Now section, they suggested to:

1) Add a list of practical action items that individuals could implement in their daily lives;
2) Include more information about the short- and long-term human implications of sea level rise and climate change; and
3) Make the information bolder and relay a sense of urgency.

Comments included:

I feel that this is really important, especially because you are asking people to take action. You could skip this page and not read the whole thing. It needs to be bolder, and things need to stand out more. If I didn't really read it, you'd think it's just one more information page…For someone like me, ok I look at these organizations, but what can I, as an individual, do to make that change? Is there someone I could write to, like a congressman or policymaker? What can we do in our homes and in our daily lives?...I'm wondering if that section will be added.

What Now was very succinct and not preachy, but you are presented with all this information, and then there were not really any practical steps…On a personal level, it'd be nice to see more specialized information on the [What Now] page…when I look at what they offer here, it is still so broad...maybe they could put information in different categories – such as the human

impact (people being displaced), species impact (species extinction), and health impact (respiratory problems) of climate change.

Where is it all going? I'm always drawn to the social effects of something. Ok, this is all very interesting, but how is this going to affect people? What's the big picture about why it's so terrible? At the end of all of this reading, I was still boggled in the scientific and the details of it all…Some of the details had been kind of hard to pick out. I'd like more information about how to get involved, as well as information about the short-term and long-term implications…There could be a little bit more of a nudge at the end with information about how many people this is affecting or pictures of flooding or something. It was very general at the end. I didn't quite walk away knowing specifics about how many people it would affect and how fast this is happening.

Additional Subpage-Specific Suggestions

Participants provided additional suggestions for specific site pages, including:

- Climate Basics – Sea Level: Going with the Flow: Add a map so users can see where the Jakobshavn Ice Fjord is in Greenland.
- Sea Change Science – Rock Wrangling: On the Road: Convert the On the Road page into a blog and move it to a separate blog section of the website.
- Sea Change Science – All About Time: Strontium Dating: Provide information on who devised and patented the strontium dating technique.
- Sea Change Science – What's in a Number: Making Sense: Add a bulleted overview explaining the meaning of the results or the outcomes.
- Sea Change Science – What's in a Number: What it Means: Highlight or visually emphasize the call to collaborate with other researchers.

Impacts

We present findings about the impact of the site on users in two sections below: 1) Knowledge and 2) Attitudes.

Knowledge

Participants' knowledge increased through interacting with the website – all learned something about sea level rise and how scientist study it. Most specified that they learned about the process of dating shells using strontium and that this concept was completely new to them and "cool."

At the end of the study, REA asked participants what they had learned generally from the site. Feedback from each of the four participants follows:

> *I learned specific causes of sea level change, when in the past I was very generally vague in my knowledge of that. I've learned that not only can the sea rise, it can fall due to sea level change and why. I've learned how the measurement of sea level change is being undertaken by comparing this period of time to the next closest period of time that mirrors as closely as possible to this one - being the Pliocene period. I learned how they are trying to measure scientifically those changes by carbon dating techniques and also the weighing of strontium isotopes. I also learned a bit more about how they do that – a dead sea organism will retain this in its shell millions of years later. To me, that was very cool and very interesting.*
>
> *This whole process of gathering data. I'd never heard strontium before ever. I'd always heard of measuring carbon levels. But, that whole process about strontium was very new to me. I'd heard of sea level rising, but I didn't know anything about what was involved in studying that or even that there were people involved in doing that. I knew climatologists existed, but I didn't know that this was a niche that people were working on.*
>
> *The strontium level was interesting that they used shells and debris from the ocean to study at which era they were from and are that leads to the conclusion on how much the sea level is rising. I liked that they showed us how they were isolating the strontium.*
>
> *They were topics or information that I knew a little bit about but not a lot. There were new topics that I hadn't thought of, and that always means learning, and learning at some point converts to change for the better…What I've learned is that there are lots of factors and lots of things going on…the whole system called the Earth and how things interact.*

Participants also specified knowledge gained from interacting with specific sections of the site. Among the different site sections, they learned about various types of ice on the Earth, the Pliocene era, the process for dating fossils (and how involved it is), as well as the various factors that affect estimations of past sea level, such as axis upheaval and gravitational attraction. Example comments about learning by site section are included in Table 2.

Table 2: Example Participants Comments about Learning by Site Section

Site Section	Site Sub-Section or Video	Example Comments about Learning
CB*	Climate Basics	*Yes, I feel I am gaining knowledge. I was a little aware of what was going on, but I never really thought of how the sea level is rising and the ice melting and of people who live on islands and around water bodies.* *Before reading this,] I thought that the ice sheets and glaciers were all the same thing. This clarified ice sheets and the relationship of them to glaciers…I also learned how different kinds of ice affect or don't affect the sea level rise…This is something that I was ignorant about - that glaciers melting could only raise the sea by two feet but the polar ice sheets are 100 times bigger.*
SCS*	What's Sea Change Science?	*I was learning more about the Pliocene era, which maybe I'd heard of but maybe I hadn't…I'm surprised that it was as lush as it was. I expected something more arid. I think I had heard of this era in passing but didn't know too much about it. It gives a picture to what the world was like then.* *It tells you that there were early hominids in the Pliocene vs. the Pleistocene, which is where homo sapiens developed. I really didn't know about this.*
SCS	All About Time	*The second paragraph [on the Strontium Dating page] is the coolest thing so far of everything. This is fascinating – how the shell becomes a permanent marker for that date because it retains the strontium level from that period of time…That's way cool - that concept to me is, "Wow!"…Who know?* *That's cool – I've heard of what carbon dating is but I never knew that much about is, as I do now.*
SCS	Video: Part II – In the Lab	*I learned from it. Just to get that little amount of strontium, the amount of technology involved – the little things that you take for granted – like that the lab has to have everything squeaky clean. It looks like they are doing a lot of work to support their investigations and research and educating people, as well.*
SCS	What's in a Number?	*This whole axis upheaval concept is completely new to me, and it is very interesting…I was most surprised about it changing the Earth's axis…Temperature and global warming – I was somewhat familiar with that. But, I was completely unaware of how the melting of the ice fields or ice sheets can actually affect the earth's axis.*
SCS	Video: Part III –Interpreting the Results	*They talked about how the weight of the ice sheets presses on the Earth's mantle and, due to the gravitational pulls created from that, certain areas of the sea closer to the ice will rise. But, areas further away will actually become lower. They talked about how this can also change the earth's axis because of the different weight bearing factors that unbalance the load.*

*CB = Climate Basics; SCS = Sea Change Science

Several participants were surprised to find out that, in the past through natural occurrence, CO2 levels had been as high as they are now. These participants suggested adding information to the site to explain the factors that caused past levels to be so high. Comments included:

> *I was surprised to read that in the past the CO2 levels were the same as they are now. I thought that there were was no way that could be. I'm not sure how that could happen without cars and stuff like that…I'm learning stuff…[but] I'd be interested in someone talking about that even more – how was that possible and how did they drop. Also, highlighting what's different now and how can that be more detrimental.*

> *The Pliocene was a nature occurrence, but now we are pushing the Earth into an era through pollution and through energy consumption. That was interesting that the Earth was hot during that era, and that we are using that era to study how sea level rises.*

Attitudes

After interacting with the Sea Change website, the majority of the participants:

- Were more concerned about and aware of climate change and sea level rise;
- Were more willing to take action regarding the issues addressed on the site;
- Found the site engaging, especially when using its interactive elements;
- Wanted to revisit the site in the future in order to learn more and get updates; *and*
- Would share the site with their friends and/or family.

We provide details about each of these findings within the three sections below: 1) Attitudes about Climate Change & Sea Level Rise; 2) Taking Action; and 3) Engagement & Future Use.

Attitudes about Climate Change & Sea Level Rise

Even though all participants were already aware of and concerned about climate change before visiting the site, their level of concern increased after interacting with the site. Participants' level of awareness and concern about sea level rise, specifically, also increased, as participants became more informed about it.

> *It definitely had some impact [on how I feel about sea level rise]. When you think about climate change, there has not been much talk about the sea change. You know it's getting hotter and that the ice caps are melting, but you never think of the sea level rising. It definitely made me more conscious of what is happening.*

Yes, [the website affected how I feel] in terms of my level of concern about climate change…Seeing the pictures of it and that there are so many people dedicated to study this. It's made me very concerned about that, especially living here in the Bay Area, it's going to affect a lot of people…I'd heard about [sea level rise] before, but when I think about global warming, I think of warming and people complaining about gas prices. It hadn't been on the forefront of my mind that sea level rise is a huge component of global warming. It reinforced that this is a major issue.

It made me more concerned about it and enlightened in the form of being able to tell other people things about it in the course of conversations. I think that I could talk about this part of it more intelligently. It's also stimulated me, in a way that makes me want to learn more.

One participant did not feel that the site influenced her level of concern about these issues as much as it could have, for example if the site had more human impact stories to enable users to connect to the content on a personal level.

[The site] reiterated what I've been feeling about [climate change]…but the human part of it or the human interest stories were missing…Maybe if they had brought more human interest stories, it would get more people interested. You always want to see how it affects people because it could affect you one day...Then, people are able to connect.

Taking Action

Several participants noted that the site affected their willingness to take action regarding the issues addressed on the site, mainly by expanding their knowledge and awareness. Example comments include:

Of course, [the website] affects my willingness to take action…being more conservative in consumption of power and energy, and teaching our kids to do the same. As a filmmaker, something like this would inspire some people to do film. The content is compelling enough to make you want to change something and find out how to do it or read up more about the other organizations that are working to bring about this change.

It stimulates your awareness and interest in it by teaching you about it.

There are cause and effect scenarios that I didn't consider and didn't know about. Knowing them, what I have learned is that I have to look closer and understand more in order to be active in this and to take action.

Though as previously described in the What Now section, several participants also said that the site lacked specifics to guide and rally users to take action:

> *If one of the objectives [of the site] is to educate people and pull people towards the science and understanding, that's not going to do it for the person who's not [already] alarmed [about climate change]…over the next few centuries, it's going to get a bit warmer…but show me directly how that couple of degrees affects things – show it to me in terms of direct impact and time…We're in danger now, and that's what we have to see.*

> *It makes you want not live too close to water level, but I leave it feel like I learned something but not really knowing how to take action.*

Engagement & Future Use

Participants' perception of how engaging the website was varied (Table 3), but on the whole, they found the site engaging, particularly when watching the videos or using the site's interactive elements. Interestingly, engagement ratings correlated with age level, with older participants rating engagement levels higher.

Table 3: How Engaging was the Website?

Participant	Rating*	Example Comments about Learning
High Engagement** Male (60 yrs old)	5	*As you go from each area to the next, you are more enlightened than the last, and more drawn in and interested in it.*
Medium Engagement Male (54 yrs old)	4	*I was learning something early on already, and when I learn something, I look for more to learn…The qualification is that I'm coming into this [already] alarmed about global warming and the Earth in general, and I'm interested in this topic already. I found it engaging.*
Medium Engagement Female (45 yrs old)	3.5	*I'd rate it a 3.5 because of the videos and I enjoyed reading the content. The videos were really well done. They helped to visualize what one was reading and put it into perspective.*
High Engagement Female (28 yrs old)	3	*I didn't see as much involvement. I was almost just passive, trying to take in as much information as possible…[to increase engagement levels, add more] interactive functions, where you can manipulate the information or time, like the interactive ice map that I stumbled on.*

*Scale=1: Not Engaging At All, 2, 3, 4, 5: Very Engaging.
**Participant "engagement level" based on the screener survey.

The fifty-four year old participant expressed concern that the site might not engage younger participants:

> *I'm my nephews or nieces who are in their 20's, I'm not sure this would engage them, even though they have a social and ecology conscious. I think some of the topics aren't really brought alive the way they could be and some are boring…Sea Change Science could be boiled down to a lot less, and how long it took to find out what Pliomax and Pliocene were. The Pliomax Team page should have something about it a lot earlier.*

Three of the participants said that they would revisit the site in the future in order to learn more or get updates about the Pliomax Team's work. These participants would also share the site with friends and family. One noted that the site would be most suitable for her contacts with scientific backgrounds, while the others felt it was accessible for adults, in general. Comments included:

> *Yes. I want to know the website address. I'd put it on Facebook, if I'm allowed to talk about it publically. This is fascinating. This is a complete eye-opener and great. Everyone ought to read it and go to it.*

> *There are things that I learned, but I want to come back and learn more…to find out more about this, that, and the other thing. I would recommend it to a friend. This is a place where the content is pretty well explained and uncomplicated and accessible overall.*

> *I'd definitely like to visit it again. I'd like to forward this website to friends and family with more scientific background, and then revisit the site with them, maybe to help better understand some of the sections. My mom is into climate change but doesn't have a climate change background. I don't know if this would be the right website for her. Maybe I'd ask her to just watch the video. Maybe it's more for people who are pretty science savvy. On the research side, I'm getting the impression that this is a work in progress, so I'd return to see if there are any updates or more resources.*

One participant, who did not want to revisit the site as is, said that she would be more inclined to go back to the site in the future if updates (e.g., a blog and/or Twitter feed) and personal interest stories were added:

> *Right now, it doesn't hold my interest…Add a Twitter feed to get people hooked. So, every time they discover something, they would tweet it, and you'd see the tweet on there…They could keep updating a blog with news about what they are doing and how they are collecting and analyzing data. Every time they go on an expedition, they would update it.*

Limitations and Future Studies

The chief limitation of the study was the small size of the sample, as well as the limited diversity of it. Specifically, all four participants were from a single geographic area (the San Francisco Bay Area), were interested in science and climate change, and believed that human activity contributed to global warming. It may be that these are the likely audiences for the site, no matter what. The other main limitation was that participant exploration of the website was artificial – participants were instructed to explore the sections of the website in a specific order and spend a defined amount of time investigating each section of the site. This artificial nature of the study may very well have influenced participants' experiences with the site and their learning and engagement levels. Participants noted some of the effects of these time constraints, and, in some cases, how they would have liked more or less time with portions of the site:

> *Because we are so rushed, I'm not really reading.*
>
> *If I had spent more time on it, I probably would have been able to enjoy it more, but it was good.*
>
> *I would have clicked on the video first without reading anything, but I didn't because we were short on time.*
>
> *If I were watching [Video Part II: In the Lab] on my own, I probably would have paused it, or it wouldn't have held my interest when they got to the lab.*

Future studies might aim to gather feedback from a larger number of participants in a wider geographic area, and with varying pre-existing degrees of interest in science and beliefs about climate change. This data could help develop a better understanding of the influence of the website on a more diverse sample. Additionally, attempts could be made to gather feedback from users who interact with the site in a more natural manner. For example, future site visitors could be asked, via an online pop-up message, to complete a Web-based questionnaire about their experiences with the site. Alternatively, if doing another in-person study, participants could freely explore the site before providing evaluators feedback on it. Additionally, users could explore and give feedback on newer site sections – those not completed at the time of this study (e.g., the Resources section).

Recommendations

Rework the presentation of content in order to streamline it and reduce the amount of text on a single page. Specifically:

- Break up content by adding headings and subheadings.
- Bullet the most important content.
- Replace paragraphs with several, shorter sentences.
- Increase the font size.

Once engaged with the site and its content, participants described it as informative and easy-to-understand. However, they felt that the way information was presented on the site potentially rendered it inaccessible for visitors who approach the site naturally, due to the amount, format, and size of the text. Streamlining pages will make the content more Web-friendly and help keep users engaged and from feeling overwhelmed.

Increase the number of interactive elements on the site. Participants greatly enjoyed the interactive portions of the site, often noting that these tools, particularly the videos, enhanced the site and helped solidify learning. They often described the videos as extremely high quality and as a highlight of the site. Since interactive site elements help increase learning and engagement, explore ways to incorporate more interactivity into the site (e.g., by adding more videos or an interactive quiz). Adding a greater number of interactive site elements will also likely increase the accessibility of the site for younger populations. Consider adding a few youth-targeted interactive elements (such as an animated video or an interactive game for kids).

Highlight the interactive elements on the site to ensure they "jump out" to users. Given the appeal and benefits of the interactive site elements described above, make sure that the interactive portions of the site are readily apparent to users, so as not to be missed. Consider adding hyperlinks within the text to link the text to the videos or other interactive site elements. Ensure that interactive site elements are easily apparent visually and distinguishable from static images (e.g., add a border or mouse-over effect).

Add navigational tools to guide users through the content of the site in a manner that ensures comprehension. While participants described the site's navigation as straightforward and clear, they also wanted more support for how to navigate the content of the site if freely exploring the site on their own. Suggestions included: 1) providing an overview guide with a recommended order for visiting sections, 2) adding "prerequisite" information at the beginning of each

site subsection, and 3) providing an overview of subpages contained within each subsection.

Emphasize how users can connect with site material on a personal level in order to guide and rally them to take action by:

- Including more specific information or stories about the short- and long-term human implications of sea level rise and climate change;
- Adding a list of practical action items that individuals could take in their daily lives; and
- Making the information bolder, relaying a sense of urgency.

While the What Now page was clear and provided general resources for taking action, users felt the page lacked specific information about how individuals could take action or make changes in their daily lives. On the whole, participants said that the site provided a great deal of useful scientific information, but they also relayed the importance of being able to connect with the information on a personal level.

Explore ways for the site to reach and engage a broader audience beyond increasing the number interactive site elements. Findings suggested that the site might appeal more to older users. Several participants expressed concern about whether the site would be engaging for younger generation participants or for those with less scientific backgrounds. Depending on the desired target audience for the site, further examine the appeal of the site for a range of different audiences.

Add updates to the site or a blog to draw users to revisit the site in the future. Given that the Pliomax Team work is ongoing, adding a blog or Twitter feed with updates about expeditions and discoveries would likely make the site more appealing to return visitors.

Consider the following additional section or subsection specific suggestions:

- Homepage:
  - Add a "Contact Us" link in the footer of the page.
  - Play the video automatically when a visitor loads the page.
- About:
  - Include a brief overview at the top of the page to clearly define Pliomax, the Pliomax team, and the mission of the organization.
- Climate Basics-Sea Level: Going with the Flow:
  - Add a map so users can see where the Jakobshavn Ice Fjord is in Greenland.

- Sea Change Science-What's Sea Change Science: When Was the Pliocene:
    - Explain the natural factors that may have caused CO2 levels in the Pliocene to be as high as they are becoming now, since this was surprising and confusing to users.
    - Consider moving the interactive Timeline of Earth's History to an earlier site page in order to clarify what the Pliocene is to users upfront.
- Sea Change Science-Rock Wrangling: On the Road:
    - Convert the On the Road page into a blog and move it to a separate blog section of the website.
- Sea Change Science-All About Time: Strontium Dating:
    - Provide information on who devised and patented the strontium dating technique.
- Sea Change Science-What's in a Number:
    - Explore ways to make the content more understandable, as participants described this as the most difficult-to-understand section of the site due to the complicated nature of the concepts covered.
- Sea Change Science-What's in a Number: Making Sense:
    - Add a bulleted overview explaining the meaning of the results or the outcomes.
- Sea Change Science-What's in a Number: What it Means:
    - Highlight or visually emphasize the call to collaborate with other researchers.