

Spiral Zoom on a Nasturtium Leaf

Formative Evaluation

Adam Klinger

February 8, 2009

Acknowledgements

The author would like to thank Joyce Ma for designing the first version of the interview questions, and Nancy Carlisle for recruiting visitors and administering the interviews for this study.

This report was based on work supported by the National Science Foundation under Grant No. ESI-0532536. Any opinions, findings, and conclusions or recommendations expressed in this report are those of the author and do not necessarily reflect the views of the Foundation.



THIS IS A FORMATIVE EVALUATION REPORT

Formative evaluation studies like this one often:

- **are conducted quickly**, which may mean
 - small sample sizes
 - expedited analyses
 - brief reports

- **look at an earlier version** of the exhibit/program, which may mean
 - a focus on problems and solutions, rather than successes
 - a change in form or title of the final exhibit/program



Joyce Ma
Exploratorium
3601 Lyon Street
San Francisco
joycem at exploratorium dot edu
415 674-2874

Table of Contents

Purpose.....	4
Highlighted Results	5
Methods.....	6
Data	6
Results	7
What is confusing about the zoom?	7
Does the zoom help visitors understand the phenomenon? How so?.....	8
Does the zoom help visitors understand the size of the nanocrystals?	9
What relationships do visitors see between the images in the zoom? Do they see a magnification / containment relationship? Do they see the size relationship?	10
What connections do visitors see between the scale bar and the spiral?	11
Recommendations.....	12
Appendix A	13
Interview questions	13

Purpose

This formative evaluation was designed to see how the addition of an interactive media piece enhanced visitors understanding of Nasturtium, a life sciences exhibit that demonstrates the water repelling properties of nasturtium leaves. The media piece allows visitors to view leaf structures at progressively higher magnifications to better illustrate their scale and function.

The zoom media piece places images of the leaf in a spiral arrangement. The magnification of each image is greater than the last, ranging from the macro scale (a whole leaf – 8 cm, Figure 1) to the nano scale (wax nanocrystal bundles – 2 μm , Figure 2). By turning a knob or touching the screen, visitors can scroll through the images in succession and read about nanocrystal bundles.

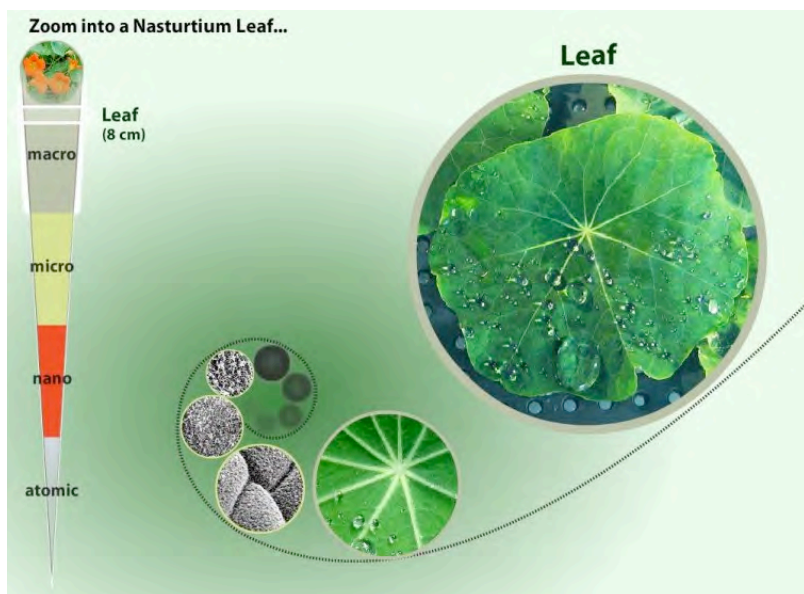


Figure 1

*Spiral Zoom for a
Nasturtium Leaf at
Minimum Magnification*

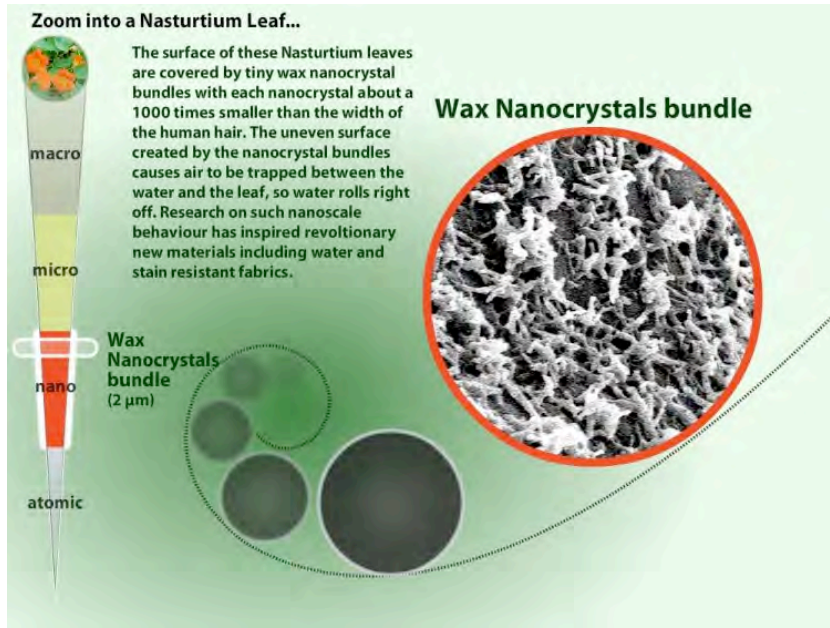


Figure 2

Spiral Zoom at Maximum Magnification

The development team wished to answer the following questions:

- Did the zoom confuse visitors?
- Did the zoom help visitors understand the exhibit phenomenon? How so?
- Did the zoom help visitors understand the size of the nanocrystals?
- What relationships do visitors see between the images in the zoom? More specifically,
 - Do they see a magnification / containment relationship?
 - Do they see the size relationship?
- What connections do visitors see between the scale bar and the spiral?

Highlighted Results

- 90% of those interviewed felt that the media piece helped them understand the exhibit, to a greater or lesser degree. When asked, about half of visitors could relay the exhibit's main message - that nanocrystals on the surface of nasturtium leaves have water-repelling properties.
- The majority of visitors left with some knowledge about the size of nanocrystals and credited the media piece as helping their understanding. Out of all the features of the media, the ability to zoom through the progressively magnified images was most frequently cited as helpful.
- Most of the visitors correctly understood the size/containment relationship of the zoom images. A majority also understood that the position of the scale bar slider was

related to the magnification of the images in the spiral. About a third of the visitors stated that the scale helped them understand the relationship between the images.

- Some visitors were confused or distracted by the inability to view atomic scale images, lack of explanatory text for intermediate images, or the jump in scale and coloring between macro- and microscopic images.

Methods

A kiosk with the zoom multimedia installed (Figure 1) was placed adjacent to the existing Nasturtium exhibit (Figure 3) in the life sciences area of the museum. The evaluator approached every third visitor appearing to be 10 or older and asked him/her if they would be willing to use the prototype and answer questions afterwards. If the selected visitor was a minor, consent was obtained from an accompanying adult. The visitor was asked to use the exhibit as they normally would, but make sure he or she spent some time looking at the media. When finished, the visitor was interviewed about the experience (see Appendix A for interview questions).



Figure 3

.....
*Nasturtium Exhibit (without
media kiosk)*
.....

Data

Twenty-nine visitors were interviewed on 8/20/2008, 8/30/2008 and 8/31/008. Of these, 5 visitors used the exhibit at a time when the physical knob was broken, forcing

them to rely on the touch screen. No systematic differences in their response were noted, and their responses were kept in the dataset.

Table1. Demographics (N = 29)

Gender	Count	(%)
Male	18	(62%)
Female	11	(38%)
Total	29	

Age Group	Count	(%)
8-12	2	(7%)
13-17	4	(14%)
18-20s	12	(41%)
30s	9	(31%)
40s	2	(7%)
Total	29	

Results

What is confusing about the zoom?

Many visitors were confused or distracted by the inability to view atomic scale images, lack of explanatory text for intermediate images and the jump from color to black and white images.

- 11 of 29 visitors (38%) were confused or distracted by the absence atomic scale images.
 - “No, except you can’t get down to the atomic level on the scale. - Not that I would know what that represents anyway.”
 - “It doesn’t [the images] go to the atomic level. At the last levels [grayed out circles without images], there’s nothing going on.”
- 8 of 29 visitors (28%) wished for explanatory text to accompany each slide.
 - “I was struck by the lack of explanation before the nano level pictured, and by no further explanation at the atomic level. I would’ve liked an explanation of the changes at each level shown.”
 - “There was not much detail - Only the nano part has detail. It appears to be missing information.”
- 6 of 29 visitors (21%) thought that one or more of the zoom images did not fit with the rest.

Of those six, 4 were confused by the jump between color and black and white slides.

 - “The jump from the non-color picture to the color picture was vague - it was the only one I noticed. Everything else flowed.”

“The transition from the 1st, 2nd, and 3rd slides is ok. But, the transition from the veins to the next black and white slide is confusing - there might be something missing, or it could be the color [that appears confusing].”

Does the zoom help visitors understand the phenomenon? How so?

90% of visitors felt that the media piece helped them understand the exhibit to some degree. About half of visitors could relay the exhibit’s main message - that nanocrystals on the surface of nasturtium leaves had water-repelling properties.

- 16 of 29 visitors (55%) unequivocally thought that the media helped them understand what was going on in the tank.

“Yes it helped. We see it happening; water going to a leaf and the leaf growing and the screen describes the action.”

“Yes. I saw the tank first and then saw the explanation in the [media box.]”

“Yes. The first slide is of the leaf and the dial process gave life to what was going on in the tank.”

- Another 10 of 29 visitors (34%) thought that the media partially helped them understand, but that it could be improved.
- 3 of 29 visitors (10%) thought that the media was not at all helpful to their understanding of the exhibit.
- The most common suggestion by those who thought the media could do a better job at explanation was to use text that explicitly linked to the phenomena visible in the tank.

“I would suggest a heading that explains what’s happening; for example, why does water bead up so well on these leaves?”

“Only because it’s sitting right here [adjacent to tank]. There’s no information at the nasturtium tank stating “observe how water beads up on each leaf...etc.” to explain what the exhibit is about.”

“No. The media box explains and makes sense (technically you can see what’s explained), but it [doesn’t include an explanation of the water droplets visible in the tank.]”

- 15 of 29 visitors (52%) understood that the exhibit was about nanocrystals on the surface of the Nasturtium leaves that have water-repelling properties.

“This is demonstrating how the structure on the surface of a leaf causes water to roll off. I immediately think of materials that can be made to be water resistant and their use.”

“Unless you zoom down in, you don’t know what it’s about. It’s about

creating a micro or nano structure that resists water...to reflect or bead water with some material.”

- 7 of 29 visitors (24%) understood the exhibit showed a structure at different scales or levels.

“Taking a deeper look at leaves and how each level appears - the idea of water rolling off.”

“It goes into structures and those found deeper in the leaf.”

- 7 of 29 visitors (24%) thought that the exhibit was designed to inform visitors about applied nanotechnology based on the properties of wax nanocrystal bundles.

“It’s about how to use it [plant’s water resistance] to build new products better at shedding water.”

“How botany and different types of leaves work, specifically the nasturtium. How it’s contributed to the creation of new materials.”

Does the zoom help visitors understand the size of the nanocrystals?

Most visitors left with some understanding of the size of nanocrystals and credited the media piece as having helped that understanding. The ability to zoom through progressively magnified images was the feature often cited as helpful. 19 of 27 (70%) thought that the media piece helped them imagine the size of nanocrystals, to a greater or lesser degree.

- When asked what element was the most helpful in this understanding, 7 of 19 (37%) mentioned the zoom.

“The pictures. When you think about veins and you go 2 levels down [slide images], that’s pretty small.”

“The images were powerful and illustrative. You can really see how small by turning the handle.”

“Zooming in on the screen [helped him visualize].”

- 4 of 19 (21%) cited the media images as helpful, but did not specifically mention the zoom.

“It [the images within the circles] gave a picture that helped create an image in my mind.”

“The pictures helped. With just the label “nanocrystal” and no pictures, you would have no idea.

- 4 of 19 (21%) specifically mentioned the phrase "... about 1000 times smaller than the width of a human hair" as helpful in their understanding.

The pictures are good, but the description of the width of the human hair really did it."

[The reference on] How this corresponds to the width of a human hair helped."

- When asked to describe the size of a nanocrystal, 8 of 24 (33%) came up with their own analogy

"I never heard the term prior to this exhibit. Based on this, I would link it in size to molecules - really small."

"2 millionths of a meter, using the scale given [at the left on the screen as a reference]. However, I try to use a [visual] scale like the width of the Explo building, as a reference. If the Explo is 100 meters, then a nanocrystal would equal the thickness of a fingernail."

- 5 of 24 visitors (26%) used the comparison with the width of a human hair that was provided by the media piece text when asked to describe the size of nanocrystals.

"I have no idea - 1,000 times smaller than the width of a human hair."

"1,000 times smaller than the width of a human hair."

- 2 of 24 (8%) described nanocrystals as small, but without further specificity.

"It's very tiny. I didn't get to a specific part on this [the narrative]. You have to read through the exhibit [to find an answer]."

"Pretty darn small"

- 3 of 24 (13%) could not describe the size of nanocrystals.

"I don't work on that."

"I can't." I'm seeing a picture [in the exhibit], but I have nothing to compare it to. It would be helpful to have a comparison; i.e. 10x or 5x smaller than an item to compare in size with a nanocrystal."

What relationships do visitors see between the images in the zoom? Do they see a magnification / containment relationship? Do they see the size relationship?

Most visitors correctly understood the size/containment relationship of the zoom images.

- 23 of 29 (79%) understood that the slides were progressively greater magnifications of a nasturtium leaf.

"It pinpoints a part of each of the areas of the picture before and goes on from that."

"It's going from low magnification to higher, so you can see what is inside and outside of a leaf."

"Zooming in closer and closer to the leaf and what actually makes up the leaf."

- 6 of 29 (21%) Did not describe a containment or size relationship between the slides.

"It's about layers - microscopic layers of what you're seeing with the naked eye."

"They're all leaves; they're about leaves."

"Not exactly." [Beginning with the slide showing the veins on the leaf to the one showing veins close-up, he didn't see the relationship.]
"How the plant grows. [gestured to the scale] I would be interested to know why the plant is so water resistant."

"It's not clear."

What connections do visitors see between the scale bar and the spiral?

Most visitors understood that the position of the slider was directly related and proportional to the magnification of the images in the spiral. More than a third of the visitors stated that the scale helped them understand the relationship between the images.

- 29 of 29 visitors (100%) noticed the scale bar on the left of the screen.
- 21 of 29 visitors (72%) understood that the scale bar was directly related and proportional to the magnification of the images in the spiral.

"The circle that is larger is shown at the top of the scale. The circle [image] gets smaller as the scale moves to a smaller level."

"It shows you the corresponding view from macro to nano. I was looking for more narrative as you drill down."

"It's moving down as you move in on the image."

- 12 of 29 (43%) stated that the scale is what helped them see the relationship between the images.

“The scale on the left helps (nice animation). Without the scale, you could think these were different images.”

“You can see it and the label explains along with the scale [left]. This combination tells you you’re going deeper.”

“By looking at the ruler on the left.”

Recommendations

- Remove the lower atomic section of the scale bar and grayed out circles in the zoom spiral, to avoid distracting visitors from the intended content.
- Consider a more progressive jump in image size between macro- and micro-scale images. Select images that allow visitors to more easily identify similar structures in each image, to better emphasize the containment relationship.
- Provide explanatory text for lower magnification images, not just for the final nanoscale image. If there is concern that this could distract visitors from a focus on the nanocrystal bundles, it may be helpful to provide more introductory text at the minimum magnification level to help visitors know what they are looking at and why it’s important.

Appendix A

Interview questions

1. In your opinion, what was this exhibit about?
2. Was there anything at all confusing about this exhibit? [**Probe**: anything else that was confusing?]

May I ask you a few questions about this [**gesture to media**] in particular?

3. Did you find anything confusing about this [**gesture to media**]? [**Probe to exhaustion**.]
4. Did this [**gesture to media**] help you figure out what is going on here [**gesture to tank**] or not so much? How so? / Why not – what might have helped?
5. When you look through these images, do any of these seem to not belong with the rest?
 - a. [**If yes**] Why's that?
6. What do you think is the relationship between these images? [**gesture to images in circles**] [**Probe to exhaustion**: like what does this have to do with these?]
 - a. Can you tell me, what made you think so?
7. Did you notice this [**scale slide**] on the side? **YES** **NO**
 - a. [**If YES**] Do you see any relationship between this [**scale/slide**] and these [**balls/images**]? [**Probe for description of relationship**: 'So, how are they related?']
8. Did this exhibit help you imagine how small nanocrystals are?
 - a. Can you say more? What about the exhibit helped you?

b. How would you describe how small a nanocrystal is?

Now, in general

9. Did you find out anything new at this exhibit?

10. Do you have any suggestions for how we might improve this exhibit?