

## Illustration – Zoom into a Butterfly

Formative Evaluation

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### **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



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## Purpose

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This formative evaluation looks at the second version of an illustration created as part of the NISE initiative to help visitors visualize the nanoscale structures in a butterfly wing. The first version of the illustration was evaluated last November. This latest version now includes annotations to call out the different structures of the butterfly wing and incorporates changes made to better align with scientific content. (See Figure 1.)

In particular, this evaluation was conducted to determine:

- What did visitors think the illustration was about.
- What, if anything, did visitors find confusing about this illustration.
- Whether or not visitors recognized the representation used for atoms.
- If the illustration conveyed (relative) size information.
- If juxtaposing a similar illustration of another subject matter could help visitors interpret this illustration of the butterfly wing.



## Summary Of Findings

- Most (71%) of the visitors thought that the illustration was ‘zooming in’ to a butterfly’s wing.
- About half (9/19) of the visitors we interviewed found something confusing about the illustration. Five people thought the annotations were difficult to understand. Some others felt that the illustration was disorienting, complicated or overly abstract, but were unable to articulate more specifically what was confusing them.
- Every visitor associated the ball-and-stick representation with atoms and / or molecules.
- Most (about 75%) visitors were able to identify the size relationship between different objects included in the illustration. Furthermore, when asked if the illustration helped them imagine how small these structures were, 58% said that it did. They gave various reasons, including recognizing a familiar object such as the butterfly or the atom, reading the text, and the graphic elements used.
- About 60% of the visitors interviewed said that having a zoom of the human bloodstream helped them make sense of the butterfly zoom. Others, however, found it superfluous or, worse, confusing.

## Method

A 25-inch by 38-inch copy of the illustration was mounted on poster board, set on an easel, and placed in the Skylight area of the Exploratorium.

An evaluator approached every third visitor who crossed an imaginary line on the floor for an interview, asking only those visitors 10 years old or older. If the visitor was a minor, we would also ask the accompanying adult for permission to talk with the child about the poster. These interviews were conducted with individual visitors, although other members of the visiting group could look on if they chose. The interview questions can be found in Appendix A.

## Data

We interviewed 20 individuals on two consecutive days, Friday, August 15 and Saturday, August 16, 2008. Most of the visitors we talked with were adults. Their demographic information is given below.

Gender	Count (out of 20)
Male	11
Female	9

Age Group	Count (out of 20)
Child (10-12)	0
Teen	2
Adult	18

## Results

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### What did visitors think the illustration was about?

- Most (10/14 or 71%) of the visitors thought that the illustration showed the smaller and smaller parts of a butterfly. For example,
  - Visitor10: What 's composed to make a butterfly.
  - Visitor14: The makings of a butterfly wing from particle to physical appearance.
- A few (3/14) of the other visitors thought the illustration was about something (unspecified) about butterflies.
  - Visitor12: A butterfly wing.
- And, two visitors thought:
  - Visitor7: The whole point is showing how coloration on a molecular level relates to how butterflies communicate with each other.
  - Visitor16: Some sort of evolution in life.

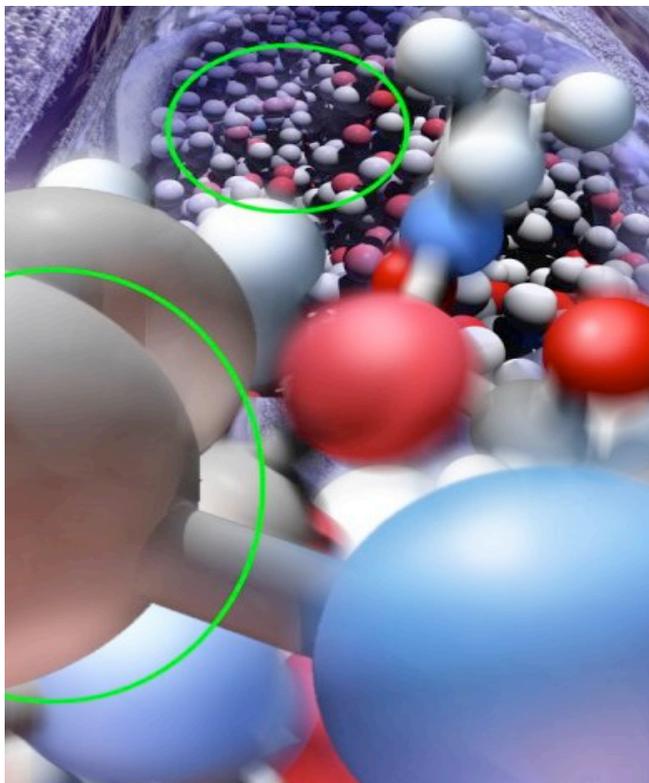
### Did visitors find anything confusing about the illustration?

- About half (9/19) of the visitors we interviewed found something confusing about the illustration, but some had difficulties articulating what exactly was confusing about it. They touched on the following points:
  - The text is difficult to read
    - Visitor8: Maybe some of the words should be highlighted. I don 't know if I 'd read it.
    - Visitor15: It 's a little wordy.
    - Visitor17: It uses a lot of jargon in the text.
    - Visitor4: It 's too much. I wouldn't read it.
    - Visitor20: For the layperson this is a little; it started to lose me (wing scales section). It 's interesting, but it started to lose me.
  - It is disorienting
    - Visitor4: I think it would be better if it was the other way (horizontal).
    - Visitor11: At first I wouldn't think of it as a deconstruction of a butterfly. If I was a kid it would be kind of scary.
    - Visitor15: The jump from the butterfly wings to atoms.
  - It's too complicated overall
    - Visitor6: Too deep for me.
    - Visitor18: I personally think there 's a lot of information. I 'm not sure it would be, it seems like it 's in depth. A little too much information, especially for a younger audience.
  - It is difficult to understand without the text
    - Visitor5: When I first looked at it I didn't know, but then after reading I understood.
  - It's too abstract overall
    - Visitor16: It 's very conceptual. It 's not super clear.

- Their confusion was echoed in the suggestions some of these visitors gave at the end of the interview for improving the illustration. More specifically, they suggested that we
  - more clearly indicate what is a magnification of what
    - Visitor2: Sort of get it. That 's all part of it. What part are we looking at? (If there was a circle indicating what we were looking at) To understand it 's a microscopic view.
    - Visitor8: A little picture to show (what area is actually being magnified).
    - Visitor14: Make a circle magnifying a particular spot.
  - help visitors know where to focus
    - Visitor4: Your eye is drawn to the atoms. It would be better if you looked at the butterfly first because that is what we know (rather than seeing the atoms first). Make it horizontal instead.
    - Visitor6: A kid as the human (instead of an adult). The information is good and all, but if the concept is atoms, make that stand out.
    - Visitor7: If there were directions to start at the bottom and go up.
- Most (17/20 or 85%) visitors did not want any additional information in the illustration. The few who did want to know more, did not ask for information about nanoscale structures but more generally about butterflies:
  - Visitor18: Maybe how butterflies interact with each other. How they act in a social setting.
  - Visitor20: It would be great to hear more about migration.

### **Did visitors recognize the depiction of the atoms?**

- Most visitors recognized the ball-and-stick representation for atoms and molecules. (See Figure 2.)



**Figure 2.**

*What visitors thought the ‘balls’ represented*

Q: What do you think these things are?	Count (out of 20)
Atom	17
Molecule	3

This is in contrast to the first iteration wherein only 8/14 visitors correctly identified the atoms and molecules. We suspect that the annotations, which were absent in the earlier version, helped with interpretation.

### Did visitors see the size relationships depicted in the illustration?

- Most (15/19 or 79%) visitors knew that different parts of the illustrations were a magnified view of other parts (Figure 3 and Figure 4).

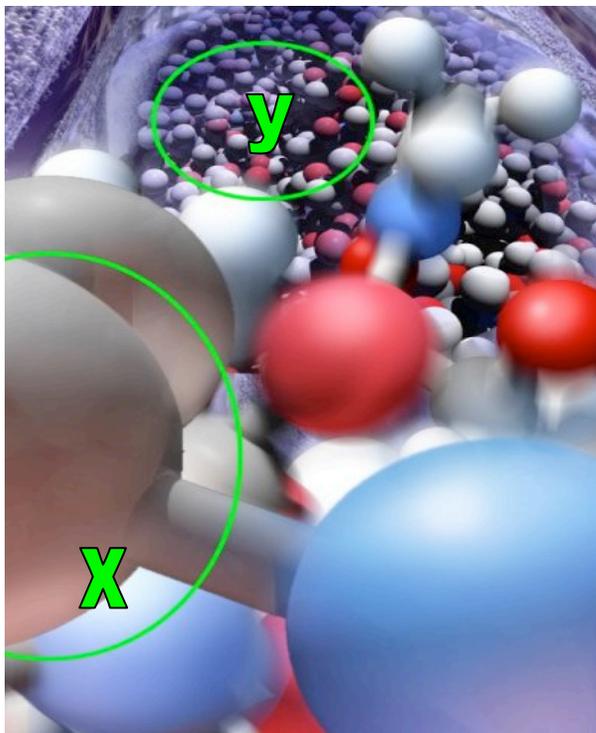


Figure 3.

What visitors thought the 'balls' represented

Q: How is this [X] is related to that [Y]?	Count (out of 20)
<b>[X] is a building block of [Y] e.g.</b> Visitor2: (Points to the big atoms) These are the building blocks of the polymers. Visitor18: These are building blocks (big atoms) that form the polymers	7
<b>[X] is a closer look at [Y] e.g.</b> Visitor9: You can tell magnification increases.	6
<b>[X] and [Y] are atoms</b>	2
<b>[X] and [Y] are related somehow (unspecified relationship)</b>	5

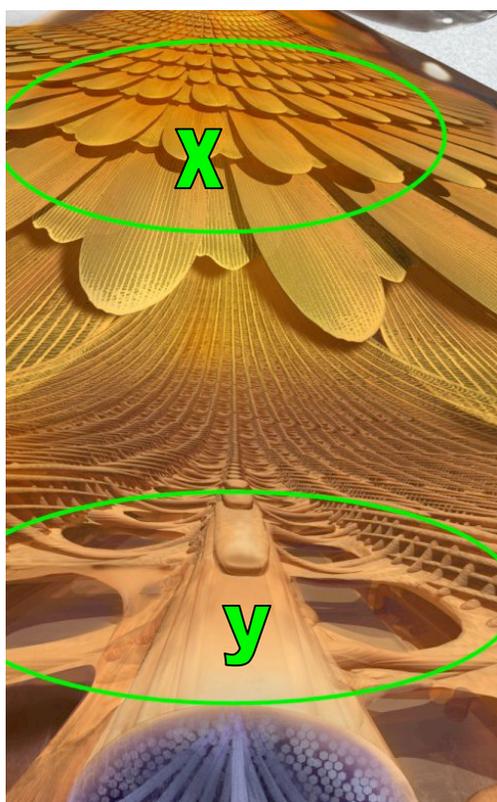


Figure 4.

What visitors thought the 'balls' represented

Q: Can you tell if this thing here [X], is bigger than or smaller than that thing here [Y] in real life, or are they about the same size in real life?	Count (out of 20)
<b>[X] is bigger than [Y] in real life</b>	15
<b>[X] is smaller than [Y] in real life</b>	1
<b>[X] and [Y] are about the same size in real life</b>	3

Some visitors were able to articulate why they thought so.

- The illustration gives a sense of going from bigger to smaller. For example,
  - Visitor16: The patterns get geometrically smaller from near to far. There is a singular focal point.
  - Visitor18: The butterfly here. The 3D gives a sense you are zooming in scale.
- Visitors knew from prior knowledge. For instance,
  - Visitor2: I know atoms are the smallest part.
  - Visitor19: Just because I've done this before so I already know about these things.
- The text
  - Visitor5: After reading it I understood it was at a microscopic level.

However, we note that two visitors thought that some relationships between elements in the illustration were challenging to decipher:

Visitor11: Yes and no. Not enough of a transition. Too quick to jump out at you.  
Visitor17: It looks like they are trying to show a polymer, but it 's too jumbled.

- When we asked directly if the illustration helped visitors imagine how small the nanoscale objects are, 11/19 (58%) thought it did. These visitors thought the following elements helped:
  - A familiar object in the macroscale that they know is small.
    - Visitor4: The size of butterflies at the top.
    - Visitor10: They have to be kind of small if they all go into that (the butterfly).
    - Visitor12: Having the butterfly in relation to size.
    - Visitor13: Gives representation of layers in butterfly.
  - The atom, which they know to be small.
    - Visitor8: Think about how small those are. The building blocks of life.
  - Certain visual elements
    - Visitor5: The gradual (quality) of the poster.
    - Visitor15: How it sections is good.
    - Visitor18: The fact that it 's starting from the outside view of monarch and giving indication you are getting into smaller and smaller regions.
  - The text
    - Visitor5: From reading the information.
    - Visitor7: Just how it correlates with the text (the images).
    - Visitor20: There 's so many that goes into the making of a butterfly. With these explanations helps to know what formulates.

## Does having a similar perspective illustration help visitors interpret the butterfly illustrations?

- Results do not indicate a strong leaning either way; 12/20 (60%) thought that looking at the human bloodstream illustration (Figure 5) next to the butterfly illustration did NOT help them make more sense of the butterfly illustration, while the other 40% did. Visitors in the later group felt that the human illustration was more familiar and easier to relate to:

Visitor6: Yes. It hits closer to home.

Visitor15: Yes because we know. You can relate to a human being more than a butterfly.

It helps understand butterfly, the inside of wings. It 's good atoms are same size.

You can relate your atoms to the atoms in a butterfly.



Figure 5.

Illustration of Human Bloodstream

## Recommendations

This study was the first step in determining how the visiting public interprets scientific images of the nanoscale. It has brought up interesting findings, which we plan to pursue with more targeted evaluations. Specifically, we plan to look at the different ways of noting size and scale on these images to identify those that are meaningful to visitors and to experiment with different color maps to elicit guidelines for the use of color in these images. This set of studies should better inform our use of these types of scientific visualizations of the nanoscale for public interpretation.

## Appendix A

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0. In your opinion, what is this poster about, if anything?
1. Is there anything confusing about this poster?
2. *[If they did not talk about the text]* Did you get a chance to read any of this on the side? Was there anything confusing about what you read?  
  
*[If they already talked about the text]* Was there anything else confusing about what you read?
3. Is there any additional information that you wanted to see in the text but didn't find? What?
4. So, what do you think these things are [*point to **atoms***]?
  - a. *[If they don't say atoms]* So, these are actually supposed to be atoms. Is that surprising to you? How so?
5. Can you tell from this poster, how is this [*point to **small atoms***] is related to that [*point to **big atoms***]? *[If they say they are both atoms, ask: so are they different in any way? How so?]*
6. These posters include things that in real life are actually different sizes, but we're not sure if that's clear. Looking at the poster, can you tell if this thing here [*point to **yellow scale***], is bigger than or smaller than that thing here [*point to **smaller yellow structure***] in real life, or are they about the same size in real life?
  - a. Can you say a little about why do you think that?
7. Does the poster help you imagine how small these [*gesture to lower part of the poster*] are?
  - a. What about the poster helped you?
  - b. How would you describe how small this [*pt to blue tube*] is?

So here is another poster.

8. Does seeing this [*pt to original*] with this [*pt to new*] change the way you think about this [*pt to original*]? How so?
9. Do you have any suggestions for us to improve these posters?