

Cellular Universe
Focus Groups at the Maryland Science Center
February 25 & 26, 2006

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Prepared by Minda Borun, Museum Solutions

Introduction

The Maryland Science Center has received a SEPA grant to develop an exhibition, intern program and web site focusing on cell biology and stem cell research. The working title of the exhibition is *Cellular Universe*. The exhibit is intended to serve the following audiences:

- Families with children age nine and older
- School groups (grades four and up)
- Adults
- 9th grade underserved high school students in three local schools and/or community centers.

Topics the exhibit will treat include:

- Structure and function of cells
- Stem cells and their potential, the controversy surrounding stem cell research, additional ethical issues involved
- The process of clinical trials
- Current science research

The Science Center has contracted with Minda Borun, Museum Solutions, to evaluate the exhibition, intern program and website. The first stage of this evaluation, part of the planning process for the exhibit, consists of front-end studies of museum visitors to determine adults' and children's baseline knowledge and preconceptions about cell biology and stem cell research.

The Focus Groups

Four focus groups with significant audience segments including children ages 9-13, high school students ages 14-18, adults, and teachers were held at the Science Center on February 25 and 26, 2006. The groups were originally scheduled for the weekend of February 11 and 12, but had to be rescheduled due to a snowstorm. This rescheduling is partially responsible for the fact that the groups were somewhat under-attended.

A total of twenty-seven people participated in the focus groups:

<u>Number of Participants</u>	
Middle School	7
High School	8
Teachers	8
Parents	4

Each group was asked questions designed to provide exhibit and program developers with an understanding of visitors' interest in cell biology and stem cell research, awareness of and interest in selected current science issues, and response to specific proposed exhibit elements. The results of these focus groups are intended to serve as a guide in the development of the exhibit design plan, the programs, and the web site.

Summary of Findings

Three fundamental misconceptions emerged:

1. Among the middle school students, there was confusion between the cell and the atom since both are referred to as "the smallest unit" and as "building blocks".
2. There was also some confusion between stem cells and plant cells and also cells from the brain stem.
3. More importantly, most H.S. students and parents believed that stem cells come from aborted fetuses and some even thought that fetuses were aborted specifically for the purpose of obtaining stem cells. They found this idea to be wrong and disturbing to the point where some parents did not want the topic discussed in the Museum.

The first two misconceptions had limited distribution; the third was quite widespread.

Additional observations from the focus groups

- Of the four groups, only the Middle School children did not know what stem cells are or how they are obtained. They had a sense that stem cells are important, but they didn't understand why. The Middle School children did not know about the issue surrounding stem cell research. The children said they were interested in learning about stem cells, but did not know enough to formulate specific questions.
- The other three groups had heard of stem cells and knew something about their potential in medical research. They also knew there is a controversy around stem cell research, but High School students and parents both thought that stem cells come from aborted fetuses and that this is the basis of the controversy. Teachers were only slightly less confused about the definition of embryonic and adult stem cells and how they are obtained.

- All of the teachers thought their students would be interested in learning about stem cells, although they thought that some parents might have a problem with the topic. One teacher suggested that the stem cell area be marked so that it could be avoided if need be. Also, the topic would have to be made relevant to the children's everyday life.
- Unlike the other three groups, parents said they were not interested in learning more about stem cells. They thought the topic was above their heads and not relevant to them personally. In order to attract a family audience to the exhibit, it will be important to somehow separate the section on stem cells from those dealing with basic cell biology. Additionally, the topic of stem cells will have to be separated from the issue of abortion.
- The adults (parents and teachers) felt it was important for the Museum to stick to the facts and not advocate a particular position on stem cell research.
- Only one participant reported having seen an exhibit on the cell. This was the Microbes exhibit. Clearly, there is a need for an interpretation of basic cell biology.
- Almost all of the groups suggested the idea of a giant walk-through cell and this experience received the highest overall rating. Clearly, it will be an appealing icon for the exhibition. Ideas for the exhibit included visuals to help people understand the structure, function, and variety of cells.
- The H.S. students were very excited by the idea of real laboratory experiments. They wanted a novel experience they couldn't have at home. This activity appealed across all four groups and is clearly appropriate to the topic and target audiences.
- Parents' ratings of exhibit experiences were similar to those of the H.S. students and teachers. They gave the highest ratings to the Walk-through cell and real lab experiments. They gave the lowest ratings to scientists being interviewed by high school students and to critiquing science news stories.
- In discussing the spin browser and video of fetal development, some of the participants mentioned wanting to see models or real specimens showing various stages of development. Perhaps a set of developmental specimens could supplement the video. The teachers expressed concern that human fetal development would lead to questions about sex. They would be more comfortable with examples from other species. This seemed to be a group suggestion effect since it did not come up in any of the other groups.
- The H.S. students liked the spin browser video technology; but, they were not comfortable with the idea of real fetal specimens. It seemed that they were picturing very advanced stages of development and did not want to see anything looking like dead babies. If this idea is pursued, it will need to be carefully prototyped. Parents seemed to like the idea of looking at fetal development, but were worried about kids getting carried away with the spin browser technology. Like the teachers, they suggested having specimens at different stages of development along with the video.

- The sequence of blocks did not appeal to most of the groups. It seemed like a mixed message, with a medium designed for the very young, but a message for older students and adults. If this technique is used, it will need not to look like juvenile block play.
- The High School student interviewers did not appeal to most groups. The H.S. students themselves weren't interested in this idea and the parents and teachers thought it would detract from talking to scientists. Only the Middle School kids liked the idea, because they thought it would make the High School students look foolish! Like the H.S. students, the teachers were interested in what the scientists had to say, but thought the emphasis should be on the voting rather than on talking heads. Both teachers and parents were concerned about the possible lack of communication skills among the scientists and also that they might not maintain a neutral position on stem cell issues. The adults predicted [erroneously] that the students would not be interested in what scientists had to say. This may be related to some of the concerns mentioned above about propounding a stem cell research point of view.

Some activities held particular appeal for only one of the groups:

- The Middle School students really liked the idea of an online teleconference with scientists. The other groups thought this would be too time-consuming and difficult to manage.
- The H.S. students wanted the exhibit to have a sequence or path.
- The H.S. students liked the idea of learning to critique news stories. The other groups thought this activity was too much like school.
- Only the H.S. students were asked to rate the video game idea. They liked the game notion, but thought it would have to be challenging, yet brief. They didn't think the game had to have fancy technology—just good game design.

Detailed Results

The results of the group discussions are reported here group-by-group, since each of the groups had a distinct perspective and knowledge base on the subjects of cell biology and stem cells. Questions are shown in bold face. Moderator and museum staff comments are shown in italics. Multiple answers were accepted for all open ended questions. The number of similar answers is given in parentheses ().

MIDDLE SCHOOL GROUP

N = 7

The Maryland Science Center is planning a new exhibit about Cells. We would like to know what you think about this subject.

1. How many of you have visited the Maryland Science Center before today?

Visited before	5	71%
First visit	2	29%

2. Who can tell me what a cell is and why cells are called “the building blocks of life?”

- *Children sometimes confuse cells and atoms since both are referred to as “the smallest unit” and as “building blocks”.*

Part of your body that makes your body work
It’s an atom and the world is made up of atoms.
They create body tissues.
They help fight off diseases in your body.
There are many different types of cells-- blood, skin.
We’re made up of them.
Skin is made up of cells.
Every time you lose a skin cell it grows back.
Except with brain cells.
I have no clue – We haven’t studied it yet (5th grade).

3. Do you think you would visit an exhibit about cells?

- *Most of the children indicated that they would visit an exhibit on cells.*

4. What would you like to see in this exhibit?

- *The children’s ideas for the exhibit included visuals to help them understand the structure and function of cells.*

The exact picture you just showed me [photograph of red blood cells].
The inside of your body with the cells and pictures in which cells are magnified.
Giant cells.
A microscope with cell slides and different types of cells.
A gigantic lighted picture of cells with things inside and outside of it.
Different cells showing what they do.
How many cells could fit into this water bottle?
Diagrams of different parts of the cell – nucleus and all the different types of parts.
The mitochondria.
Pictures that you could wear glasses and see in 3D.

5. Is there anything you would not like to see in this exhibit?

Something not about cells.

Something kind of boring like instead of just having a description of cells, maybe you could have a game.

You could have a matching game where you have to place the word where the cell is supposed to be.

Make sure it doesn't just describe cells, but describe in a way that attracts the reader. If they just read the headline it's not going to appeal.

6. Can you name some different kinds of cells?

Blood cells

Red blood cells

Animal cells

Plant cells

Bone cells

Skin cells

Organ cells

You basically find cells anywhere in your body, even in your fingernails.

Moderator shows photo of red blood cells]

They are really, really small.

Smaller than the width of a human hair.

The purple things are platelets. That's covered in 6th grade.

7. Have you heard of stem cells?

Yes	3	43%
Maybe	2	29%
No	1	14%
No answer	1	14%

13. How are stem cells different from other cells?

- *The Middle School children did not know what stem cells are or how they are obtained.*

They are the central cell.

They are in plants.

The type of cell that is at the stem of your brain.

14. Why do scientists think it is important to study stem cells?

- *The children had a sense that stem cells are important, but they didn't understand why.*

They can save lives. I'm not really sure but my friend's mother requires advanced stem cells and they are working on that.

They are like the central cells of all the cells. If it's a plant cell, the cells that make photosynthesis would be the biggest ones. The head one, like the leader.

10. How many of you think there is a problem with studying stem cells?

- *The Middle School children did not know about the issue surrounding stem cell research.*

I have heard there is a problem but don't remember what it was.

11. Are you interested in learning about stem cells?

- *The children said they were interested in learning about stem cells, but did not know enough to formulate specific questions.*

Yes	7	100%
No	0	0%

[At this point, Dr. Roberta Cooks told the group what a stem cell is and why there is a controversy over stem cells research.]

12. Now I'm going give you a list of experiences that might be in the Cell exhibit. Please rate each of them from 5 (love it) to 1 (hate it) and we'll talk about what you like and what you don't like.

**Means and Ranges of Suggested Activities Ratings
1 (hate it) to 5 (love it)**

	Middle School	
Walk-through cell	4.6	3 - 5
Experiments in real lab	4.2	3 - 5
Video of human egg developing	3.7	2 - 5
Blocks of stages in human baby development	3.0	2 - 4
Questions answered by scientists interviewed by students	4.1	3.5 - 5
Online teleconferencing	4.9	4.5 - 5
Online stem cell research	3.4	2 - 4.5
Interpreting science news stories.	3.1	1 - 5

- *The activities that were most popular with Middle School children were online teleconferencing with real scientists and the giant walk-through cell. They did not like the idea of arranging blocks (too babyish) or learning to critique science news stories.*

Walk-through a giant cell:

- **experience the sights and sounds of a living cell;**
- **see videos of real cells in action;**
- **explore hands-on exhibits showing different cell parts making proteins,**
- **guess what organ will develop from different cells.**

I like hands-on activities.

Like the idea that you could walk-through and see it.

I think that would be lots of fun.

I like to see videos.

Guessing what would develop from different cells would be a good challenge.

What age groups will be allowed in? It might scare the little kids. My baby sister went to another museum and we went into a heart and she was scared. Maybe you could make a smaller one for little kids-- like a playground.

The cell nucleus could be a jungle gym or slide.

I can understand little kids being scared of that. I'm scared of things inside my body. It's a little gross.

Would you want it not to be too dark?

- *The kids expressed concern that the walk in cell area might be too dark.*

If they had signs then it wouldn't have to be very dark.

Neon lights could show you where you had to go.

You could have glow in the dark footprints.

There could be different kinds of cells on the floor to follow.

Conduct experiments with living cells in a real laboratory:

- collect data on live bacteria and other single-cell life forms
- collect DNA from wheat germ
- analyze human DNA for signs of genetic disease.

- *The kids felt that the lab would need staff for guidance.*

I love doing experiments in science class.

I've never been an experiment person.

I wouldn't like to mess up and it would be kind of gross.

With clear directions and someone to help you – would that make it better?

Yeah.

Use a dial to control a video of an egg developing into a human baby. Compare it to videos of the early development of zebra fish, mice and worms that are used in research.

Could you just press a button and make it go regularly by itself?

Gross.

It would be kind of cool to see inside the egg, to see how the cells develop. You need to have two different things--one for the outside and one for the inside. If you don't want to see the outside you can see the inside.

You can rewind it and fast forward.

I'd like it better if it wasn't a video but was a model.

You can buy model hearts that you can take apart.

You could see what the cells were.

There's a computer game and you can make puppets and you can record a movie and play it back. You could make it expand into two different cells.

I like being able to control things. Like in *Make a Star* where you decide how big it's going to be.

- *Some of the children preferred a set of models to a video. This suggestion came up in other groups as well. Perhaps a set of real specimens at various stages of development could supplement the video?*

Arrange a set of blocks to show stages in the development of a human baby.

This could be for little kids if they want to put it together. It will help them understand and their parents could help teach it without difficulty. This would make it very easy for parents to teach little kids what cells are and how they work.

It kind of seems more for little kids. Blocks aren't my thing.

This sounds like Health Class all over again.

I saw a computer one and a blocks one and the computer one was much more fun.

Kind of interesting if the blocks were bigger.

One big cell and one little cell for kids.

Pick from a list of questions about stem cell research, and then watch answers from several different scientists being interviewed by high school students. Cast your own vote on the issues and find out what other visitors think.

- *The kids didn't understand the point of having High School students conducting interviews with scientists.*

It would be kind of interesting.

It would be funny to see the high school students fail.

It would be interesting to not just see what different scientists think of about stem cell research, but what they do.

I want to know how they would find out about stem cells.

It would be very interesting because someone could have the totally opposite idea. And you would be able to see whose answer you like, who was better and more logical. Then you could post them on the web site.

I don't really get it.

Have a conversation with scientists through an online teleconference.

- *The Middle School students really liked the idea of an online teleconference with scientists, although some thought they would be self-conscious.*

That would be so cool.

That would be scary how you could just ask the questions. It would be freaky if you're in front of a really famous scientist.

Most scientists you don't know about.

It would cool, but I don't think it would be for younger kids because they would feel awkward talking to a random scientist that they don't know about. Some kids don't even know about Albert Einstein.

Would the scientists sit there all day long?

I might not get to say what I wanted.

The little kids would ask the littler questions.

If every scientist had half an hour then if you like a particular scientist, you could come back later that day. You could show the times on the brochure like for the IMAX.

Older kids wouldn't want to be with younger kids. You could have different times.

Older kids should be able to go with younger kids because the younger ones are shy.

Scientists would be ready for the questions. If it's a younger kid it would be a more general answer.

You could have three different computers with three different scientists.

Perform an online stem cell research experiment and learn government safety requirements.

You could do this at your house instead of coming here.

At home you wouldn't know which website to go to.

Some people don't have computers at home.

To learn the government safety requirements would be cool.

I don't do a lot of science stuff at home.

Usually you're doing something else at home or you're away and can't get to your computer.

If a visitor were here visiting a hotel and they didn't have a laptop and wanted to learn about cells they could come here.

A college student who wanted to become a scientist could come here to learn about cells.

Learn to interpret and question science news stories by reading about stem cell research and deciding if the story is true, false or biased.

- *Some children liked the idea of critiquing news stories, but the overall rating was low.*

Don't like having to read. (2)

Science teachers wouldn't give you this.

It would be a good way to experiment to see if you could tell you if it's a true or false story.

I thought it was interesting. You would learn new things by reading different stories.

I like guessing.

If you're just getting into it [in school] then if you go here and read about them –then when you go back o school you would actually know about it.

It would be a bit more fun because you know how to interpret it and if a news guy said something false or biased then you could write to him.

HIGH SCHOOL GROUP

N =8

The Maryland Science Center is planning a new exhibit about Cells. We would like to know what you think about this subject.

1. How many of you have visited the Maryland Science Center before today?

Visited before	8	100%
First visit	0	0%

Family visit (3)

Class trip (2)

Dad works here (1)

2. What is a cell and why are cells called “the building blocks of life?”

It’s the basic unit of life – everything living is composed of cells.

3. Do you think you would visit an exhibit about cells?

- *Most of the H.S. students said they would visit an exhibit about cells.*

Yes	7	88%
No*	1	12%

* depends on how interesting it is and what other kids say about it

4. What would you like to see in this exhibit?

- *Like the Middle School students, the H.S. kids came up with the idea of a giant walk-through cell.*

A cell we could walk into and go around the parts of.

Actual sculpture of cells – parts of it – it would be the entryway to the exhibit.

A big video screen with videos of cells like at the Exploratorium but bigger [seen on Smart Board in room]

Room with cells with different areas--nucleus, ribosomes.

Lots of pictures of cells – a variety of cells in diverse forms.

Cross-sections of organelles and some large ones that you could walk into.

Lots of pretty colors.

Dim lighting closed off with little hallways and tunnels that you can walk-through.

5. Is there anything you would not like to see in this exhibit?

- *The H.S. students wanted the exhibit to be hands-on and to have a sequence or path.*

It has to be interactive (8)

It should have an obvious path or way to go (5)

There should be lots of areas of things to look at. It's not very fun with only little pictures with writing under them.

If you had microtubules in the cell you could follow their path through the cell.

6. Have you seen an exhibit on cells in another museum?

- *None of the H.S. students had seen an exhibit on the cell.*

7. What did you like and dislike about the exhibit?

[No answers reported]

8. Can you name some different types of cells?

Eukaryotic and prokaryotic-- they have a nucleus or don't.

Blood cell, tissue cells, liver cell.

Nerve cell.

Brain cell.

9. Have you heard of stem cells?

- *All of the H.S. students had heard of stem cells. They seemed to know what they are and were aware of the controversy surrounding stem cell research.*

Yes	8	100%
No	0	0%

10. How are stem cells different from other cells?

They are undeveloped-- like a fetus.

They can become any other type of cell.

They are the first type of cell to form.

11. How many of you think there is a problem with studying stem cells?

- *All were aware of the controversy.*

12. If yes, what is the problem? (What are the issues?)

- *The H.S. students shared the widespread misconception that stem cells for research come from aborted fetuses.*

Embryos are inside the cells and the scientists kill them.
The only way to get stem cells is from fetuses. Killing fetuses is bad.

Moderator--Do they use aborted babies to get stem cells?

The easiest way to get stem cells is from aborted fetuses. People are worried it will encourage abortion.

[At this point Dr. Roberta Cooks explained that researchers couldn't use aborted fetuses for stem cells because they are too old. Stem cells are obtained from excess embryos created through in vitro fertilization. The embryos that aren't implanted in the mother are discarded. These are the embryos used for stem cells.]

Moderator—There is still controversy about when human life begins.

13. Why do scientists think it is important to study stem cells?

It could lead to finding cures for many types of diseases-- like Alzheimer's.
You can culture cells and depending on what you put in the medium, you can make other cells.

14. Are you interested in learning more about stem cells?

- *All of the H.S. students were interested in learning more about stem cells.*

Yes	8	100%
No	0	0%

15. If yes, what would you like to learn?

Idea – have a cell playground in a large cell.

16. Now I'm going give you a list of experiences that might be in the Cell exhibit. Please rate each of them from 5 (love it) to 1 (hate it) and we'll talk about what you like and what you don't like.

- The H.S. students gave the highest scores to the walk-through cell and to conducting experiments in a real lab. They disliked the blocks and online stem cell research.

**Means and Ranges of Suggested Activities Ratings
1 (hate it) to 5 (love it)**

	High School
Walk-through cell	4.5 4 - 5
Experiments in real lab	4.8 3 - 5
Video of human egg developing	4.0 3 - 5
Blocks of stages in human baby development	2.5 1 - 3.5
Questions answered by scientists interviewed by students	3.0 2 - 4
Online teleconferencing	3.5 1 - 5
Online stem cell research	2.8 1 - 4
Interpreting science news stories.	3.9 2 - 5
Protein video game	3.7 3 - 5

Walk-through a giant cell:

- **experience the sights and sounds of a living cell;**
 - **see videos of real cells in action;**
 - **explore models of cell parts making proteins,**
 - **guess what organ will develop from different cells.**
- *The students liked the idea of hearing sounds of cells and the hands-on activities.*

What was your favorite?

Models of cell parts--not just making proteins, need other organelles showing cell function. Seeing visuals will help people really understand.

I like all four parts.

These are pretty good ideas. I think you should have a tube or playground type way of getting through the cell.

I like the hands-on parts, especially guess which organ will develop.

I like the videos of real cells. It's helpful for visual learners.

Anyone could come up with this idea so it's not that creative.

Maybe a maze, like the sound and video components. I'm not sure about the "guess what organ" part.

Conduct experiments with living cells in a real laboratory:

- **collect data on live bacteria and other single-cell life forms**
 - **collect DNA from wheat germ**
 - **analyze human DNA for signs of genetic disease.**
- *The H.S. students were very excited by the idea of real laboratory experiments. They wanted a novel experience they couldn't have at home.*

How many have seen the wet lab here?

Yes	0	0%
No	8	100%

I like working with real things-- not videos.

It just really appeals to me to because it's real.

You can use it as a way to teach about lab safety too.

It seems kind of intense for something you just walk-through. It seems like too much.

I like it. You could look through a microscope at prepared slides of plant cells and animal cells.

It might be too time-consuming. You would have to gauge it to all age groups.

I've never seen this in a museum before. It would be a new experience-- something different.

It appealed to me because I like DNA. What kind of things would they be doing with this – electrophoresis or something else?

[Dr. Matthews explained wheat germ and simulated electrophoresis.]

This is a reason why I would want to come here. Looking at pictures I can do online.

Use a dial to control a video of an egg developing into a human baby. Compare it to videos of the early development of zebra fish, mice and worms that are used in research.

[The Exploratorium site with videos of stem cells and mitosis was shown on Smart Board in room]

- *The H.S. students liked the spin browser technology. They were not comfortable with the idea of real fetal specimens.*

It's not that special; it's interesting to look at a few times but not something that you can come back to. (2)

You could see how similar they all are when they first start and you how different parts are formed, like fingers start out attached and then the cells in between them die.

Most text books in school show it in stills, so using a dial to control the movement would be interesting.

This is an excellent idea. I think there is one upstairs.

I like that you can slow it down and speed it up. A zoom feature would be cool.

I like that all embryos are similar at first. You can also highlight the use of animals for research.

I agree that you would expect to see it here, but I like the idea.

Would it be interesting to have real specimens at different stages? Would you prefer to see real specimens?

Real specimens of human babies would not be appropriate for younger children. (8)

How would that work – models or real specimens? With actual specimens you would only get to see some parts; it's not continuous.

I think that both together would work well together.

Arrange a set of blocks to show stages in the development of a human baby.

- *The students thought the blocks would be intended for a younger audience.*

[Dr. Cooks explained that when the blocks are in the correct sequence, it could start a video and that the order of the blocks would be difficult for young children. But the H. S. students were not persuaded]

Blocks appeals to younger kids so why would big kid have an interest in blocks?

How about a set of slides on the computer screen that you could slide into order? That would be a good idea.

Pick from a list of questions about stem cell research, and then watch answers from several different scientists being interviewed by high school students. Cast your own vote on the issues and find out what other visitors think.

I could get that information on my own.

Would you be attracted by other high school students doing the interviews?

- *The H.S. students were not interested in seeing H.S. students interviewing scientists. They would rather just hear from scientists.*

I would not connect with the high school student aspect of it (8)

I like that idea.

I don't care who asks questions, but I want to hear the scientists' answers.

If the high school student doesn't know the information then I wouldn't want to get the wrong information. I want the experts' answers.

It's interesting. It could just be computer-based with questions and answers.

Questions could range from the most basic to more in-depth like just saying what a stem cell is, where they come from.

Have a conversation with scientists through an online teleconference

I like being able to choose your own questions, (2)

Does that mean that it is one-on-one conversation or group?

1 on 1 seems unrealistic. (2)

It's a great idea – maybe schedule 3 times a day with a group of people.

I think it is a good idea. I like the personal contact. The scientist could simplify things; he is personally talking to you.

How big would you like the screen to be?

Too big could be intimidating.

I like the size of screen in this room (Smart Board) because if smaller, it would be annoying to look over peoples' shoulders.

Perform an online stem cell research experiment and learn government safety requirements.

- *Unlike the Middle School students, H.S. students were not excited about online activities.*

Vague. Government safety is not appealing, but the experiment is interesting.

The safety part could show that stem cell research is ethical so should be included.

Why not offer this on the science center website?

Could only one person do this at a time? I like the idea of learning safety requirements so see where they stand but don't think this would appeal to a younger audience.

Learn to interpret and question science news stories by reading about stem cell research and deciding if the story is true, false or biased.

- *The H.S. students were much more positive about learning to critique news stories than were the M.S. kids.*

Can read this on my own, reading is not what I am looking for when I go to a museum. I like it but you have to be careful that you don't reinforce false information, make sure that it is short and then tell true/false.

Once we go around the exhibit and learn all these things then we could go to this to show that it is a social issue now and then we could see what is wrong or someone's personal agenda. So you need background first.

This is a good exit exhibit.

It's good to see what is false that people put out there.

Play a video game matching 3D components to make proteins.

[Note: This question was added only for the H.S. group]

- *The H.S. students basically liked the video game idea, but they wanted it to be challenging, yet brief.*

How complex would it be-- how challenging or engaging?

I like it, but don't make it too appealing to kids. You don't want it to take away from other things in the exhibit. It needs to be kind of short.

I like the idea of seeing DNA in front of you, but I think it should be a spin browser not a video game.

I think it would be good to have at least one video game because they appeal to everyone today; make it fun but not too long.

The full version could be on website.

I like it. I would play it. It might not attract adults as much.

**What level of technology [should be] incorporated into video to hold your attention?
Pac man vs. today's videos?**

- *The H.S. students didn't think the game had to have fancy technology—just good game design.*

Any kind of video game would be OK.

It could be quite challenging and interesting. If it is challenging then you can't just play it and the walk away – I would keep playing it until I get it done.

Make it so that it is easier to do the game by learning stuff in the exhibit.

There used to be a jeopardy-like game here. That was fun because you had to go through the exhibit to get the answer and it was competitive so people like that.

[Students were shown the heart cells video from the Exploratorium's web site on the Smart Board.]

What if you had a broken bone you could just throw some stem cells on there and you could get better.

I think this kind of information would be really good to put in the exhibit because it is real life.

TEACHERS' GROUP

N = 8

The Maryland Science Center is planning a new exhibit about Cells. We would like to know what you think about this subject.

Of the eight teachers: two teach elementary school, two teach middle school science, two teach high school (science and social studies), one was from Hopkins and did outreach, and one was a home schooler.

1. How many of you have visited the Maryland Science Center before today?

- *About three-quarters of the teachers had been to the Maryland Science Center before.*

Brought students before	5	63%
Science Club	1	12%
No	2	25%

2. What is a cell and why are cells called “the building blocks of life?”

- *The definition given was read from the notes from a PowerPoint presentation.*

Living, simple, small.

3. Do you think you would visit an exhibit about cells?

- *Most of the teachers said they would come to a cell exhibit.*

Yes	7	88%
No*	1	12%

* Because teaches Social Studies

4. What would you like to see in this exhibit?

Have videos (3)
Have microscopes (2)
Have puzzles (2)
Have hands-on (hand washing/wet lab) (2)
Eighth graders love video games. They might not care about stem cells, but if they could play with a stem cell video, they might like it.
Forensics/mystery (6th and 8th grades) (2)

Show different kinds of cells (plants, red blood cells, white blood cells etc.) (7)
Show different sizes of cells (4)
Size is something children can relate to (ex. How many red blood cells can fit in a nickel?) (2)
Huge red blood cell.
Most interesting are their own cells. Show one cell and then show them all cells in their body. Can start with stem cells.
Microscopy would be motivating; we use projectors to show cells.
Have something overpowering when you walk in — brightly colored – illuminated - if it is visually catching you become interested right away.
My first memory of a cell is a Red Blood Cell movie; the movie showed cells in the body.
What is the age rang for the exhibit? You need science for first grade and for older students.
The Middle School science club would love to hear about stem cells but other middle schoolers could care less.

Would a video game of cells making proteins etc. be a good idea?

It would be good to have one about cancer cells and maybe chemotherapy-- what does it do to cell.
It's difficult to show cancer because there are so many different diseases and treatments. The hardest part would be to simplify things without distorting. Talk to the Director of the microscope core [at Johns Hopkins]; they have all the pictures done. Check out cancer centers that have information already made and use it in the exhibit. This participant works in liver and GI and has spent a lot of money trying to explain these organs to families.

5. Is there anything you would not like to see in this exhibit?

No answers.

6. Have you seen an exhibit on cells in another museum?

- *None of the teachers had seen an exhibit on cells.*

Yes	0	0%
No	8	100%

7. Have you heard of stem cells?

- *All of the teachers had heard of stem cells and were able to give a simple definition.*

Yes	8	100%
No	0	0%

8. How are stem cells different from other cells?

Stem cells can reproduce into different cells.

They can reproduce all different cells – is that right?

Adult stem cells can differentiate/change into other cells e.g. bone marrow transplants.

9. Why are embryonic stem cells so important – what is the difference between adult and embryonic stem cells?

We have a lot to learn about both types. Cells have a biological clock like shoe lace caps [the] older they get they start to fall apart. Older stem cells are closer to falling apart; earlier cells have more longevity.

Embryonic Stem Cells are most flexible and can become anything; adult stem cells can do a little less.

We are in the beginning stages of figuring out both ESCs and adult Stem Cell Lines.

10. How many of you think there is a problem with studying stem cells?

- *The teachers were aware of the embryonic stem cell controversy. They shared the misconception that the stem cells come from aborted fetuses.*

The Museum should state the facts, but not take sides on the controversy. (4)

Explore fallacies of it. I always thought it had something to do with abortions but I still supported it so you should present the common misconceptions.

11. If yes, what is the problem?

- *Teachers did feel that the Museum should stick to the facts and not advocate a particular position.*

The problem with ESCs is because [parents] make embryos for babies and then have extra and [don't know] what to do with these extras.

Lots of people think that stem cells come from aborted fetuses. This is a wide-spread misconception.

[Dr. Cooks explains that stem cells come from in vitro fertilization and the excess is thrown away]

The Museum must be purely factual.

The question is when does life begin? So it is a social issue.

Is the museum trying to avoid controversy?

No matter what you do there are always extreme personalities, so there will always be social issues. The Museum should try to show that science needs to blend in with social/political issues. They are not separate fields.

I don't think you will avoid controversy [even] if you just present facts.

Just ask where stem cells come from and tell them the facts.

Moderator--Where do adult stem cells come from?

[Dr. Cooks--they start in the fetus and stay to adults – so how do you get them from the fetus?

Dr. Matthews explained that adult stem cells are used in bone marrow transplants. But, scientists argue for using both adult stem cells and embryonic stem cells because they don't want to restrict research possibilities.]

Liver has stem cells that will regenerate in a few months.

Scientist are trying to find a way to use brain stem cells for nerve damage.

It's hard to find adult stem cells.

13. Are you interested in learning more about stem cells?

- *All of the teachers thought their students would be interested in learning about stem cells, although some parents might have problems with the topic. One teacher suggested that the stem cell area be marked so that it could be avoided if need be. Also, the topic would have to be made relevant to the kids' everyday life.*

Yes*	8	100%
No	0	0%

* students would be interested

Does anyone think students would not be interested?

It depends on parents' point of view that they might not want them to know anything about it.

Kids want to know "How does it affect me today?"

14. If yes, what would you like to learn?

If main focus is cell education then they will learn that section and then students could avoid the stem cell section if they want. They would have the opportunity to learn about them. (2)

It would be cool to have our science center to stand out for something, but not controversy.

The central module would be the cell (the initial building block). Then there could be side areas about mitochondria, the genome, etc

15. Now I'm going give you a list of experiences that might be in the Cell exhibit. Please rate each of them from 5 (love it) to 1 (hate it) and we'll talk about what you like and what you don't like.

- Like the H.S. students, the teachers gave the highest scores to the walk-through cell and real lab experiments. Unlike the students, teachers gave the lowest score to online teleconferencing. They didn't think their students would be interested. This was not true of either Middle or High School students.

**Means and Ranges of Suggested Activities Ratings
1 (hate it) to 5 (love it)**

	Teachers	
Walk-through cell	4.9	4 - 5
Experiments in real lab	4.9	4 - 5
Video of human egg developing	4.1	3 - 5
Blocks of stages in human baby development	2.9	2 - 4
Questions answered by scientists interviewed by students	3.1	2 - 4
Online teleconferencing	2.7	2 - 3.5
Online stem cell research	2.9	1 - 5
Interpreting science news stories.	3.4	2 - 5

Walk-through a giant cell:

- **experience the sights and sounds of a living cell;**
- **see videos of real cells in action;**
- **explore models of cell parts making proteins,**
- **guess what organ will develop from different cells.**

My daughter would just walk-through it; if she can't touch/feel or manipulate it, she misses the big picture and focuses on smaller parts of exhibit.

The majority of students would like it if it's big, fanciful, eye catching, and huge.

It should have a "Disney-like eye factor" –huge so students would run into [it].

Elementary school students would love something like a moon bounce. Kids could bounce from nucleus to another part. They could jump around to different organelles.

The concept is good-, but what is the target age? A moon bounce is for little kids but [not] high school students.

How do you interest all age levels? It's difficult to design. May need to decide which age group is being targeted.

They would like to guess what organ will develop.

It reinforces the idea of different kinds of cells.

There should be a little something for everyone. Make it fun and inspiring to all.

Conduct experiments with living cells in a real laboratory:

- **collect data on live bacteria and other single-cell life forms**
- **collect DNA from wheat germ**
- **analyze human DNA for signs of genetic disease.**

You could have a hand washing experiment and then use ultra-violet light to show all the stuff still on their hands. Third grade kids loved that.

Younger children like the hands-on experiments, something they can touch, feel, and manipulate... not just a video.

Could a younger child collect DNA?

[Dr. Matthews explains how wet lab works and that third graders can do it. Everyone says this is good idea]

So many kids are turned off of science before high school. We want them to see that science is fun.

Use a dial to control a video of an egg developing into a human baby. Compare it to videos of the early development of zebra fish, mice and worms that are used in research.

- *Teachers were concerned that images of a developing human fetus might lead to sex education questions. They would rather see the fetal development of other species.*

Students wouldn't find it interesting.

Students would be more interested in seeing specimens at different stages.

Agree the video of zebra fish didn't grab you.

Her kids in elementary school would like using a dial.

This raises "How did I get out of your belly" questions. I wonder what kind of questions would come out of this? It would be great for parent-kid relationships, but I'm not sure about the teacher – student relationships.

A lot of kids think that a fully formed baby is in there the whole time, so this would answer questions about cells developing.

It would be nice to show the progression of cells to tissues to organisms but there is a sex education component.

It may be safer showing this in animals not in humans – *[almost everyone agrees with this]*

Baltimore students [study] reproduction in fifth grade, so it might be helpful for teachers, but all students need to have parental consent.

Comparing humans with other animals. What do you think of that idea?

- *Teachers suggested that the video be supplemented by models of various developmental stages.*

Models provide a convenient way to study life processes. You can see that mice and humans have only minor genetic differences.

Make this another part of exhibit.

Arrange a set of blocks to show stages in the development of a human baby.

This is too focused on very young people and too simple.

Pick from a list of questions about stem cell research, and then watch answers from several different scientists being interviewed by high school students. Cast your own vote on the issues and find out what other visitors think.

- *Like the H.S. students, the teachers were interested in what the scientists had to say, not seeing H.S. students conducting the interviews. Also, they felt that there should not be just talking heads; rather, the emphasis should be on the voting.*

Would be better if they could push a button and the scientist would come on.

Students just want answers; they don't want the interview part.

This wouldn't hold students' attention. Kids don't care if someone is a scientist; it's just someone talking.

It takes too long to get to the answer.

Just give the question, have them vote, give the answer from the scientist and let them decide if they would change their vote.

This is for older kids and must relate to right now.

I like the idea of voting and then kids get to see what the true answer is and how their vote compares to others.

Should the Museum collect questions ahead of time?

Yes (8)

This shouldn't just be scientists because it is a social issue, so other people should give their points of view.

Have a conversation with scientists through an online teleconference

- *Teachers were worried about the communication skills of the scientists and also that they might not maintain a neutral position on stem cell issues.*

Kids would be intimidated to speak with scientists (2)

It could get out of hand, miscommunication; they might not get accurate information.

Boring.

You don't have control over the content. Also some scientists are not good communicators or are [not] inspiring.

Moderator--What if the museum picked some qualified scientists?

Students do the Jason conference and kids are well prepared for this.

Dr. Cooks--What about showing a live experiment? They are exciting, not just asking questions.

Would be good if you had this as part of a traveling science program to teach background information before they come to the museum.

The scientists like it to be interactive so students could find this exciting.

I'm worried about the person communicating with kids.

Perform an online stem cell research experiment and learn government safety requirements.

There's not enough time during a class visit to do this.

Learn to interpret and question science news stories by reading about stem cell research and deciding if the story is true, false or biased.

- *Teachers thought this activity was too much like school.*

Kids want hands-on interactive things [in the museum]. They have to do this type of thing all the time [in school] in writing and reading etc.

Students don't want to do this.

The Social Studies teacher liked this one.

I think students come to be entertained. If we make it like class work, then they won't want to come.

PARENTS' GROUP

N = 4

The Maryland Science Center is planning a new exhibit about Cells. We would like to know what you think about this subject.

1. How many of you have visited the Maryland Science Center before today?

- *Three quarters of the parents had visited the Science Center before.*

Yes	3	75%
No	1	25%

2. What is a cell and why are cells called “the building blocks of life?”

It's the foundation for putting cells together for making tissues which in turn comprise organs which in turn compromise systems which is an entire organism.
All living things contain cells so that would coincide with the building blocks.

3. Do you think you would visit an exhibit about cells?

- *Unlike the other groups, parents did not express interest in visiting an exhibit on cells.*

Yes	1	25%
Maybe	3	75%

Just the word itself is not really interesting; it depends on what it is about.
If the child showed interest, then yes.

4. What would you like to see in this exhibit?

Hands-on, manipulative type things; not just a lot of reading.
Very visual things--cancer cells done in really beautiful colors.
Varied types of cells-- plant, animal.
Have some type of microscope available to see real cells. That will give them an actual view of what makes up the cells.
A lot of kids don't get to have the experience of working hands-on with a microscope.
I can recall cameras that come off the microscope that shows the image one person [is looking at] and everyone can see what they're seeing.

5. Is there anything you would not like to see in this exhibit?

No response.

6. Have you seen an exhibit on cells in another museum?

- *Only one parent had seen an exhibit on cells. It turned out to be the Microbes exhibit.*

Yes	1	25%
No	3	75%

There was an exhibit at MSC about bacteria (Microbes exhibit.). It was a dark room with black light. Huge plastic versions of microbes were set up on the ceiling. It was very dramatic and visually striking.

7. What did you like and dislike about the exhibit?

I remember more the look than content.

8. Can you name some different types of cells?

Plant cells, animal cells, muscle cells, skin cells, bone cells, cancer cells, or just disease in general, nerve cells (one person's response).

9. Have you heard of stem cells?

- *All of the parents had heard of stem cells. But were not clear what they are or how they are obtained.*

Yes	4	100%
No	0	0%

10. How are stem cells different from other cells?

They are more in the newspaper than other cells.
Don't really know much about it. Something related to newborn babies. Somehow stem cells can be used for treating diseases, somehow they are different.
Perhaps in the development of the cells, they haven't been assigned their job yet. They haven't been dictated that you're going to be a skin cell, bone cell. [They are cells] that haven't been designated yet. If using them for Parkinson's, they would have to have something to do with brain.

11. How many of you think there is a problem with studying stem cells?

- *All of the parents knew there was an issue about stem cell research.*

Yes	4	100%
No	0	0%

12. If yes, what is the problem?

- *Parents held the misconception that stem cells come from aborted fetuses.*

I'd say the issue has to do with the legalization of abortion because they use aborted babies' stem cells. (4)

This issue is very divisive and emotional. There is no middle ground. Bush allowed funding and research on adult stem cells as a way to find middle ground. Researchers say it stymies our research efforts. There seems to be two sources of stem cells, but scientists want to do more with embryonic cells.

Are adult stem cells from an adult?

I wasn't aware they were able to harvest stem cells from adults. I thought stem cells were only available from aborted fetuses and umbilical cords.

13. Why do scientists think it is important to study stem cells?

It could lead to new discoveries, new treatments, interventions or preventions of disease. Just making life a little easier.

Wasn't it also spinal injuries? It seems that there was some research in the area where people couldn't walk [*Christopher Reeve Foundation*].

14. Are you interested in learning more about stem cells?

- *Unlike the other three groups, parents said they were not interested in learning more about stem cells. They thought the topic was above their heads and not relevant to them personally. Also, they were afraid of being pressured by scientists to support stem cell research, which they saw as requiring aborted fetuses. It will be important to somehow separate the two issues (stem cells and abortion) in order to attract a family audience to the exhibit.*

Yes	0	0%
No	4	100%

15. If yes, what would you like to learn?

It's complicated and it's something scientists do and it's beyond my understanding. (3)

If it were to impact my life more; if my wife or children were stricken with something that stem cells could help then I would be definitely interested.

I would be more interested in the cells and [stem cells] as an offshoot; not as a central focus for the exhibit.

I'd like to know exactly what a stem cell is and where they come from. I've heard the term, but to define it would be nice.

What are they being used for currently and what they might be used for in the future?

Visually, it might be interesting to see how they are different from plant cells and animal cells. It brings to mind cells being the building blocks and stem cells being life.

Getting into the abortion issue, how can you take a life and end a life to use for research? I don't know how you get them [stem cells] from adults.

If they are ill and want to end their life and to use their stem cells.

It would make me skeptical to get into the ethical issues. I'd rather see the science. Whose opinion would be presented [if it was a topic in the exhibit]?

This is a Pandora's Box.

It would be OK as long as there was equal time given to both sides-- equal weight.

Or that it would make you think for yourself.

16. Now I'm going give you a list of experiences that might be in the Cell exhibit. Please rate each of them from 5 (love it) to 1 (hate it) and we'll talk about what you like and what you don't like.

- *Parents' ratings of exhibit experiences were similar to those of the H.S. students and teachers. They gave the highest ratings to the walk-through cell and real lab experiments. They gave the lowest ratings to scientists being interviewed by high school students and to critiquing science news stories.*

**Means and Ranges of Suggested Activities Ratings
1 (hate it) to 5 (love it)**

	Parents
Walk-through cell	5.0 5 - 5
Experiments in real lab	5.0 5 - 5
Video of human egg developing	3.8 3 - 5
Blocks of stages in human baby development	4.0 2 - 5
Questions answered by scientists interviewed by students	2.8 2 - 4
Online teleconferencing	3.3 2 - 4
Online stem cell research	3.0 1 - 4
Interpreting science news stories.	2.8 2 - 3

Walk-through a giant cell:

- **experience the sights and sounds of a living cell;**
- **see videos of real cells in action;**
- **explore models of cell parts making proteins,**
- **guess what organ will develop from different cells.**

Sounds interesting and not something that they would do frequently; a lot of different things are going on.

I like the first two the best. The hands-on type.

Anytime kids can experience, instead of just sitting there and having things told to them it has more impact. They get more out of it.

The word giant makes a difference -- to be surrounded by it.

Conduct experiments with living cells in a real laboratory:

- collect data on live bacteria and other single-cell life forms
- collect DNA from wheat germ
- analyze human DNA for signs of genetic disease.

Getting kids directly involved, giving them an actual experience, hands-on activity; that would be very good. Educators make the decision to come to the science center. [This would] make it more attractive to those who make decisions to come.

I like both the first and the second.

Would this be a good teaching tool for home school kids?

Yes. This kind of thing sticks with them and makes them remember.

One thought that came to mind is the biotech [industry] in Baltimore. You could easily tie into scientists who do this for a living.

Use a dial to control a video of an egg developing into a human baby. Compare it to videos of the early development of zebra fish, mice and worms that are used in research.

- *Parents seemed to like the idea of looking at fetal development, but were worried about kids getting carried away with the spin browser technology. Like they teachers, they suggested having specimens at different stages of development along with the video.*

If you control the video, I have visions of kids speeding it up.

I like the idea of the development because if you just show cells, big deal, but seeing the development of the cell, getting the rest of the story, that's valuable. Having something to compare it with would be beneficial.

I didn't understand why you picked a zebra fish. I guess I'd want to know more about them. Content was neat. I wasn't sure what you meant by the dial and then kids might be going so fast that they would miss the content. It sounds interesting in concept but I'm not sure how it would work. To see it real, in person, as opposed to on a video would make more of an impact. Maybe have live cells with a different stage in each container.

I thought that the kids might enjoy the manipulation and wouldn't look at the content.

Arrange a set of blocks to show stages in the development of a human baby.

It's manipulating and seeing it right there in front of you.

It's a little simplistic, but good.

The students I deal with are juniors and seniors and [it] wouldn't be much a thrill for them but for younger kids it would be good for manipulating and seeing the sequence.

Pick from a list of questions about stem cell research, and then watch answers from several different scientists being interviewed by high school students. Cast your own vote on the issues and find out what other visitors think.

- *One parent did not like getting into the issues. Others predicted [erroneously] that the kids would not be interested in what scientists had to say.*

I didn't like getting into the issues. I liked the interviewing of the students, the making their own opinion, but I didn't like the focus on issues.

It seemed like they would be standing or sitting and being talked to.

I like that they could pick from a list of questions so they don't have to just listen to a lecture.

I like the being interviewed by students and casting their votes. They would feel important.

But I'm not exactly sure of their interest.

Have a conversation with scientists through an online teleconference.

Would this be interesting to high school?

Yes.

People wouldn't know what to ask. I think both of these will tap into a particular type of person who responds that way. Teachers like this on field trips. They are useful but not as flashy.

It would be hard to come up with a question to ask. Kids have to have some basis of knowledge and interest in stem cell research.

Should we combine five and six? [Would you] rather have scheduled times to talk with scientists or have video?

Rather have video, and the answers should be brief.

Video makes sense. You know exactly what you're getting.

Unfortunately students click off when you show a video in class. They think "Teacher's not interested in teaching class today."

I like the idea of actually talking with scientists, and also for students to formulate their own questions. It's good for the more mature student or those who have more interest.

If they were learning about it at school and then came and heard scientists [it would be] better than just coming in off the street.

Perform an online stem cell research experiment and learn government safety requirements.

I'm not comfortable with a focus on stem cell research

What about the online/web-based experience as a medium?

I can't visualize what this would be. (Thought she would be seeing actual samples.)

Learn to interpret and question science news stories by reading about stem cell research and deciding if the story is true, false or biased.

- *Parents thought the news story critique was too much like a classroom experience.*

This sounds like something a teacher would do in the classroom. It's not as interesting in a museum setting. (2)

I don't think it would appeal to my child. Reading takes too long.

If you look at the whole learning approach; [this] would fit more into current events, I keep going back to the hands-on experience.

Have something about cancer.

So much depends on your life experience. A friend was diagnosed with lung cancer. I was thinking "What does it mean to have that type of cancer--basal cell." I have heard that before but don't know what it means.

SUMMARY—RATINGS OF ALL GROUPS COMBINED

**Summary: Means and Ranges of Suggested Activities Ratings
1 (hate it) to 5 (love it)**

	Middle School	High School	Teachers	Parents	All N = 27
Walk through cell	4.6 3 - 5	4.5 4 - 5	4.9 4 - 5	5.0 5 - 5	4.7 3 - 5
Experiments in real lab	4.2 3 - 5	4.8 3 - 5	4.9 4 - 5	5.0 5 - 5	4.7 3 - 5
Video of human egg developing	3.7 2 - 5	4.0 3 - 5	4.1 3 - 5	3.8 3 - 5	3.9 2 - 5
Blocks of stages in human baby development	3.0 2 - 4	2.5 1 - 3.5	2.9 2 - 4	4.0 2 - 5	3.0 1 - 5
Questions answered by scientists interviewed by students	4.1 3.5 - 5	3.0 2 - 4	3.1 2 - 4	2.8 2 - 4	3.3 2 - 5
Online teleconferencing	4.9 4.5 - 5	3.5 1 - 5	2.7 2 - 3.5	3.3 2 - 4	3.6 1 - 5
Online stem cell research	3.4 2 - 4.5	2.8 1 - 4	2.9 1 - 5	3.0 1 - 4	3.1 1 - 4.5
Interpreting science news stories.	3.1 1 - 5	3.9 2 - 5	3.4 2 - 5	2.8 2 - 3	3.4 1 - 5
Protein video game		3.7 3 - 5			

Conclusions

The topic of cell biology was interesting to three of the four groups. Many of the ideas that they offered for the exhibit were parallel to those held by the museum staff. Only the parents said they were not interested in coming to an exhibit on cells and would have to be convinced that it was interesting. The other three groups deal with cells in school and know it is a basic science topic. Also, the parents seemed concerned that their children would be pressured by scientists to support stem cell research, which in their minds meant supporting abortion! It will be very important to deal with this in the PR and advance communication and descriptions of the exhibit. Perhaps some panel discussion programs before the exhibit opens and also articles in the local press could help to dispel the misconception that stem cells come from aborted fetuses, thus opening the door to more of a family audience.

This is a difficult situation. People are inclined to avoid basic science information because of a misconception about how stem cells are obtained. This misconception, combined with people's awareness that there is a controversy about stem cell research and that the Government has limited scientists pursuit of this research has made parents uncomfortable with the idea an exhibit on this topic. However, it is precisely for this reason that the exhibit is so important.