

Cosmic Origins Front-End Report

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Purpose

The purpose of the Cosmic Origins front-end studies was to explore visitors' knowledge, misconceptions, attitudes and interests about the concepts encompassed by the planned traveling exhibition: Cosmic Origins (working title). Cosmic Origins is an exhibit that will present current science on the formation and evolution of stars, planets and life on earth, as well as the processes and technology utilized to search for new stars, planets and life beyond our earth.

Method

After an extensive review of existing work in the field in this area, the concept development team identified the remaining questions (visitor unknowns) most relevant to the content of this project. Two survey instruments were developed by the project's lead evaluator and pre-tested at the Denver Museum of Nature and Science. Three questions were duplicated, appearing on both surveys to gather a larger sample response.

To ensure a representative sample for an exhibit that is intended to travel to many different geographic regions, three data collection sites were identified:

1. The Denver Museum of Nature and Science, Denver, Colorado
2. Chabot Science Center, San Francisco, California
3. The Catawba Science Center, Hickory, North Carolina

A systematic space sampling technique was utilized, with a goal of 50 records in each location, for each survey. As well, the target sample was 50% adults, and 50% youth. The survey instruments themselves had been identified at the time of pretest as difficult for most youths under 12. Thus, the 'youth' population was generally between 12 and 17. This is a difficult population to reach at museums, and hence, the 50% youth goal was difficult to accomplish.

Visitors were intercepted and invited to participate in a short survey. Interviewers recorded responses verbatim on individual response sheets. To ensure consistency, all completed surveys were sent to Denver for data entry. All data were interpreted and analyzed by the lead evaluator. The following is a report on results.

Sample Descriptions

Total Sample N = 310

Sample by Region:

	Total	Survey One	Survey Two
Colorado	120	69	51
California	101	51	50
North Carolina	89	45	44
Combined Data	310	165	145

Sample by Gender and Age:

	Gender			Age		
	Male	Female	N/I	Youth	Adult	N/I
Colorado	46%	50%	4%	17%	82%	1%
California	48%	48%	4%	44%	55%	1%
North Carolina	38%	57%	5%	27%	65%	8%
Total	45%	51%	4%	28%	69%	3%

Note: N/I =_Not Indicated on data collection form.

Sample by Social Group:

Family Group (any adult and children combination)	56%
Alone	6%
School Group/Home school	10%
School	6.5%
Home school	3.5%
Adult Group	24%
Not Indicated	4%

Results:

Question One: Interest

On both studies N= 310

Participants were told that we “are currently in the midst of developing an exhibit that is all about what scientists know about how stars, planets and life are formed, and about the research they are doing as they look for new planets, and life beyond earth.

On a scale from 1 to 5, how interested would you say you personally are in this topic?
Why or why not?

This question is usually asked prior to the decision to move forward on an exhibit topic, however, these data had not been collected previously, and the explanation of why

participants rated their interest as they did would be most helpful to developing the entrance narrative.

This five point Likert scale was anchored by 1, representing “Not at all interested” and 5, representing “Fascinating!”

Level of Interest	Total	Gender		Location			Age
		Male	Female	CO	CA	NC	Youth
1	2.9%	4%	2%	4.1%	0	4.5%	2.6
2	4.8%	6.3%	3.5%	7%	3%	4.5%	3.8
3	20%	16.7%	23%	18.4%	16%	23.6%	21.8
4	40.5%	42.9%	38.5%	37.8%	49%	31.5%	50
5	31.9%	30.2%	32.9%	32.6%	32%	36%	21.8

Implications:

- 72.4% of participants expressed interest (4 or higher) in this concept for an exhibition.
- There was surprising little gender difference (73% of males rated it 4 or higher, 71.4 % of females).
- Significant regional differences exist. Using the 4 or higher ratings as indicators of interest, (CO 70%, CA 81% and NC 68%) California rated this exhibition significantly higher than did Colorado and North Carolina, suggesting different marketing strategies may be necessary in different regions.
- There was no interest difference by age. 71.8% of youth rated this concept 4 or higher, the same as the general public.

When asked to explain their ratings, visitors who rated their interest as 3 or below explained that the subject seemed intimidating (too advanced, too technological,) or that they did not like astronomy.

Participants who liked the exhibit concept explained an existing interest in astronomy or space, or a societal “need to know” what’s “out there.”

Question Two: Title Test

On both studies N = 310

The team developed six potential titles, all with subtitles. Participants were asked: “Now I’m going to show you 6 possible titles for this exhibit. Could you tell me which of these titles you think is most exciting?”

The tested titles were:

The Search

Stars, Planets, and Life Beyond Earth

Cosmic Origins

Our Search for Stars, Planets, and Life Beyond Earth

Outer Explorations
Stars, Planets, and Life

Beyond Earth
The Exploration of Stars, Planets, and Life

Galactic Search
Stars, Planets, and Life Beyond Earth

Stars. Planets. Life.
Our Search for Cosmic Origins

Results:

Title	Total	Gender		Location			Age	
		Male	Female	CO	CA	NC	Youth	Adult
The Search	7.1%	8.0%	5.6%	No difference			No difference	
Cosmic Origins	19.7%	21.7%	18.6%	No difference			No difference	
Outer Explorations	12.9%	No difference		No difference			18%	10%
Beyond Earth	36.5%	31.9%	39.8%	39.2%	38%	34	21%	39.8%
Galactic Search	17.1%	No difference		17.6%	18.0%	9.0%	22%	15.6%
Stars. Planets. Life.	6.8%	No difference		3.9%	4%	15.9%	No difference	

Implications:

- The clear public favorite in all regions was “Beyond Earth,” particularly among adult women and youth participants.
- Cosmic Origins, a slim leader for second place, scored significantly better with adult men.
- In North Carolina, although, “Beyond Earth” was the top scorer, both this title and “Galactic Search” were significantly less popular than in other regions. Conversely, “Stars. Planets. Life,” scored much higher in this region than in the other two.

Question Three: How is the word ‘Cosmic’ understood?

On both studies N=310

It very quickly became apparent that for the vast majority of museum visitors, the word “Cosmic” is synonymous with “Outer Space” or “the Universe.”

A small percentage of visitors (less than 5%) thought the world described something ethereal.

11% of visitors used the words solar system, but as most adults do not distinguish our solar system from deep space, they are in essence reiterating the first position of “Cosmic” as “Outer Space” or “Universe.”

It is also important to note that “Cosmic” does not include our earth – previous studies indicate that museum visitors strongly separate the domains of the earth and space. Just less than fifteen percent of participants described Cosmic as “anything outside our earth,” underscoring the strong polarization in the framework most museum visitors start with when they contemplate the earth’s position or role in the cosmos.

Question Four:

The material/stuff that the earth is made of – the whole earth – where did that material come from originally?

Note: if visitors answered the ‘Big Bang’ - the question was followed up by a probe to explore if visitors thought the earth was formed at the time of the big bang.

Sample: Survey One – N = 165

Responses:

I Don’t know	24%
God/creationist	21%
Big Bang	19%
Big Bang – then	10%
Big Bang material – earth later	9%
From stars/inside/colliding/breaking off	12%
Broke off other planets/bodies	10%
Floating around outer space	6%
Mix; God and science	3%

Remaining 5%: volcanoes, moon, recycled supernovas, magic.

Regional Differences:

	North Carolina	Colorado	California
Don’t Know	19%	23%	30%
God/creationist	35%	19%	10%
Big Bang	12%	19%	25%
Stars	13%	14%	9%
Total – that region	80%	75%	74%

Implications:

- Respondents had a difficult time with this question. The vast majority of visitors have never thought about this question.
- Numerous misconceptions, as outlined above, will need to be addressed in the planetary science portion of this exhibition.

Question Five:

How do you think the planets came to be spheres or balls that go around the sun?

Sample: Survey One: N = 165

Responses:

Gravity	50%
Gravity – spinning/rotation	12%
Gravity – attraction	4%
Gravity – orbit	6%
Gravity – Sun’s	10%
Gravity – unspecified	19%
I Don’t Know	19%
God/Creationist	15%

Responses less than 5%: (number of times response occurred in ()’s unless a single response)

Magnetism (4), shape more aerodynamic (2), from inside the planet (2), friction (2) sun’s heat, big bang, atmosphere, properties of physics, the universe, magic, gas, pressure of the universe, how they travel, change of time.

Regional Differences:

	North Carolina	Colorado	California
Gravity - all	57%	55%	37%
Gravity spinning	2%	20%	2%
Don’t know	11%	16%	31%
God	31%	7%	9%
Total – that region	80%	98%	79%

Implications:

- Visitors were much more comfortable with this question than the previous one.
- Most visitors will easily grasp the concept of gravity being the force that ‘pulls’ planets together, although the source of the gravity will need to be underscored. Also, Question Nine indicates that visitors generally think of planets as solid objects.

Question Six:

Do you think there are other solar systems out there? N= 165

(If yes) Would they be similar to ours? N=149

(If not similar) How would they be different? N= 63

Other Solar Systems?	Total	Gender		Location		
		Male	Female	CO	CA	NC
Yes	90%	96%	87%	93%	92%	84%
No	4%	3%	5%	6%	2%	5%
N/I	5%	1%	7%	1%	6%	11%

Note: no age difference

Like Ours?	Total	Gender		Location		
		Male	Female	CO	CA	NC
Yes	51%	45%	56%	56%	35%	62%
No	25%	30%	23%	30%	25%	15%
Maybe/some	8%	9%	6%	4%	17%	2.5%
We don't know	4%	7%	1%		13%	2.5%
N/I	12%	9%	14%	10%	10%	18%

Note: %'s are % of those who responded Yes, to the previous question, N = 149

No age differences

If different – How so?

N = 63

Most (25%) visitors described possible other solar systems as having very different environments, which would thus influence the type of life form possible, if at all.

There were few patterns in the remaining responses. Three visitors said other solar systems would have different types of humans. Two visitors remarked that no other solar systems would have humans, although other life forms might be possible. Other responses included: they would have evolved differently, they would be different shapes, like squares, if they were similar, we would have found them by now, they may not orbit anything, they would not be as complex.

Implications:

- Most visitors expect scientists to find other solar systems, although they are not clear on whether to expect them to be similar to ours.
- Visitors indicate they have a clear understanding that environment shapes the possibility for life.

Question Seven:

If scientists find life beyond our planet, they are expecting it to be microbes – not human-like creatures like us. Why do you think that is?

Survey Two - N= 145

44%: Other places would have extreme climates/ Microbes live where complex creatures can't

24%: Existing life form is dependent on how life starts – different processes of evolution result in different life forms

20%: I don't know

7%: We already looked for complex life and didn't find it – now we're looking for more simple life forms

2% They're wrong – I expect life to be complex

2% God would want variety

Other, single responses included: Microbes are more interesting to look for; we can't look outside our solar system; because humans believe they are superior; it's just speculation.

Regional differences: 'Extreme climate' was the primary response in Colorado and California. North Carolina visitors had a much high tendency to reply: "I don't know."

Implications:

- Respondents seem ready to accept microbes as an indication of 'life.
- Respondents again indicate that they understand that environment dictates the possibility and nature of life.
- Respondents seem to expect other planets to have very extreme climates, as compared to earth.

Question Eight:

8a) If scientists do find tiny life forms on another planet – something like bacteria – would you find that exciting?

Survey Two: N = 145

	Total	NC	CO	CA
Yes	81%	80%	75%	90%
No	18%	20%	22%	10%
Unsure	1%	0	3%	0

No age or gender differences

8b) Would that change your life? Why or why not?

	Total	NC	CO	CA
Yes	53%	66%	53%	41%
No	47%	33%	47%	59%

Visitors who did not believe it would change their lives (47%) responded in one of two ways:

1. It would not change their lives because they are expecting to find life beyond our planet (most frequent)
2. If we did find life it would be too remote to have an impact on our lives here on earth.

Visitors who did believe it would change their lives (53%) responded:

(Note: percent represent the % of those respondents who felt it would change their lives)

13% - It would mean we are not alone in the universe

13% - It would mean the earth is not the center of the universe/ it would give me a wider scope/broader perspective

9% - It would open so many possibilities – raise more questions

Sample single responses: I would think more about my origins; it would lead to more exploration; the story continues in other ways; I would realize the creator keeps on creating.

8% had negative responses:

It would make me feel so much smaller - 4%

It would make me feel threatened – 4%

Implications:

- Visitors would find the discovery of life outside our planet exciting.
- Most respondents who are not convinced such a discovery would change their lives feel this way because their current worldview already includes this as a possibility or probability.
- People certainly do not find this possibility threatening.
- Most visitors for whom this would be a paradigm shift, feel it would ‘expand’ their understanding of the universe.

Question Nine:

9a) What do you think the difference is between what stars are made of and what planets are made of?

60% Stars are gas and planets are solid

25% I don’t know

9% They’re the same

4% Stars are hotter

Other: stars are H and He; they’re just different stuff.

There were no regional, gender or age differences in responses to this question.

9b) Actually, scientists have come to understand that stars and planets and even life here on earth are all made of the same stuff. Some scientists like to say, “We are all stardust.” What do you think about that? How does that make you feel?
(In order of most to least frequent response)

I don’t believe it –28% (All regions equally)

I’m not surprised; it makes sense 19% (CA and CO only)

This conflicts with my religious beliefs. 9% (NC & CO significantly more than CA)

It would make me feel more connected, more a part of the whole. 8%

I’m not sure how I would feel. 8%

It would make me feel ‘weird’ or not good. 5%

It would make me feel insignificant, humble or small 4%

Note: 11% offered a response that did not indicate agreement or disagreement – a non-affective response such as “interesting” or “that would give us much to think about.”

Implications:

- Participants hold a very strong misconception that stars are gaseous and planets are solid. This will need to be addressed directly in the exhibition.
- The idea that living and inert things are made of similar substances is difficult for visitors. Many simply dismiss it. Further work should be done to understand how this concept could be effectively communicated to visitors.
- Those that are open to considering it, generally find it an integrating and connecting idea.

Overarching Implications

- Visitors to each of these museums expressed interest (4 or higher) in the given concept for an exhibition. There was surprising little gender difference. California rated this exhibition significantly higher than did Colorado and North Carolina, suggesting different marketing strategies may be necessary in different regions.
- The word “Cosmic” is synonymous with “Outer Space” or “the Universe.”
- The average visitor will never have thought about the origination of the materials from which the earth is formed, although they will be able to describe gravity as the influencing force in shaping the earth.
- Stars and planets are not connected in any way for most visitors – neither in their origins or composition.
- Most visitors expect scientists will find life on other planets, and understand that life will be determined by the environment it evolves in.
- The exhibition’s main theme, that “We are all stardust” is somewhat challenging for visitors, from both an intellectual and spiritual point of view. This could work to the exhibit’s advantage – in stimulating the conditions that favor a cognitive shift, or could be a barrier for some visitors. I suggest this point be explored in the formative evaluations of components that address this concept directly.
- A second round of title testing is also recommended, to ensure a ‘catchy’ title that communicates content and experience effectively.