NISE network
NANOSCALE INFORMAL SCIENCE EDUCATION

Bump and Roll Exhibit

Formative Evaluation

By Jane Miller and Sarah Cohn

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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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Background

During October of 2008, Science Museum of Minnesota visitors provided feedback on the prototype exhibit Bump and Roll. A total of 30 visitors used the exhibit. Participants were observed and interviewed. The "n" value for each question is reflective of the number of visitors who were observed or responded to that question. Additional visitor demographic information is available at the end of the report.

Results and Discussion

Exhibit's Objective

The main message of the Bump and Roll exhibit is that "nanoscience is harnessing nanoscale phenomena seen in nature to create new techniques, materials, and products." The exhibit's two main learning goals are:

- Tiny micro and nanoscale bumps can make surfaces water-repellent and self-cleaning.
- It's fun to play with water on a superhydrophobic surface, but there are lots of practical applications of the technology.

In order to assess if the exhibit is imparting these messages, the data collectors asked participants what they thought the exhibit was about. In addition, they asked visitors to explain what they saw the water do and to describe the connection between the coated pan and the leaf.

Visitor Perception of Main Message

Over one third of the participants (40%) demonstrated understanding of the exhibit's main message that nanotechnology may be derived from nature. Approximately one quarter of respondents (23%) believed that the exhibit was about new water-resistant technology, which is the first learning goal of the exhibit. An equal number of participants (23%) provided general responses about water resistance or surface properties (see Table 1). A complete list of coded responses is included in the Appendix.

Table 1: Visitor perception of main message (n=30)

	Percent of Respondents
Nature inspiring nanotechnology (main message)	40%
Hydrophobic technology	23%
Water resistance/surface properties	23%
Other	10%

When asked what they saw the water do, a majority of participants (87%) mentioned seeing the water bead up or roll off of the surface of the leaf and/or the non-metallic surface of the coated pan. More than half (57%) described seeing the water stick to the

metallic surfaces of the coated pan. Nearly half of the respondents (43%) provided answers that referred to both the hydrophobic and hydrophilic phenomena (see Table 2). A complete list of coded responses is included in the Appendix.

Table 2: What the Water did (n=30*)

	Percent of Visitors
Beaded/Repelled	87%
Stuck to metallic surfaces	57%

*Some visitors gave more than one response.

Forming Connections

Data collectors asked participants about the connection between the leaf and the coated pan. Approximately one third of the visitors (37%) recognized that the pan represented a synthetic version of the natural hydrophobic properties of the leaf. A similar number of respondents (40%) noted that the leaf and pan seemed to have the same properties. A number of visitors (20%) did not report the connection accurately (see Table 3). A complete list of coded responses is included in the Appendix.

Table 3: Connection Between Leaves and Coated Pan (n=26*)

	Percent of Visitors
Same properties	50%
Natural vs. synthetic representation of same phenomenon	42%
Other	12%

*Some visitors gave more than one response.

Observed Behaviors

Visitors were observed while using the Bump and Roll exhibit (see Table 4). A majority of participants pressed the button to drop water on both the leaf plate and the coated plate (67% and 70%, respectively) and used the joystick to tilt both plates (77% for the leaf plate; 80% for the coated plate). Only one third of the visitors played around with the water on the leaf while nearly two thirds (60%) played around with the water on the coated plate. One third of those observed attempted to get the water off of the coated plate and more than half (57%) looked at the large label. Data collectors recorded any difficulties they observed in the use of the exhibit. Three visitors were observed to have noticeable difficulty finding the water button.

Table 4: Participant Behavior

	Percent of Visitors
Use joystick to move plate	80%
Use joystick to tilt leaf	77%
Press button to drop water on plate	70%
Press button to drop water on leaf	67%
Play around with water on plate	60%
Look at large label	57%

Ease of Understanding

Visitors were asked how easy it was to determine what to do with the exhibit. Most respondents (80%) indicated that they found the exhibit easy to use (see Table 5).

Table 5: Ease of Understanding Exhibit (n=30)

	Percent of Visitors
It was so easy, I didn't have to think about it	50%
It was easy to figure out	30%
It was a little difficult to figure out	17%
It was so difficult, I couldn't figure it out	3%

Data collectors asked those experiencing difficulties to elaborate. Most responses referred to the visitor being unsure what the exhibit was about. Others struggled with listening to the directions or recognizing how to get water:

- At first, I thought it [both pans] was the same. I thought the leaf was missing from the one [indicating coated plate].
- Figuring out what it [the exhibit] was.
- [It] should say that the first step is to listen.
- Had to read.
- Some stuff that you needed to do. [Collector asked, "What stuff?"] On the computer.
- I didn't know what the red button was for. I wasn't able to activate water on the system – water didn't come out.

Participant Enjoyment

Participants were asked to rate how much fun they had while using the exhibit. A large majority of respondents (83%) found the exhibit to be enjoyable and reported having fun (see Table 6). This data supports the second learning objective of the exhibit.

Table 6: Level of enjoyment (n=30)

	Percent of Visitors
It was so fun, I'd encourage others to try it out	30%
It was fun	53%
It wasn't really fun	13%
It wasn't fun at all	3%

Conclusions

The Bump and Roll exhibit appears to be mostly successful in imparting its main message that nanotechnology is inspired by nature. The exhibit also conveyed both learning goals to a large number of visitors. Participants had few problems using the exhibit but reported that it was enjoyable. One area of difficulty was in finding the button to drop water on the plate. Explicitly labeling the button may further facilitate visitors' use.

Visitor Demographics

Visitor information was self-reported. Nearly two thirds of the visitors (63%) were male. All but one of the respondents came to the museum in a group, with slightly over half of the visitors (53%) attending in a group of adults and children. The rest (43%) were members of adult only groups. The majority of participants (60%) were adults (see Table 7).

Table 7: Visitor age range (n=30)

	Percent of Respondents
8-12	27%
13-17	13%
18-21	7%
22-29	13%
30-39	7%
40-49	10%
50-59	10%
60+	13%

Appendix

Visitors' perception of main messages (n=30)

40% (12) Nature inspiring nanotechnology

- Use nature to satisfy needs.
- I would say learning from nature and what we can learn from that.
- Trying to show how Mother Nature is trying to use the same things we do.
- How nanotechnology is based off nature, I guess.
- A super hydrophobic coating. Comparing nature to technology.
- Water repellent features in nature on a small scale, based on small-scale phenomena.
- How they came up with things.
- The small waxy bump on the surface of certain plants that scientists are trying to recreate.
- Water repelling. How nature has water repelling items and how we can use that to develop practical applications.
- How nature can be imitated for practical use in our environment.
- How scientists are learning to use ideas from nature to create better product in the future, especially graffiti-proof paint.
- Science is creating new technology after nature for multiple purposes.

23% (7) Hydrophobic technology

- This is about hydrophobic surfaces – self-cleaning, helpful in everyday.
- To develop a non-stick product. Trying to make self-stick products.
- Trying to show new technology. New nanomaterial paints.
- What technology can do.
- New technological research. How to use things and apply science.
- The future of water-resistant materials. Inventions to come, previous inventions.
- Future uses for nanotechnology to improve future science.

23% (7) Water resistance/surface properties

- I guess the texture of a cabbage leaf.
- How you can balance water.
- Surface properties.
- How water would be resistant to different types of metal.
- Water resistance.
- Waterproof.
- About movement of water on plants like cabbage.

10% (3) Other

- I don't know.
- How fruits and vegetables can help make a better environment and can help clean things.
- Kind of like the differences between them.

What the Water Did (n=30*)

*Some visitors shared more than one response.

87% (26) Beaded/Repelled

- Slides, on the white surface, slides around.
- Sliding around and plate feared water so it pushed it away.
- It beaded almost as if there was a wax coating.
- When I was rolling it around it stuck to the metal but not the other parts.
- Repelled from repellant surfaces.
- It would slip down on the cabbage.
- It rolled right off.
- Well there were certain areas that it'd bead up and not move, so you needed to move it before it hit those areas.
- We saw it bead up on the surface of the leaf and pan.
- It balled up.
- It kind of just bounced off. It didn't absorb. It kind of just rolled off.
- I don't know. It [water] just went around.
- Bead.
- Mostly rolled off other areas.
- I saw it bead and then run off.
- It beaded up.
- In both cases, it beaded up. The metal, it chose to stay on metal parts but not the other substance.
- Resist water, especially on the leaf.
- Certain areas when resistant roll off. Similar to GoreTex a corollary to what we're looking at.
- Rolled off. Didn't absorb.
- It beaded up.
- It beads up and repels up off the leaf and the man-made pan surface.
- The water collects itself, it can go to places where it sticks or doesn't stick.
- Beaded up. The air trapped on the surface. Causes surface tension.
- Beaded up and fell right off the leaf. On the pan did the same thing except the round spots.
- The water beaded up on the coated surfaces.

57% (17) Stuck to Metal Surfaces

- On metallic surfaces, it sticks.
- Metal attracted to water.
- When I was rolling it around it stuck to the metal but not the other parts.
- Adhere to non repellent surfaces.
- Well there were certain areas that it'd bead up and not move, so you needed to move it before it hit those areas.
- It kind of stuck to some of the sticky bumps.
- Stuck to metal.

- Didn't stick to anything but the metal.
- It stucks. It stuck to the dots.
- Mostly clung to silver spots.
- Would stick to the metal part [on the coated pan].
- The drops went to the metal [coated] and the other did that to the leaf [leaf pan].
- The metal, it chose to stay on metal parts but not the other substance.
- The cabbage didn't soak up the water at all. Got that waxy material on top.
- On the pan it congregates together on the surface can and sticks there.
- On the pan did the same thing except the round spots.
- It can go to places where it sticks or doesn't stick.
- On the non-coated surface it stuck.

Relationship Between Leaf and Coated Pan (n=26*)

*Some visitors gave more than one response.

50% (13) Same properties

- Really similar. Four places on plate stick to water. None on cabbage.
- That they used whatever is going on chemically with the leaf to get the same effect with the pan.
- They both beaded in certain spots.
- I think the pan just mimicked what the leaf did.
- They both can balance water.
- Same amount of resistance.
- Same surface.
- They both were water repellant.
- Both of them are hydrophobic.
- The material was close. Velvety and soft on both. Both did same thing.
- They both were resisting water.
- Trying to show something. Water does the same in both.
- They both have the same waxy material. Water beads up.

42% (11) Natural vs. synthetic representation of same phenomenon

- Leaves made tiny bumps and coated with hydrophobic surface. The plate has a synthetic hydrophobic surface.
- Nature's ability to shed water and man's adaptation to it.
- Trying to show science (the coated one) and this one (the leaf one) nature.
- The surface properties of the leaf are mimicked by the nanotechnology of the pan.
- Scientific material was more enhanced than the cabbage leaf.
- They mimic the coating. Took the idea from the plant and worked in industrial applications.
- The synthetic surface is mimicking the surface of the leaf relative to repelling water.
- The pan is coated with teflon and the leaf does the same thing.
- Pan imitates nature in a microscopic way.

- It's like the plate is a man-made version of the leaf. The same concept that the water doesn't stick.
- The pan was developed from the leaf. Connection between nature and cabbage.

12% (3) Other

- The leaf is resistant and the pan is not.
- Bead up more on the cabbage leaf.
- Didn't see a connection.