

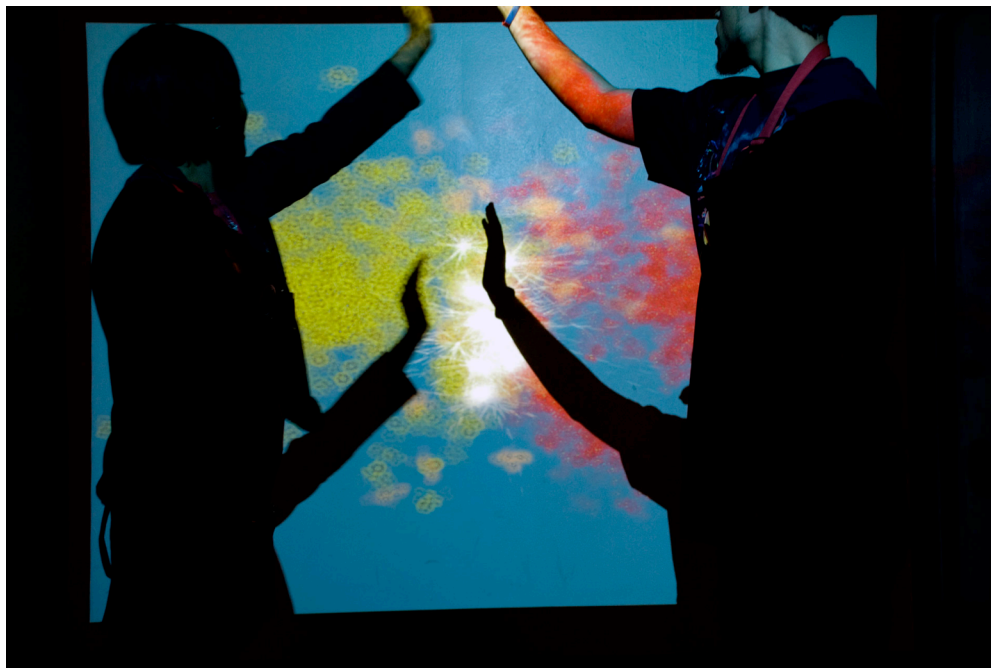


## Diffusion Exhibit (Mixing Molecules)

*Diffusion* is an immersive video interactive display demonstrating the collision of molecules. This digital shadow interface allows visitors to use their shadows to “push” animated molecules that are projected onto a screen in a darkened room. This collision produces a series of bright white sparks. Visitors can also use their shadows to push a “What?” icon, which allows a projection of the message “Molecules are always in motion. If they happen to collide in just the right way, they can react to form bigger molecules.”

The piece was created by an interdisciplinary team of artists, scientists, and informal science educators. The designer and artist is Zack Simpson (who is himself a molecular biologist.); David Goodsell, a molecular biologist from the Scripps Research Institute (who is also an artist); Carl Batt, a molecular biologist from Cornell; and Eric Siegel from the New York Hall of Science who commissioned, installed and evaluated the work.

*Diffusion* was funded by the Viz Lab strand of the Nanoscience Informal Science Education network, with support from the National Science Foundation. It has traveled to several sites including MRS meetings, Hall of Science public events, and other public events, since its completion in Feb 2008.



## METHODS

Brief interviews were conducted with 53 visitor groups during the Presidents' Week 2008 school holiday. Data was collected in one hour blocks during mid-day when the museum was relatively busy. Because it was a holiday week, the audience was uncharacteristically families rather than school groups. 63% were family groups with elementary school aged children. The rest were school groups or adults.

This data includes only interviews conducted with visitor groups that spent at least one minute in the exhibit. A number of visitors walked in and out of the room briefly and waved a hand in front of the screen or did not interact with it, but were not asked to comment on the experience. Groups that spent at least one minute in the room, interacting with or observing the exhibit were asked to participate in a brief interview about the experience. The interviews were 1-2 minutes in length. In most cases, all group members were in agreement or one member of the group spoke on behalf of the others. Responses were collected on a one page form by one of the two data collectors, and transferred to a database where all responses within a category could be coded and compared.

## SURVEY RESULTS

### How enjoyable/ fun was this activity?

11%	Very enjoyable/ fun
47%	Enjoyable/ fun
34%	Somewhat enjoyable/ fun
8%	Not enjoyable/ fun

### How easy was it to figure out what to do here?

10%	Very easy
28%	Easy
34%	Somewhat easy
28%	Not easy

### In your own words, what is this exhibit trying to show?

The enjoyable experience did not necessarily translate to an understanding of the concept or task, with many of the groups enjoying dancing, clapping or observing their shadows. When asked what they thought the exhibit was trying to show, the responses were (n=53)

41%	Molecules collide, react, combine or come together
23%	Molecules (often followed by a question mark)

15%	Don't know
15%	Sound and Light
7%	Germs, Bacteria or DNA

While 41% mentioned “molecules colliding, combining or reacting” as the point of the activity, they were less clear as to what the result of these collisions are. Of the total respondents, 17% specified that reacting molecules will form new or bigger molecules, and 10% interpreted explosions or color change as a result of molecule collision. (n=53)

14%	Molecule collide (but did not specify outcome of reaction)
10%	Molecules collide to make a new chemical
7%	Molecules collide to make a bigger molecule
5%	Molecules collide to make an explosion
5%	Molecules collide and change color

**Does this exhibit connect to/ remind you of anything else that you know about?**

39%	Nothing
15%	School/ Science Class
11%	Germs/ Bacteria
11%	A different science topic (light, sound, evaporation, blood, space)
7%	A chemical reaction (baking soda & vinegar, hydrogen peroxide, matches)
4%	Another exhibit (Mathematica and Marvelous Molecules)
14 %	Something they've seen elsewhere. Other answers included popcorn, computers, legos, air hockey, fireworks, movies, a Smartboard.

**Was anything confusing or frustrating?**

32%	“Did not know what to do” in the exhibit
26%	The “What” Button
23%	No confusion/frustration
9%	Too high for young children to use
9%	Could not get the molecules to move

It became apparent that the groups that read the signage immediately were much more likely to complete the task and/or grasp the concept. Many of the others waved their arms, clapped their hands, smacked the wall, shouted, or even posed for pictures. Some of these actions led to an eventually discovery of a reaction between molecules, while others were content to simply observe their shadows or the animation. Those who were not confused or frustrated (23%) either read the sign immediately, or did not realize that they did not complete the task, and were therefore not frustrated by it. The number of visitors who read the sign was not recorded.

The “What” button was confusing for a number of visitors (26%) . This was a white oval on the left side of the screen that, when in contact with a shadow, flashed a message onto the screen. Approximately half of the groups used the “What button.” Those who commented on the button said that they did not know what to do with it, could not get it to stay on, or it got in the way while they were playing.

Other visitors had a strong grasp of what they were trying to accomplish, but had difficulty either getting the molecules to move and the reactions to take place (9%) or were too short to have their shadow reach the screen. (9%)

Near the conclusion of these interviews, an adjustment was made to the exhibit allowing for more ease of operation (the molecules reacted more easily and vigorously) and higher number of visitors accomplishing the specified task. Future evaluations would likely show a reduction in the number of people who “didn’t know what to do” or “couldn’t make it work.”

### **Does this make you want to learn about anything else?**

While 41% of visitors did not want to learn more, 28% wanted to know more about the phenomenon (What happens when they come together? What are the molecules used in the example? Do they really explode like that?) A few of the parents would have liked similar manipulatives nearby so that their children could relate the experience to something else about molecules.

41%	No
18%	More about molecules and chemical reactions
10%	More about what happens when ‘they’ come together
10%	More about science
7%	How to make the exhibit work/ what is supposed to happen
7%	Technology- how the computer interacts with shadow
7%	Miscellaneous

### **Visitor Demographics**

28%	Under age 8
57%	Age 9-16
11%	Age 17-24
28%	Age 25-40
13%	Age 41-55
4%	Over 55

## Recommendations

In response to these evaluation results, we have made some programming changes to Diffusion and are planning two interpretive changes. Finally, there is one potential change that we or others using the piece could make.

- Improve operability and colors (done)
- Consider physical switch for animation (planned)
- Change signage to model visitor behavior (planned)
- Train Explainers more thoroughly (planned)
- Integrate the piece into an exhibition on nanoscale or molecules (potential)

## Acknowledgements

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