

Sea Urchin with Dr. Fred Wilt

Joyce Ma

August 2006

Microscope Imaging Station – Front-End Sea Urchin with Dr. Fred Wilt

Joyce Ma
August 2006

PURPOSE

Dr. Fred Wilt of UC Berkeley gave a one-hour long talk to visitors about sea urchin fertilization and early embryo development at the Microscope Imaging Station (MIS) demonstration station on August 8, 2006. During his talk, Dr. Wilt touched on various aspects about past and current research conducted with sea urchin and in a series of demonstrations showed the fertilization and development processes under a microscope. An outline of the talk, with questions from the audience, can be found in Appendix A.

Because Dr. Wilt planned to talk about a range of topics related to the sea urchin and to demonstrate various processes, we decided to use this public talk as an opportunity to gauge

- What visitors find interesting about sea urchins
- What may be new to visitors
- What, if anything, visitors find confusing
- What personal connections visitors may make with the content

We hope that these findings would help inform the development of our media pieces and possibly the website.

METHOD

Approximately 20-30 people were at the talk at any one time, though not everyone stayed for the full one hour. Three evaluators attended the talk. One evaluator took notes on what Dr. Wilt discussed and showed, and questions from the audience. The other two evaluators interviewed visitors, who stayed for at least 10 minutes of the talk, as they left. At the end of the talk, all three evaluators looked for visitors whom they remembered seeing at the talk for an interview. See Appendix B for the interview questions.

DATA COLLECTED

We interviewed 8 different visitor groups.

Group Type	Count (out of 8 interviews)
Adult peer group	3
Multigenerational group ¹	2
Individual adults	2
Individual senior	1

As part of their interviews, we asked visitors if they had studied biology in school. The results are tabulated below:

Biology education (highest level reported)	Count (out of 11 individuals)
Middle School Biology	1
High School Biology	3
College Biology	5
Graduate School Biology	2

RESULTS

Visitors' Interests

All the visitors found the talk *Interesting*. When asked to explain why, they talked about:

- *Seeing the processes in real-time (5/8)*
 - Visitor2: Actually seeing it happening live, the egg being fertilized
 - Visitor3: Because it was real, because it was actually happening.
 - Visitor4: From my biology background (female is a middle school science teacher) , I know that the sperm fertilize the egg, but seeing it happen was amazing.
 - Visitor6: seeing the stuff in real time.
 - Visitor8: to see in real time, see with my eyes the fertilization happening
- *Seeing fertilization (3/8)*
 - Visitor2: Actually seeing it happening live, the egg being fertilized
 - Visitor4: From my biology background (female is a middle school science teacher) , I know that the sperm fertilize the egg, but seeing it happen was amazing.
 - Visitor8: to see in real time, see with my eyes, the fertilization happening

¹ Only the adult(s) participated in the interviews.

- *The speaker (3/8)*
 Visitor5: (male) I liked HIM! He was extremely ambitious and amazed.
 Visitor7: I'm fired up about this stuff. You never get enough info from the real experts on things. It wasn't your basic lecture like (imitating:)"And here we have the blah blah blah, and here we have the blah blah blah." I'd take a course from [Prof. Wilt] in a heartbeat.
 Visitor8: the simplicity of [Wilt's] delivery
- *Seeing the (high quality) images (2/8)*
 Visitor3: The fact that there are many images, making it easier to understand, instead of [just] a book.
 Visitor6: The picture was really clear. The depth in the video especially the monitor on the counter. It looked 3D.
- *Finding material for their students (2/8). These comments were from teachers.*
 Visitor1: Well, I'm looking at it as a high school biology teacher. So I'm looking for things I can use with my students.
 Visitor8: [the demonstration] would cause my students to get excited
- *The relevance of the subject matter to their own lives (1/8)*
 Visitor8: explained how the urchins are used, to give them context (e.g. we eat them, they are used in cancer research, how it's used in medicine)
- *The skilled microscopist (1/8)*
 Visitor8: impressed with Kristina and her microscope skills

What visitors found to be the MOST interesting

We asked visitors what they found the *most* interesting and grouped their responses into two broad categories. 'What they saw' can inform the selection of video assets, and 'What they heard' can inform the stories told in our media pieces.

- *What they saw*
 - The fertilization (5/8)
 Visitor1: I didn't hear real well, but he talked about the sperm actually going into the nucleus of the egg.[because] being able to use it at the beginning of the genetics unit and have the kids get to see that.
 Visitor2: Relating it to human life, when the sperm and the egg is fertilized
 Visitor6: Sperm. Seeing the fertilization. That exact moment. See in real-time compared to seeing it in a textbook.
 Visitor4: When the membrane formed [because] I knew that something happens for just 1 sperm to enter the egg, but seeing how it all happened was the most interesting.

Visitor7: I guess how quickly the fertilization membrane forms around the embryo. There's a lot of unrequited love outside that embryo! Those guys must be pretty disappointed. [because] I was always curious, with all that DNA coming at you, how is it that one and only one manages to break through? How do they --the egg and sperm--communicate that to each other?

– How cells divide (3/8)

Visitor2: Watching the cell divide. How quickly it all happens.

Visitor3: The way cells divide from the nucleus. It was interesting to see it happen. [because] It's something I've never seen before.

Visitor8: to see the video, division in real time [because I] have never seen that before.

- *What they heard*

– Cancer treatment (1/8)

Visitor5: Develop drugs to stop mitosis for cancer. The history to this.

– The history of sea urchins and research (1/8)

Visitor5: Develop drugs to stop mitosis for cancer. The history to this. [because] It put it [the research] in context. The historical context.

What was new to visitors

We asked visitors if they saw or heard anything that was new to them and when possible, probed for any preconceptions they had before the talk.

- *Everything was new (2/8)*

Visitor4: (male) everything was new to me.

Visitor7: I didn't have any thoughts before, except, How does this process occur? What are the triggering things that allow this to happen? And how does [the egg] make sense out of that chaos. (Q: What ideas did you have about this process or sea urchins before this?) The only thing I knew about sea urchins before this was having seen the controversy around the valuable sea urchin roe in Santa Barbara--I had no idea that was an industry.

- *A membrane forms during fertilization (2/8)*

Visitor4: (female) I thought [only one sperm gets in because of] chemical reaction. Some chemical reaction so only one sperm enters. I didn't know that a membrane forms.

Visitor5: I never asked myself before how eggs managed to have only 1 sperm and not others. I watched the whole thing.

(female) [before I thought] it was some chemical process.

(male) I never asked myself (how only one sperm enters). Accidentally, others die before

- *How sea urchins are used in research (1/8)*
Visitor6: That we use sea urchins to study cell division. Small sea urchins. [Before, I thought they] used some animal. I just didn't know which one.
- *The biomedical research (1/8)*
Visitor8: Facts of what you may use it for (ex: cancer chemotherapy)
- *The development of the sea urchin (1/8)*
Visitor3: About the life of the urchins. Their life. It was nice to see the professor point out, "Here is the skeleton..." And their way of life. (Q: What did you think of urchins before?) (No answer) To see baby sea urchins and see them grow up was interesting.
- *Potential new teaching material (1/8)*
Visitor1: Not other than just being able to pull this up--this particular imagery--and use it in Minnesota.
- *Nothing (1/8)*
Visitor2: not really. I've seen it all on TV before.

What visitors found difficult to understand

Most visitors said that everything was very clear. One visitor, who was not a native English speaker, however, mentioned that she had difficulties with the language. And, one other visitor thought the connection between mitosis and actin can be potentially confusing:

Visitor8: the part about mechanical division, the actin that is in the mitotic division is acting in the same way as actin in muscle. Students may not have understood that fully.

What visitors found personally relevant

Finally, we asked visitors what, if anything, they found particularly meaningful or personally relevant. Although a couple of visitors found nothing of personal relevance, others mentioned:

- *Cancer treatment (3/8)*
Visitor5: The drug development for cancer. If [you] have cancer, then it's important.
Visitor6: (female): seeing how chemotherapy works. I'm a nurse and I work with kids with cancer. I see sores and hair loss. I get what that's from.
Visitor7: I'd like to know more about the chemotherapy end of it; when you get to my age, these issues become more common, and I'd like to know more about chemotherapy--that targets cell division--and how that works.
- *Human development (2/8)*
Visitor3: It's kind of stupid, but I remember the movie with John Travolta, "Look Who's Talking." In the beginning of that you see the human embryo dividing and it reminded me of that.

Visitor4: no. We don't have kids but one day we might have some and we'll know how it happens.

- *Stem cell harvesting (1/8)*

Visitor8: The last part about stem cells, if it's easier to get it here than other organisms, it's good to hear that there are non-human options. Why not focus on animal models now, then we don't waste money, time and arguing about the use of human cells. We should use what we have access to, go as far as we can in this, then consider using human cells. That's just my political view and may not have anything to do with the demo.

SUMMARY

In general, visitors were particularly interested in seeing the fertilization process happen in real-time. They talked about that process in detail and mentioned being surprised by what they saw. Visitors also appreciated seeing cell division, and although some visitors mentioned other parts of early embryo development, no one mentioned any details of the developmental stages. These details may be less riveting than watching fertilization or cell division, an impression that finds support in earlier evaluation work conducted for the sea urchin.²

Most visitors found some personal relevance in what they heard. In particular, they mentioned the cancer treatment research and the connection to human development that Dr. Wilt described.

ACKNOWLEDGEMENTS

The author would like to thank Rita Shiau for taking notes during the talk, and Rita Shiau and Fay Dearborn for help in conducting the interviews.

This material is based upon work supported by the National Institutes of Health Grant 1 R25 RR022728-01.



Department of Health and Human Services • National Institutes of Health

Supported by a Science Education
Partnership Award (SEPA) from the
National Center for Research Resources

² In an earlier study, we showed visitors sea urchin embryos in various stages of development at the Zeiss microscope. The accompanying media piece described the details of the different developmental stages. But, when they were asked to describe what they saw, few visitors identified any of the embryos' parts or the behaviors (beyond moving) in their subsequent interview.

APPENDIX A

Notes from Wilt Lecture – 8/8/06 (1pm)

Background:

- sea urchins were used for development studies when Wilt was starting in his career because animal embryos (such as chicken) weren't widely available
- sea urchins are also commercially important for us on the West Coast because it is our major fishing crop, exported to Japan for consumption
- sex was first discovered in sea urchins in the 17th century by a German scientist – the actual observation of sperm and egg interaction
 - it was also the first time that scientists observed that each parent contributes something to the child
- has impact on biomedicine today

Demonstration: adding sperm to eggs

- after a sperm successfully penetrates the egg, a jelly layer forms and thickens which prevents further fertilization by other sperm, of the same or more importantly, of different species
- question: “is that a nucleus around 5:30?” (while looking at video of fertilized egg) [answer: no, can't see the nucleus just yet]
- audience observation: crowd watched the real time action of the sperms under the microscope.

Demonstration: eggs fertilized at 10:30am, at 2-4-cell stage

- at this stage, can see the nucleus and mitotic apparatus, which pulls the chromosomes apart and “cuts up” the cell into the daughter cells
- the microtubules that pull the chromosomes apart were discovered in the 1950's
- as a result of this discovery in the sea urchin, this knowledge was applied to develop chemotherapy drugs that target the mitotic apparatus – to stop the cell from dividing
 - he likened this to the process that stops our hair from growing at a certain age
- question: “did the sperm die?” (not sure whether he was referring to the sperm that penetrated the egg, or the ones that didn't) [answer: they all swam themselves to death]

Demonstration: video of eggs at ~400 cells

- here we can begin to see cells that would eventually form the intestines, skeletons, mouth, anus
- we can also see cilia on the surface of the cell that helps it to move. The cells in this demonstration have been “given a sleeping pill” so they're still.
- In the 1800's, scientists often had to wait a long time to see this real time fertilization that we're seeing now. Once a year sea urchins would be shipped from Naples to Munich, where scientists from many countries gathered to study them.
- Wilt shared a story about how he became interested in studying sea urchins. He said “follow your instinct, and study something interesting to you – you may get a pay off”

Demonstration: urchin larvae at ~72 hours

- audience observation: crowd watching the very different shape that the larvae has taken at this stage, as Wilt pointed out the different organs
- Wilt then shared about the life cycle of sea urchin – how most larvae float in the ocean as plankton in the wintertime, and most will get eaten. The ones that survive undergo metamorphosis, much like a caterpillar. Most of the larvae we see will disappear as it transforms into a baby sea urchin, about half an inch long.
- He also explained what plankton was – the start of the food chain, eventually eaten by shrimp, fish, etc.

Demonstration: watching a real time division of cells from 2 to 4

- audience observation: crowd watching the live action over 1-2 minutes
- again described the 2 parts of division – one of which caused by actin fibers pulling against each other, much like our muscle fibers do.
- question (said to Charlie during the talk): “are they dividing right now?” [answer: yes]
- question (by Exploratorium staff): “how long will this take?”
- question (by Exploratorium staff): “when you say there’s an actin belt, where is it?” [Wilt pointed this out on the monitor]
- question (by Exploratorium staff): “how well-controlled is the rate of cell division?” [answer: it’s largely temperature-regulated, and very regular; for room temp, usually divides once every 50 minutes.]
- question: *I missed the actual wording of it, but it was a question about the nuclear membrane.*
- question (by Exploratorium staff): “where are the stem cells?” [answer: there are 5 cells on the side of the embryo. People also study stem cells in zebrafish]

APPENDIX B***Interview Questions***

1. About how much of the talk did you stay for?
2. Can you tell me a little about what you remember from the talk?
3. In general, how interesting did you find that talk? Would you say that was ...

Uninteresting	Somewhat Uninteresting	Neutral	Somewhat Interesting	Interesting
---------------	---------------------------	---------	-------------------------	-------------

4. What made it _____ for you?
5. What did you hear at the talk that was the most interesting to you? [*If no answer, probe: Anything?*]
 - a. What made that the most interesting?
6. Did you find out anything new at the talk? What?
7. Was there anything confusing about anything you heard? What?
8. Did you hear anything at the demonstration that you thought was particularly meaningful or important in your own life? [*If YES*] What?
9. We would like our new exhibit to work for people regardless of their background in biology. Have you studied biology before in school?

YES	NO
-----	----

[*If YES*]

- a. When was the last time you studied biology? Was it in

Middle School

High School

College (as an undergraduate)

Graduate School