

# Traits of Life - Study B: Asking for Visitors' Commonalities

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# Traits of Life Front-end Evaluation: Study ‘B’ Asking for Visitors’ Commonalities

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## Appendix (not included in web-based report)

Verbatim responses, listed by question

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### 1. Introduction

This report describes Study B, the second of two studies that constitute the front-end evaluation for the “Traits of Life” project, conducted in August 1999.

### 2. Goals

The goal of the two front-end studies was to get a sense what visitors believe to be the commonalities (if any) among all living things. The goal of this particular study was to find what characteristics visitors think of as common to life, and to what extent their versions differ from ours.

### 3. Props for Interview

A small but diverse group of living things were shown to visitors during this interview. The living things displayed on a table were:

- 2 medium grasshoppers
- 3 zebrafish
- 1 slime mould in a petri dish
- photobacteria on a slide under a wentzscope
- 1 african violet
- bacteria in a container growing in mud from the lagoon

At the outset of the interview, the interviewer pointed to each in turn, naming it and providing a brief description only if the visitor asked or expressed confusion.

### 4. Interview Questions

The interview was composed of five questions and one sub-question (indented below). Taken as a group, the questions probed the visitors to think of commonalities in a variety of ways, including considering living things on a large and small scale, and thinking about structural and chemical components of them.

The questions were:

- 1) Thinking of all the different living things in the world, not just these on the table but all of the different living things there are, can you think of anything that they all have in common?
- 2) How about if you imagine looking at parts of living things through a really powerful microscope—even more powerful than this one. Do you think all living things would have anything in common if you looked at them on that tiny scale?
- 3) Thinking about the different stuff that makes up living things, like the chemicals or other substances that are inside them, do you think that there's any chemical, or substance, or stuff, that's common to all living things?
- 4) Now thinking about the different shapes and structures and parts of living things, do you think there are any structures or shapes that are found in all living things?
- 5) How about microscopically small things—do you think there are tiny structures or shapes or objects that might be common to all living things?  
 How about anything slightly larger / smaller than \_\_\_\_\_ [using example provided by visitor from previous question]. Do you think there are any tiny structures or shapes or objects that are larger / smaller than \_\_\_\_\_ [same example as above] that are common to all living things?

## 5. Methods

A total of 40 people were interviewed between July 28, 1999 and August 15, 1999. The interviews were conducted between 11:15 AM and 5:00 PM. 20 of the interviews were conducted on a weekday and the remaining 20 were conducted on weekends. 13 of the interviewees were children (aged 10–16) and the remaining 27 were adults (aged 17 and over). 19 males and 21 females were interviewed. 2 out of the 40 participants spoke English as a second language.

Interviewees were chosen by a systematic sampling process. The interviews were conducted at Bay 7 between the “Skeleton in a Closet” exhibit and the Sea Hare Tank. The typical interaction lasted approximately 15 minutes.

Responses were recorded as close to verbatim as possible. After gathering the data, we coded the responses based on the content of the commonalities visitors thought of.

In the analysis, we decided not to separate the responses according to which question visitors were answering, because visitors’ responses tended to spill out beyond the boundaries of the questions posed. Instead, we chose to treat the entire interview as a single question with multiple probes, and we analyzed it on the basis of the range of commonalities visitors were able to think of during the interviews. The exception to this is the special analysis made of answers to the first question, which was deliberately kept very open in order to determine which commonalities first came to mind for visitors.

## 6. Findings

### Behavioral commonalities

In answering the first and most open-ended question, “Can you think of anything that all living things have in common?” both children and adults most often replied by giving one or more behavioral commonalities. By “behavioral commonalities,” we mean anything that living things do (such as grow or move). Very often, these were closely tied to specific needs (such as eating to get energy). Charts 1 and 2 summarize these behavioral commonalities, as given by visitors at any point throughout the interview.

For both adults and children, the most frequently suggested behavioral commonality was eating, or needing food. This was followed by breathing and moving. The category “needs good environment” has been included as a behavioral category, but it is a rather broader set of concepts than the others, mostly focusing on the interdependence of living things and the need for a specialized habitat. It is interesting to note that the adult and children patterns of responses in the “behavioral” category are very similar, even in terms of actual percentages. This contrasts with most front-end studies (and the latter parts of this one) which show children knowing significantly less than adults.

### Structural commonalities

Because the interview was (deliberately) heavily weighted toward the “common design” theme currently under development, there were many opportunities for visitors to think of common structures, shapes, or objects. In particular, questions 2,4, and 5 all ask visitors to think about structural commonalities at various scales.

Charts 3 and 4 summarize the structural commonalities that visitors said were common to all living things. Once again, these charts summarize responses throughout the interview. The charts show that, for both adults and children, the most frequently given structures common to all living things were cells. This was stated by fully 78% of adults and 46% of children.

Among adults, a minority named some universal subcellular structures, such as the cell’s nucleus (19%), the cell wall/membrane (30%), and DNA or genetic material (37%). About 30% of both adults and children suggested macroscopic commonalities, such as skin or circulatory vessels or flesh. In several cases, these responses seem to come from visitors considering a subset of living things, namely the larger multicellular animals. On the other hand, two visitors in this category talked of commonalities that applied more to unicellular or microscopic organisms. Several others talked in general about structural properties and functions more generally.

There were two unexpected categories of response. One was the “geometric shape” responses, where visitors thought of specific types of common shapes, such as circles, lines or rectangles, as being common to living things on a large or small scale. This type of response was probably cued heavily by the word “shapes” in our questions; it was intended to be interpreted rather less literally than as classical geometrical shape. The second unexpected response category was “bacteria,” given by 15% of adults and 8% of children.

### Common substances

Visitors were asked specifically in question 3 if they thought there were any kinds of “chemicals, substances, or stuff” common to all living things. However, some visitors also mentioned common substances in other parts of the interview, and these responses were all pooled to create Charts 5 and 6.

The most frequently mentioned substance found in all living things was water (or in a few cases, “fluid”), which was stated by and 30% of adults and 38% of children. Organic molecules, such as proteins or amino acids, <sup>1</sup>were mentioned by 22% of adults but none of the children; this was the largest single difference between adults and children in the category of universal substances. Among the elements given as common to all living things, carbon was the most frequently mentioned (by 26% of adults and 8% of children).

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<sup>1</sup> This category excludes DNA, which we categorized separately under “structures”

Other elements given by visitors were hydrogen, oxygen, nitrogen, and “traces of magnesium.”

A sizeable minority of visitors also mentioned atoms or even subatomic particles as common to all living things; this was probably heavily cued by the questions asking for tiny or microscopic structures.

#### Visitors’ first thoughts

Charts 7 and 8 show how visitors answered the first (and most open-ended) question about “any kinds of commonalities among all living things.” The great majority of both adults and children (86% and 83% respectively) gave answers in the “behavioral” category, such as eating, breathing, growing, etc. Most of these answers also had the quality of describing the things an organism needs to stay alive. Based on the Traits of Life proposal, these behavioral commonalities could be categorized as primarily relevant to the “*Staying Alive*” trait. Much less frequently mentioned were reproduction (primarily relevant to the “*Passing it on*” trait) and common structures or contents of living things (primarily relevant to the “*Common Design*” trait).

Although it became clear later in the interview that, when prompted, most visitors could name some kind of “common design” commonality, the significance of this result is that the “staying alive” commonalities are what comes to mind first when visitors think of traits of life. In addition, most of the visitors (24 out of 34) who mentioned behaviors gave several kinds of behaviors, not just one.

#### Comments on diversity

It is interesting that, in spite of the interview questions asking only for commonalities, fully 52% of adults and 54% of children spontaneously talked about differences and diversity among living things (e.g., “No, there’s nothing in common; some are vertebrates and some are invertebrates.”) Much of this probably arose as visitors thought of a possible trait, and then wanted to check it to see whether it really was true for all living things. Nevertheless, some of the visitors were quite sophisticated in their thinking about diversity and parallel structures (e.g. “They all have their own specific function... I could say a fish would have blood but this plant doesn’t; it has sap.) Some of the most revealing aspects of visitors’ thinking happened when they were struggling with the tensions between commonalities and differences; perhaps this could be a focus for inquiry in the project going forward.

The list of “noted differences” is given after Chart 8.

## 7. Summary of Findings

### Commonalities related to “Common Design”

Visitors were given several opportunities (questions 2,3,4,5) to think of commonalities specifically related to common design. Overall, 96% of adults and 62% of children were able to suggest some kind of structural commonality (though not necessarily correct). Among both adults and children, the most frequently mentioned common structures were cells (78% of adults, 46% of children). In terms of substances, 74% of adults and 54% of children were able to think of some kind of substance, chemical or “stuff” that is common to all living things. Among both adults and children, the most frequently mentioned substance was water.

### Commonalities related to “Staying Alive”

Both adults and children were much more likely to spontaneously think of commonalities related to “staying alive” than to the other two traits, and they were often able to give many examples (in fact, two visitors gave 5 examples when answering the first question!). Two visitors specifically said that these were the signs of life that they had learned in biology classes. When giving specific behavioral commonalities, adults and children responded very similarly; the most frequently cited commonalities were eating, breathing, and moving.

### Commonalities related to “Passing it On”

This front-end interview did not ask visitors to talk in depth about the knowledge of reproduction, and none did. Those interviewees who did mention it as a commonality (19% of adults and 15% of children) simply listed “reproduction” as one of the behaviors of life, along with eating and breathing. Nobody described universal reproductive mechanisms, either within cells or within populations, and nobody described common behaviors or talked about evolution in any way. This does not mean that visitors do not know such things; all the numbers in this study represent lower bounds to visitor knowledge because we have no idea how many relevant commonalities did not spring to mind for them during the interview. Also, the organisms displayed were mostly single and separated, so it is quite possible that a set of larger aquariums and terrariums might have cued more visitors to talk about ecosystems and/or social behaviors.

### Overall “Traits” framework

In spite of the many methodological constraints on this study, the data suggest that:

- a) Many visitors, even children, can identify some of the key commonalities of life. In particular, the great majority of adults and almost half of the children know that all living things have cells. They also know several of the behavioral commonalities and common needs that organisms have, such as eating, moving, and breathing.
- b) Visitors over a range of ages are likely to be more familiar with behavioral commonalities than structural or substance commonalities.
- c) Visitors are highly unlikely to come in with a mental framework that matches the 3 main traits of the *Traits of Life* project. (Nobody interviewed laid out a pre-existing conceptual framework that was even close to that of the Traits development team.) This does not, however, mean that the individual traits or sub-traits are unfamiliar to visitors.

## **8. Acknowledgments**

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Figure 1

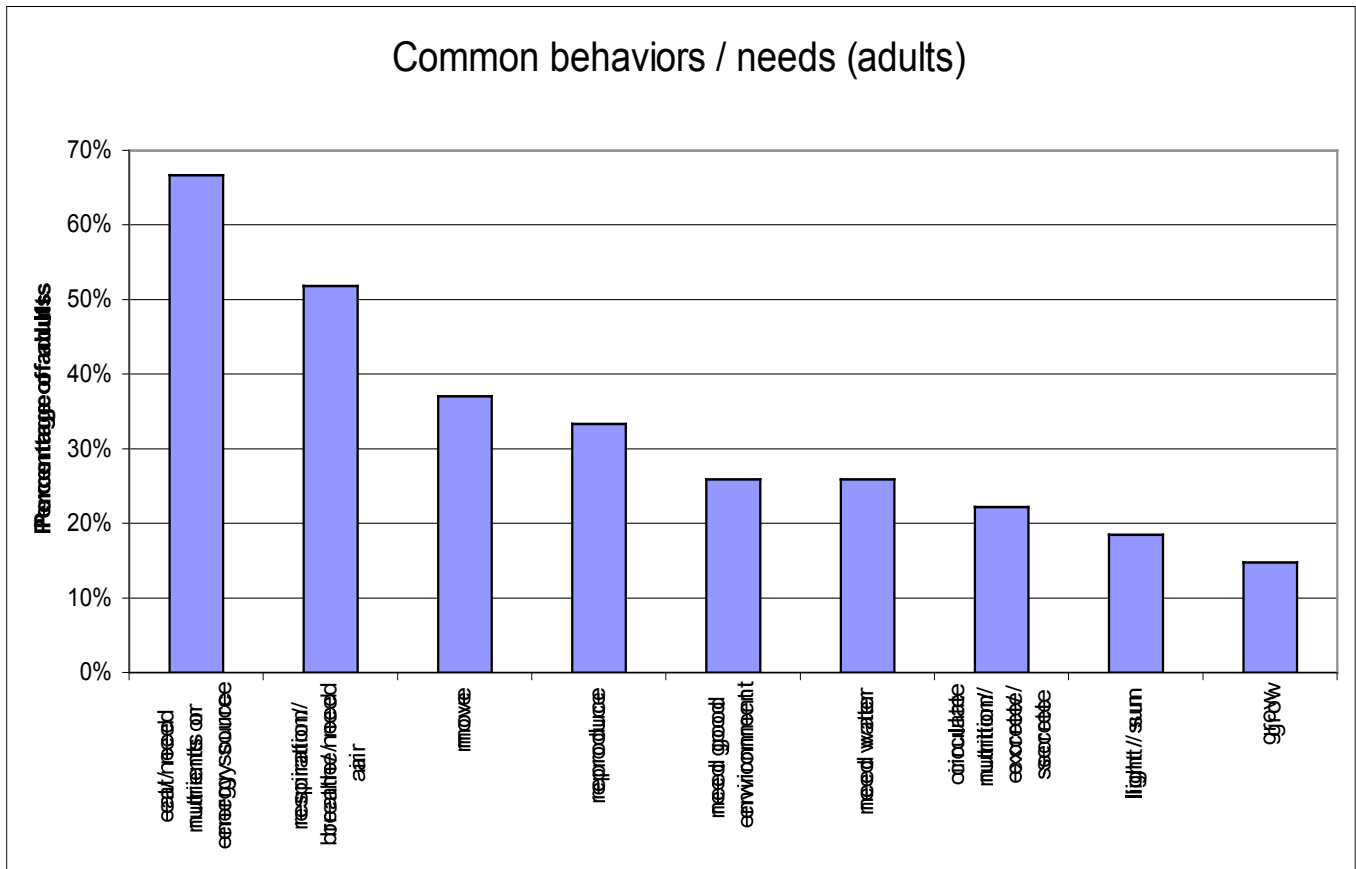


Figure 2

## Common behaviors / needs (children)

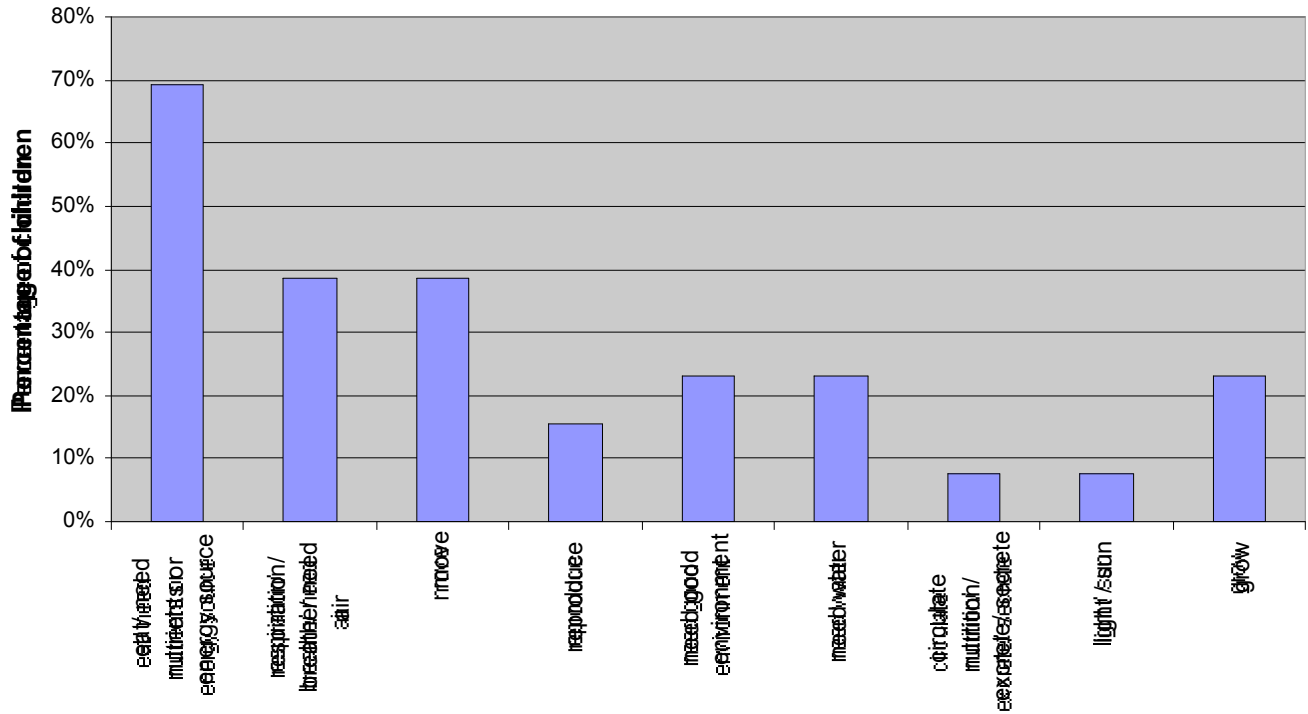


Figure 3

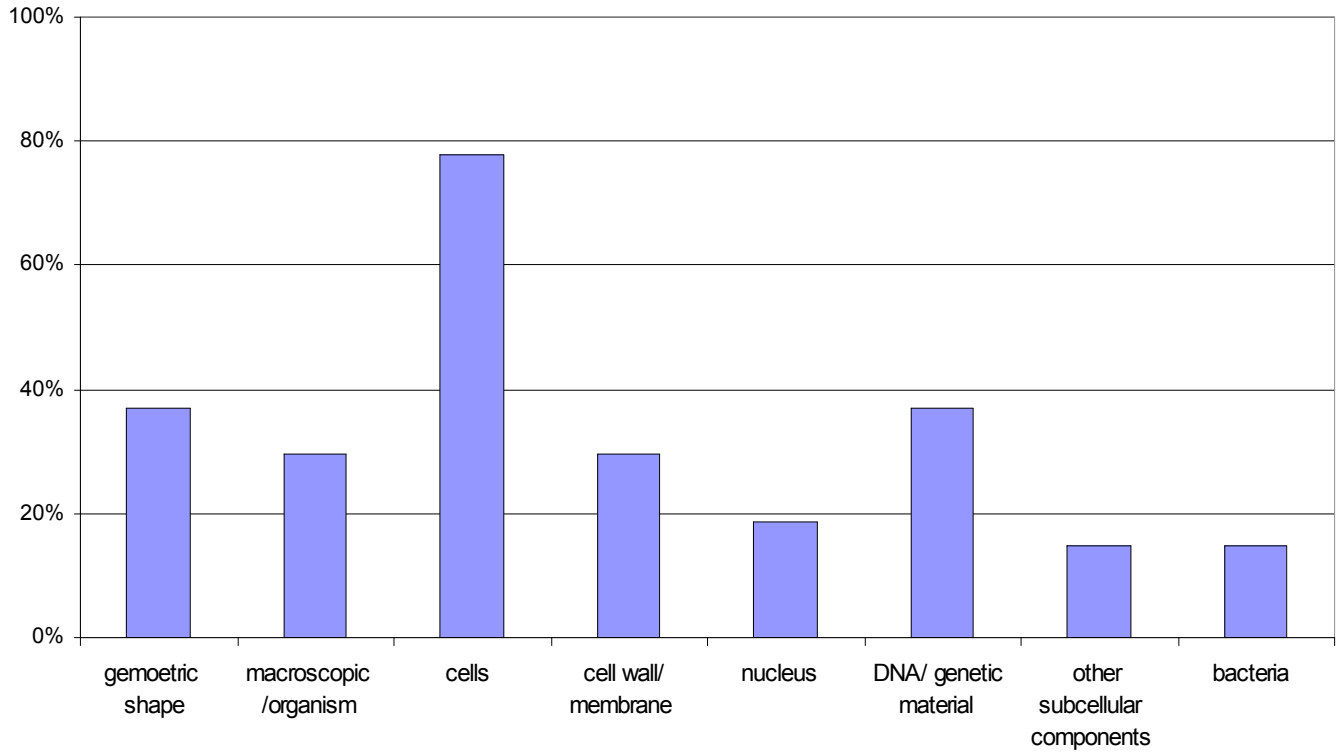
**Common structures / shapes / objects (adults)**

Figure 4

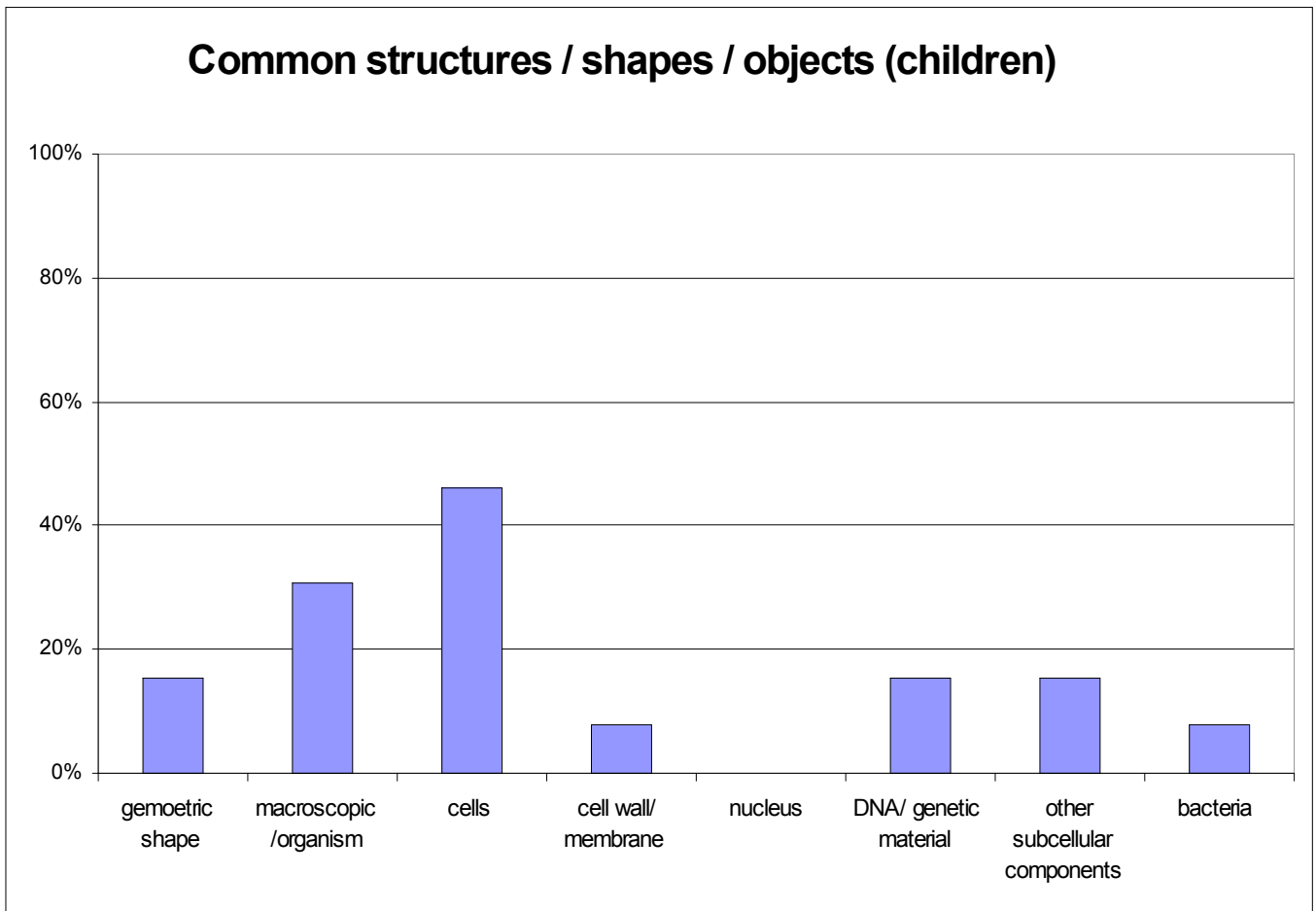


Figure 5

### Common substances (adults)

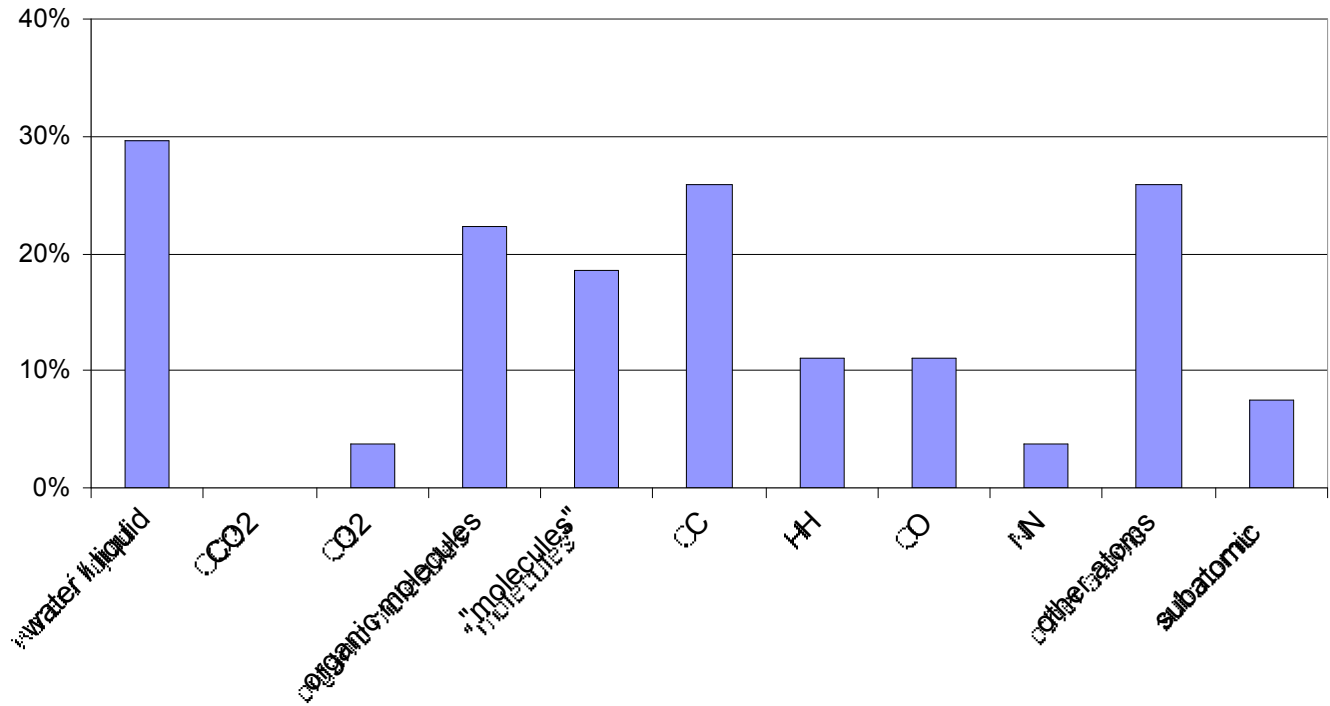


Figure 6

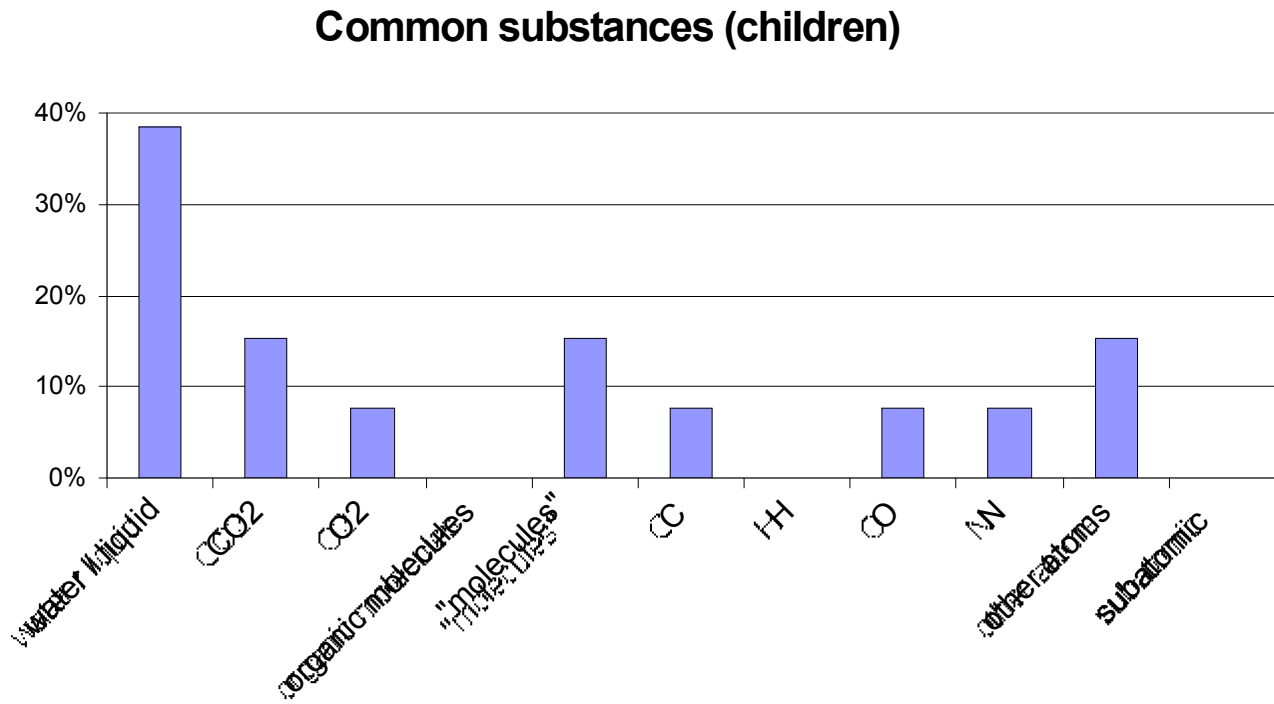


Figure 7

### Spontaneous commonalities given by adults (question 1)

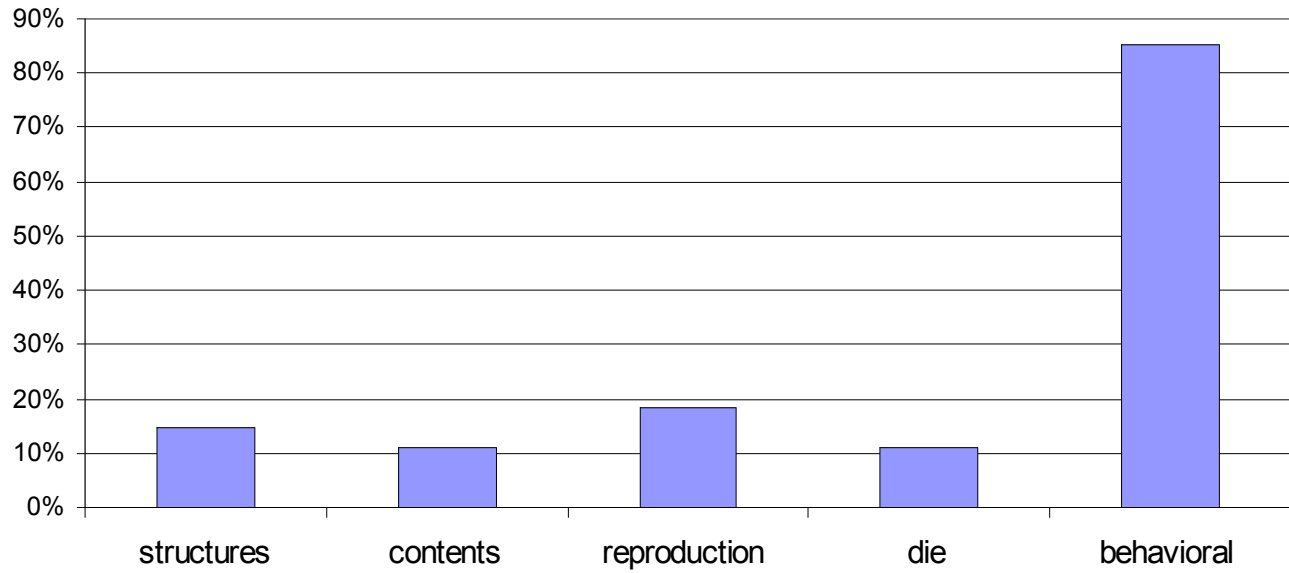


Figure 8

### Spontaneous commonalities given by children (question 1)

