

Traits of Life: Common Design- Branching Study

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THIS IS **NOT** A DEFINITIVE FINAL REPORT

FORMATIVE evaluation studies like this one often:

- **are conducted quickly**, which may mean
 - small sample sizes
 - expedited analyses
 - brief reports

- **look at an earlier version** of the exhibit/program, which may mean
 - a focus on problems and solutions, rather than successes
 - a change in form or title of the final exhibit/program

Traits.Common Design.#1.Branching.Interview.Report

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December 10, 1999

Exhibit under Evaluation: Branching

- Four exhibit elements:
 - Slime mould in a petri dish. Backlit.
 - Roots of a pinto bean in agar suspended in a vial. Backlit.
 - Chick embryo in yolk in petri dish. Backlit.
 - Blood vessels in your eye from the exhibit, Blood Vessels of the Eye. Graphics were covered.
- No graphics were used.
- A magnifying glass was on hand to examine the elements closely.

Goals of the Evaluation

- To find out if visitors recognize branching patterns in the different elements
- To find out if visitors see similarities in branching between the different elements
- To find out if the branching is easy to notice in the chosen exhibit elements
- To find out how much visitors know about branching and its prevalence in nature
- To find out if visitors can cite other examples of branching in nature, and if so, what.

Method of Evaluation

- Eleven groups were interviewed including a total of fourteen people were interviewed.
- The interviews were conducted over a period of two days. The first five interviews were conducted on Thursday, October 7, 1999 between 1:15 PM and 3:00 PM. The second six interviews were conducted on Friday, October 8, 1999 between 11:15 AM and 1:00 PM.
- The interviews were conducted across from the life sciences laboratory between Bay 6 and Bay 7.
- The interviews were conducted by an evaluator. Questions were answered at the conclusion of the interview by the evaluator and the developer (John Magolske).
- Visitors were asked to observe the four elements (slime mould, roots, chick embryo, blood vessels of the human eye) individually and then later to find commonalities between the four elements.
- Interviews lasted approximately 20 minutes.

Interview Demographics:

- Female: 50% 8-12 (3), 13-19 (2), 20s (1), 30s (1)
- Male: 50% 8-12 (3), 13-19 (0), 20s (2), 30s (1), 40s (1)
- Group: Adults (6), Teens (Ages 13-19) (1), Kids (Ages 8-12) (4)

Interview #:

1- Female, 20s	7- Female, 30s
2- Male, 20s	8- Male, 40s
3- Female, 9, 11, 12	9- Male, 10
4- Male, 8	10- Two females, 16
5- Male, 30s	11- Male, 20s
6- Male, 10	

Findings of Evaluation

(* Note: Multiple answers were taken into consideration in analyzing the data. Therefore, the total sum of responses is not equal to 100% where noted with an asterisk*)

Slime Mould

Take a look at all four of these things, what do you notice about them?*

- *7/11 of the visitors noticed branching patterns or veins*
- *4/11 of the visitors noticed extraneous elements to the slime mould, such as condensation or the square piece of paper used to start the slime mould growing.*
- *3/11 of the visitors noticed colors or shapes within the slime mould other than branching characteristics*
- *2/11 of the visitors noticed that the slime mould was not moving*
- *2/11 of the visitors made other comments on the slime mould or exhibit.*

7/11 - Noticed branching patterns or veins

- 2- All the bubbles [condensation]. Similar veins are protruding to form a central location. I don't see any motion or movement. I don't know what the square is [blotting paper].
- 3- It's white. It keeps growing. It has lots of veins. (Kid)
- 6- Looks like a tree with lots of roots. Wow! Look at that part (dark part). (Kid)
- 8- Root-like things. I can actually see the fungus [points to the square]. It's almost solid.
- 9- It has veins, too. It has little veins coming out of big ones. (Kid)
- 10- Oh, we saw these before. Intricate network of veins and stuff. Central stuff. They branch off. (Teen)
- 11- Looks kind of like veins. All are interconnected. Looks like a leaf.

4/11 - Extraneous elements to the slime mould, such as condensation or the square piece of paper used to start the slime mould growing.

- 2- All the bubbles [condensation]. Similar veins are protruding to form a central location. I don't see any motion or movement. I don't know what the square is [blotting paper].
- 5- Looks like it's foggy.
- 6- Looks like a tree with lots of roots. Wow! Look at that part (blotting paper). (Kid)
- 8- Root-like things. I can actually see the fungus [points to the square]. It's almost solid.

3/11 - Colors or shapes within the slime mould other than branching characteristics

- 1- I think this is from the chicken display. There's these dots. I don't notice that they're moving.
- 3- It's white. It keeps growing. It has lots of veins. (Kid)
- 8- Root-like things. I can actually see the fungus [points to the blotting paper]. It's almost solid.

2/11 - Not moving

- 1- I think this is from the chicken display. There's these dots. I don't notice that they're moving.
- 2- All the bubbles [condensation]. Similar veins are protruding to form a central location. I don't see any motion or movement. I don't know what the square is [blotting paper].

2/11 - Other

- 4- It kind of looks like an eyeball. (Kid)
- 7- I'm not really good at science.

Roots

Take a look at all four of these things, what do you notice about them?*

- *8/11 of the visitors noticed and identified the roots as roots*
- *6/11 of the visitors noticed the hairs on roots*
- *3/11 of the visitors noticed that the roots were branching out*
- *3/11 of the visitors noticed parts of the plant besides the roots or hairs on the roots*

8/11 - Noticed and identified the roots as roots but did not comment on their branching pattern

- 3- You've got a bean between nails. It's growing. I see the root structure. (Kid)
- 4- It has roots. (Kid)
- 5- All the roots are sticking out.
- 6- It has roots. If you look carefully you can see root hairs. (Kid)
- 8- Roots.
- 9- Roots and smaller roots coming off of big roots. It looks fuzzy. (Kid)
- 10- Tap root. Little hairs. (Teen)

6/11 - Hairs on roots

- 1- All these hairy things. They have the fuzzy things all over but at the ends.
- 2- Branching out again with the roots. Furry things on the roots.
- 6- It has roots. If you look carefully you can see root hairs. (Kid)
- 9- Roots and smaller roots coming off of big roots. It looks fuzzy. (Kid)
- 10- Tap root. Little hairs. (Teen)
- 11- Has little hairs. Little bubbles. Definitely not as exciting as the chick embryo.

3/11 - Noticed that the roots are branching out

- 2- Branching out again with the roots. Furry things on the roots.
- 5- All the roots are sticking out.
- 9- Roots and smaller roots coming off of big roots. It looks fuzzy. (Kid)

3/11 - Other parts of the plant besides the roots or hairs on the roots

- 3- You've got a bean between nails. It's growing. I see the root structure. (Kid)
- 7- It's in water. It's starting to grow.
- 11- Has little hairs. Little bubbles. Definitely not as exciting as the chick embryo.

Blood Vessels

Take a look at all four of these things, what do you notice about them?*

- *12/14 of the visitors noticed that they were looking at blood vessels/veins/lines of the eye*
- *2/14 of the visitors noticed the branching pattern of the blood vessels*
- *2/14 of the visitors noticed lines but didn't relate them to blood vessels in the eye.*

12/14 - That they are blood vessels/veins/lines of the eye

- 1- Black lines. Like squiggles. (K: What are they?) The lines of my eye.
- 2- Like lines. Little branching things. Blood vessels. I can see the imprint.
- 3- I can see the veins in my eye (Kid, 11).
 - I can see the eye veins in there (Kid, 13).
- 5- Little blood vessels. They're not red.
- 6- You can see the veins in my eye. (Kid)
- 7- I see blood vessels. It's really cool.
- 8- See blood vessels. Look kind of soft. Kind of reddish.

9- Blood vessels. Smaller veins. (Kid)

10- That's kind of cool. You can see vessels. They're black. You can see them branch off with a white background. (Teen)

11- Looks like veins. That is cool! Wow!

2/14 - Noticed branching pattern of the blood vessels

2- Like lines. Little branching things. Blood vessels. I can see the imprint.

10- That's kind of cool. You can see vessels. They're black. You can see them branch off with a white background. (Teen)

2/14 - Noticed lines but didn't related them to blood vessels in the eye.

3- Little lines. I don't know what they're for (Kid).

4- A lot of lines. (Kid)

Chick Embryo

Take a look at all four of these things, what do you notice about them?

- *7/11 of the visitors noticed veins branching to/from the embryo*
- *2/11 of the visitors noticed parts of the embryo but not the branching veins*
- *2/11 of the visitors asked if the embryo was dead*

7/11 - Veins branching to/from the embryo

1- There's more of an embryo. All these red lines. It's pulsing. Do you have to change this every day? Do the red lines nourish the chick?

2- Thought I saw something thumping in the middle [chick heart]. That's a heart, I guess. (K: What do you notice about the whole thing?) It looks gross. Veins are branching out from it. I assume it is an embryo from a chick egg. There's the heart and the eye.

3- It's got a chicken and lots of blood veins. (Kid)

6- I saw over there the heart was beating. [at the chick embryo exhibit]. It has veins and stuff. (Kid)

8- A heart. Blood vessels. Yolk.

9- Little veins. It has a baby in it. Is it fertilized? It looks like it is. It has a lot of colors. It has a heart beat. (Kid)

10- Blood vessels. A little sac. Color changes. There's a central point. (Teen)

2/11 - Parts of the embryo but not the branching veins

4- It looks like a little heart. (Kid)

11- There's a heart beating. I see a little eyeball.

2/11 - Wondered if the embryo was dead.

5- Is it dead?

7- It looks like it's dead. It looks like something people could learn from.

What do you think these four things have in common? Why?

Additional question: Do you notice any similarities in shape, pattern, or form? What?

(Note: The additional question was only asked if the first question did not draw a response about similar shape, pattern, or form in the four elements)

- *7/11 of the visitors noticed that all four elements had veins, vessels, or lines but they didn't elaborate to say that they all branched, or that the veins, vessels, or lines had a common purpose.*
- *4/11 of the visitors noticed that all four elements shared a branching pattern*

7/11 - Veins, vessels, lines

- 1- The line things. They all had that. (K: Additional question) Just the lines.
- 4- They all have little things that look like roots. (K: Additional question) Lines. (Kid)
- 6- They all had veins. (Kid)
- 7- They all have vessels.
- 8- They all had something like vessels. Same kind of structure.
- 9- They all have veins. They're all kind of alive. (Kid)
- 11- They all sprout out. They look like veins.

4/11 - Branching pattern

- 2- A similar structure. Veins branching out. I don't know if they're all blood vessels. But thing are branching out in all of them. (K: Additional question) Kind of lines branching out from the center form. They all form from the center except the eye one.
- 3- Veins. That's their blood system. Plants get food. It's how you live. (K: Additional question) They all have veins that connect to other veins. They all have a base. (Kid)
- 5- They have little vein things. (K: Additional question) They all have stuff branching off.
- 10- All of them have things branching off of a main thing. (Teen)

Do you think that shape, pattern, or form is prevalent in nature? Why or why not?

- *11/11 of the visitors thought that branching is prevalent in nature.*
 - *8/11 stated that the purpose of branching was for nutrient circulation and delivery.*
 - *4/11 stated that the purpose of branching was to carry outside nutrients or water in to the organism.*
 - *Additionally, 4/11 of the visitors said that branching helped to circulate nutrients throughout the organism.*
 - *1/11 stated that the purpose of branching was to increase surface area and to stabilize and secure the organism.*
 - *3/11 of the visitors did not explain why branching is prevalent.**
- *3/11 of the visitors spontaneously cited an example of branching other than the chosen exhibit elements.*

4/11 - To carry outside nutrients and/or water in to a central source

- 1- I guess so. I imagine the roots feed the plant. Capillaries carry blood. Same for the chick [carry blood]. I don't know anything about fungus.
- 2- Leaves have it. The body has a nerve system. Maybe it's a way of gathering. Maybe it's about nutrients. More surface area to bring in stuff. A securing device. Maybe it helps keep the egg attached to the yolk. It's a way to get nutrients to it. The longer the veins get the finer they are.
- 3- Yes. It brings blood to the chick. It brings water to the plant. To the eyes it brings blood. It connects outside parts to main part. (Kid)

6- God made them all alike. Without them they couldn't live. The roots bring the water to the plant. (Kid)

4/11 - To circulate nutrients throughout/within the organism

1- I guess so. I imagine the roots feed the plant. Capillaries carry blood. Same for the chick [carry blood]. I don't know anything about fungus.

2- Leaves have it. The body has a nerve system. Maybe it's a way of gathering. Maybe it's about nutrients. More surface area to bring in stuff. A securing device. Maybe it helps keep the egg attached to the yolk. It's a way to get nutrients to it. The longer the veins get the finer they are.

8- In a system of transport all things have main lines or other lines. Railroads work the same way. (Baby starts crying; visitor cuts interview)

11- Everything has veins to pump nutrients through the organism.

3/11 - Didn't say/gave other reasons

4- Yes. A lot of things have lines. (Kid)

5- Leaves of plants have those patterns. Skin has a similar pattern.

7- Everything has vessels.

1/11 - To increase surface area, and to stabilize, support, and secure the organism

2- Leaves have it. The body has a nerve system. Maybe it's a way of gathering. Maybe it's about nutrients. More surface area to bring in stuff. A securing device. Maybe it helps keep the egg attached to the yolk. It's a way to get nutrients to it. The longer the veins get the finer they are.

Actually, these four living things are similar in shape, pattern, and form. This pattern (point to each) is called branching and it is often found in nature; (Developer or evaluator shows visitors where branching occurs in each of the exhibit elements.) Why do you think these branching patterns are prevalent in nature?

- *3/7 of the visitors stated that the purpose of branching is to circulate and import nutrients into an organism.*
- *4/7 of the visitors did not state why branching is prevalent in nature beyond stating that it is just a part of nature.*

3/7 - Nutrient circulation/importation

2- It depends on the context. I don't know if veins are a way of getting food. I don't know if it's a way of finding more moisture. Maybe it grows to a more nutrient rich part of the yolk for the chick embryo. For the eye, I have no idea.

3- Like the tree. It starts with a seed. Then it goes to the roots. It needs nutrients. Veins go out to get them. (Kid)

10- To grow. The root has them for the surface area. The chick embryo has them because it needs to grow and create. The slime mould has them for more surface area. The blood vessels have them because we need to see and everything needs to be supplied through them. (Teen)

4/7 - Don't know/ Just a part of nature

1- I don't know.

4- It's just a part of nature. (Kid)

- 5- Because things grow that way, in a random direction.
- 6- Because without them, they couldn't live. (Kid)

Can you think of other examples in nature when branching occurs?*

- *8/9 of the visitors were able to cite other examples in nature when branching occurs. (Note: 3 out of the 11 respondents to the previous question spontaneously cited other examples where branching occurs in nature before being asked to do so. Another visitor cited another example of branching later in the interview when asked for suggestions about how to make the exhibit better. These responses (N=13) have been combined along with the direct responses to this question.)*

- *Examples of branching cited by visitors:*

- *8/13 - The human body and animals— the nervous system, skin, blood system*
- *6/13 - Trees*
- *6/13 - Plants besides trees or parts of trees, such as leaves*
- *3/13 - Human built structures (e.g., flying buttresses, railroads, freeways)*
- *2/13 - Cellular and sub-cellular examples (cells, neurons, etc.)*
- *1/13 - Crystals*

1- I was going to say **trees** but I guess that's really similar to this. **Grapes**. The rest of **your body**.

2- **Leaves. Roots of trees. Vein structure in people**. That's all I can think of.

3- A **tree**. In your **arm [veins]**. A **leaf**. (Kid)

4- Humans have the **heart and veins**. **Aspen trees** like we have in Utah. (Kid)

5- **Trees. All plants** have branches. **Animals** have branching. (K: Where?) In their **cells. Hair** branches.

6- No. (Kid)

7- Maybe in the **neurons in your brain**.

10- **Trees. Support systems. Flying buttresses**. (Teen)

11- Even **crystals** branch. **Blood vessels. All living things**.

- *3 spontaneously cited "other" examples of branching from the previous question:*

2- **Leaves** have it. The **body** has a nerve system. Maybe it's a way of gathering. Maybe it's about nutrients. More surface area to bring in stuff. A securing device. Maybe it helps keep the egg attached to the yolk. It's a way to get nutrients to it. The longer the veins get the finer they are.

5- **Leaves** of plants have those patterns. **Skin** has a similar pattern.

8- In a system of transport all things have main lines or other lines. **Railroads** work the same way. (Baby starts crying; visitor cuts interview)

- *A spontaneously cited example of branching from question asking for suggestions about how to make this exhibit better:*

5- Maybe an example that people can relate to in the physical world, like a **freeway**. And how it branches to your house. Relate it to something you know.

(Note: Interviews #8 and #9 left after this question.)

How do you think these living things benefit from branching?

- *3/7 of the visitors thought that living things benefit from branching because it helps with nutrient circulation and importation*
- *2/7 of the visitors thought that branching helps living things to grow*
- *2/7 of the visitors thought that branching keeps living things alive but did not elaborate*

3/7 - Nutrient circulation, importation

- 1- They carry necessary materials through to it in an efficient way.
- 3- They're healthier. They get more nutrients. (Kid)
- 4- For the roots, it helps them grow and get water. (Kid)

2/7 - Helps living things to grow

- 5- Living things have to grow.
- 6- So they can grow. (Kid)

2/7 - Helps living things in general

- 7- It helps blood flow and stuff like that. You need blood vessels.
- 11- Branching keeps things alive. It keeps things from dying.

Was anything confusing to you?*

- *6/9 of the visitors found something to be confusing about the exhibit*
Of the 6 visitors who found something to be confusing:
 - *3/6 were confused by the slime mould*
 - *2/6 were confused by blood vessels of the eye*
 - *1/6 were confused by the pinto bean roots*
- *4/9 did not find anything to be confusing about the exhibit*

6/9 of the visitors found something to be confusing about the exhibit

3/6 were confused by the slime mould

- 1- No. I didn't know what that [slime mould] was.
- 2- Just the square on the slime mould. The blood vessels were hard to get down. I thought lines on the black background were what I was supposed to see.
- 5- Slime mould. I didn't know what I was looking at.

2/6 were confused by blood vessels of the eye

- 2- Just the square on the slime mould. The blood vessels were hard to get down. I thought lines on the black background were what I was supposed to see.
- 3- You couldn't get the blood vessels in your eye right off the bat; Didn't know what it was. (Kid) No. If someone walked up and didn't know what they were looking at, it would be confusing. (Kid)

1/6 were confused by the pinto bean roots

- 11- I didn't know what I was supposed to see with the plant. I liked the eyeball. The chicken embryo was cool, too.

4/9 did not find anything to be confusing about the exhibit

- 4- No. (Kid)
- 6- No. (Kid)

7- At first I didn't know what was happening. Usually I don't take the time to look at the directions on exhibits.

10- No. (Teen)

What questions do you have about this exhibit?*

- *5/8 of the visitors had questions about why and how living things branch*
- *7/8 of the visitors had questions about specific exhibit elements:*
 - *2/7 of the questions were about eye blood vessels*
 - *2/7 of the questions were about the lime mould*
 - *2/7 of the questions were about the chick embryo*
 - *1/7 of the questions were about the root*

1- Where else do you have branching in nature? Why is branching prevalent in nature? I was just reading about human embryos. They said you can use embryos to test for humans. Can you test other branching things to test in others?

2- Why do things branch? What are other examples that are neat? What purposes (Nutrition, grounding, etc.) do branches have? What are branches made of? Do they reproduce if you cut off the roots? Why are the blood vessels in your eye? When you're tired or drunk do the blood vessels get bigger or do they just look that way?

3- How do they all start branching? (Kid) What causes them to branch? How do they know to branch? (Kid)

4- Where does the slime mould grow in nature? What's going on in the yolk? (Kid)

5- Why do things branch?

6- How does it [capillaries] branch to the eye? (Kid)

10- How big can root systems get? Why do they stop branching? (Teen)

11- How did we get the chick embryos in the dish without breaking it? How old is the chick embryo? How long did it take to grow the slime mould? How come slime mould moved over to one side?

What do you think of this exhibit idea?

- *7/8 of the visitors found the exhibit idea to be interesting. 5/8 of the visitors elaborated to say that the exhibit idea was interesting because of the interrelatedness of the different exhibit elements.*
- *1/8 of the visitors found the exhibit to be "interesting but not that interesting."*

1- I like it. I didn't notice the branching in the chick embryo exhibit. I didn't notice the red things either. It's interesting that there's similarities between blood vessels and fungus.

2- I think it's neat. I like the recurring things.

3- It's neat because these are all related. It's good to know your eye and everything is the same. (Kid)

4- Interesting because it's a common thing. I like it. (Kid)

5- Is it just on branching? On why thing branch? It's interesting but not that interesting.

6- It's neat that the slime mould came from one cell. (Kid)

10- It's cool that you can make the connection between the different things. (Teen)

11- It's pretty neat. Everything in this building is really great.

Do you have any suggestions for how to make this exhibit better?

- ***Suggestions for how to make the exhibit better included suggestions about individual exhibit elements, adding more or different exhibit elements, and making the exhibit more interactive in general.***

- 1- I especially liked the blood vessels because it makes it relevant to you.
- 2- Branches are not clear in the slime mould. It would help if you saw the things travelling through the veins in the microscope in the slime mould. In the eye, I didn't know what the blood vessels were for. I never thought they had a reason for being there.
- 3- Have something you can touch. Put a sign up that says that these are all related. Make it more of an eye opener. Make it more colorful. More hands on stuff that you can touch. Something that is more noticeable. Say what each one is. Have answers at the bottom.
(Kids)
- 4- No. I like the close up with the magnifying glass and the chick embryo. (Kid)
- 5- Maybe an example that people can relate to in the physical world, like a freeway. And how it branches to your house. Relate it to something you know.
- 6- Have a visual picture of eye veins.
- 10- Use more examples. Use the heart instead of the eye blood vessels. (Teen)
- 11- Now that I understand what the root is about, I think it's good. That was the least interesting part- the root. The chick embryo is amazing.

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