Prior knowledge of young zoo visitors regarding sharks: challenges for Environmental and Science Education?

At the Crossroads of Environmental and Science Education:
Towards an International Collaborative Research Agenda

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Aggressive
Dangerous
Man eaters

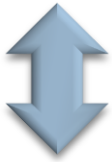
Body board

Poster at airport

Shark attacks are premeditated (Feller 2007)

Goals

- Access the prior knowledge of young zoo visitors about sharks *"How full is your luggage?"*
- Building a Learning Progression Hypothesis (LPH)
- Identify obstacles to the conceptual progression



- Rethinking our educational strategies
- Support our decisions in environmental education and science education

Research problem

What is the prior knowledge of young zoo visitors regarding sharks?

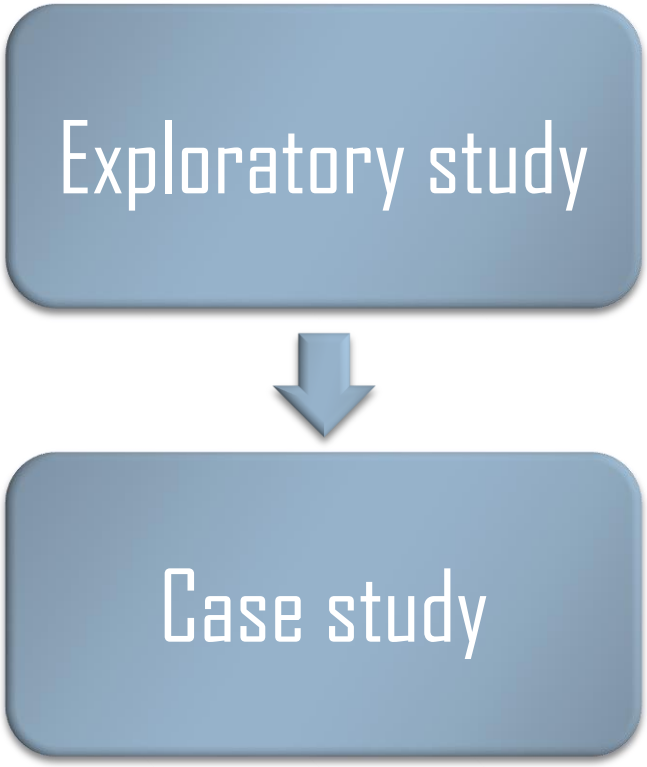
How do visitors' perceptions permit the building of Learning Progression Hypothesis (LPH)?

What are the visitors' obstacles to the conceptual progression?

Research context

- "Shark Week" at Zoomarine park in Portugal
- Question: What is a shark to you?
- 720 drawings from people between 3 and 72 years of age

Research study



Exploratory study

What is a shark to you?

- We filtered 720 drawings by age and content viability - independent of nationality, gender, graphic dexterity or prior knowledge
- 230 children's drawings selected (between 6 and 16 years old)
- Content analysis of drawings – Codification & Categorization

Draft LP Hypothesis

Case study
Stake (2005)

What is a shark to you?

Intentional sample – most rich in information (Patton, 2002)

- 5 children were selected: 8, 11 (x3) and 14 years old

- Drawings and in depth-interviews (semi-structured interviews)

- Content analysis of drawings and interviews – Codification & Categorization

Final LP Hypothesis

Script of interview

Biology

- Which group do sharks belong to?
- How many senses do sharks often use?

Anatomy

- What are the function of the teeth?
- How many fins do sharks have?

Ecology

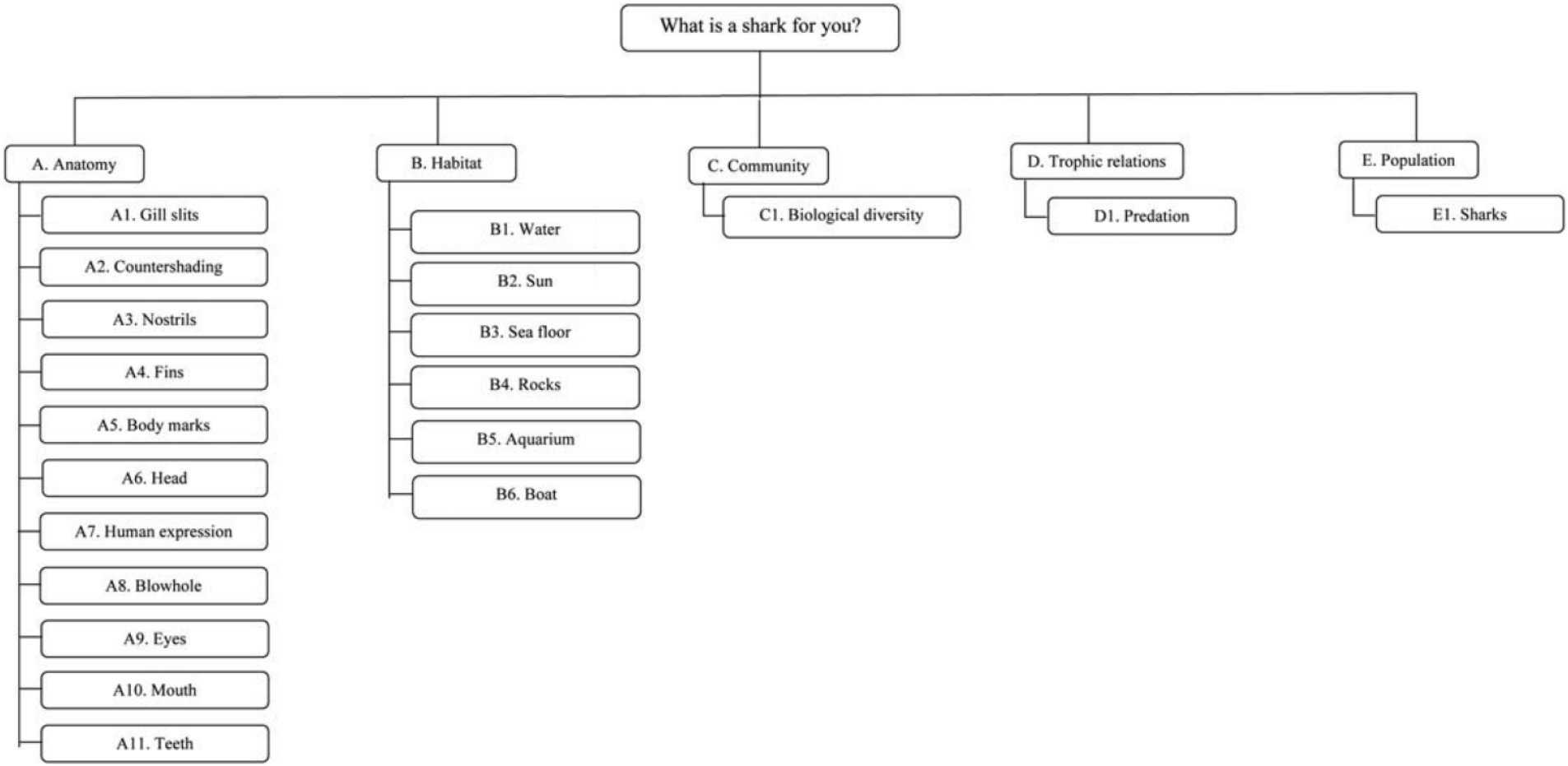
- Are sharks social animals?
- Are sharks important for the oceans?

Environment

- Where do sharks live?
- Are there sharks in Portugal?

Exploratory study

5 categories and 19 subcategories

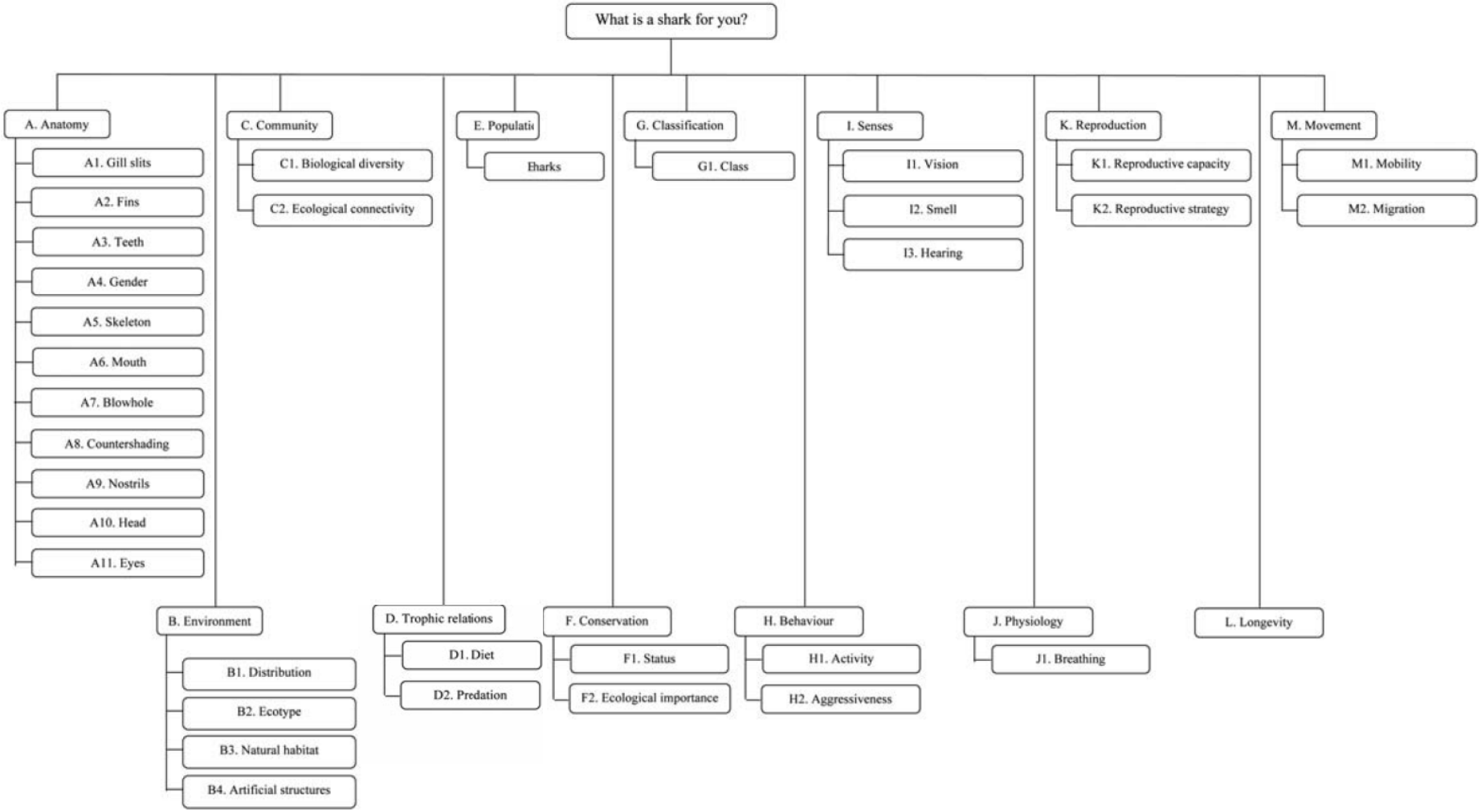


5 Categories

- Anatomy
- Habitat
- Community
- Trophic relations
- Population

Case study

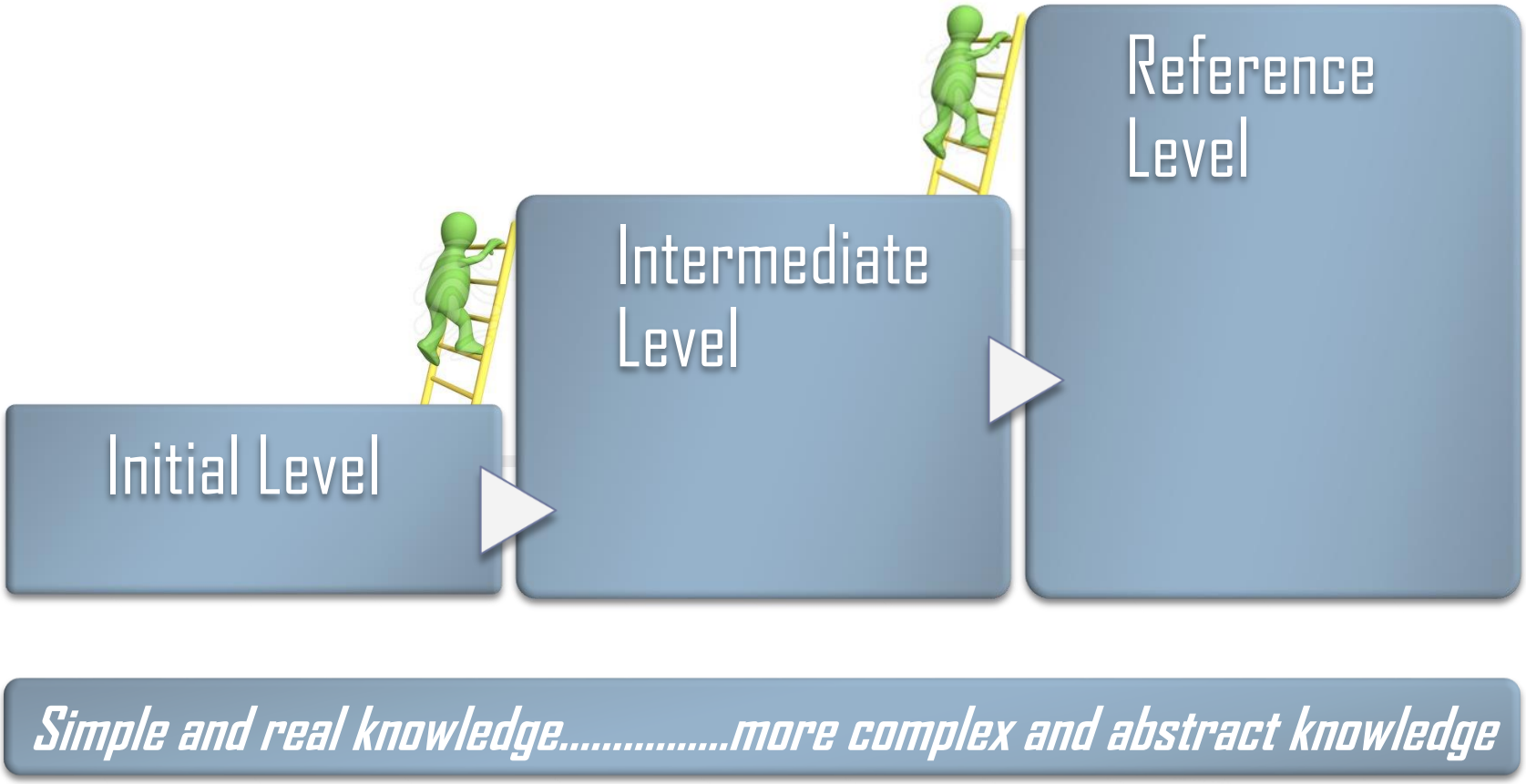
13 categories and 13 subcategories



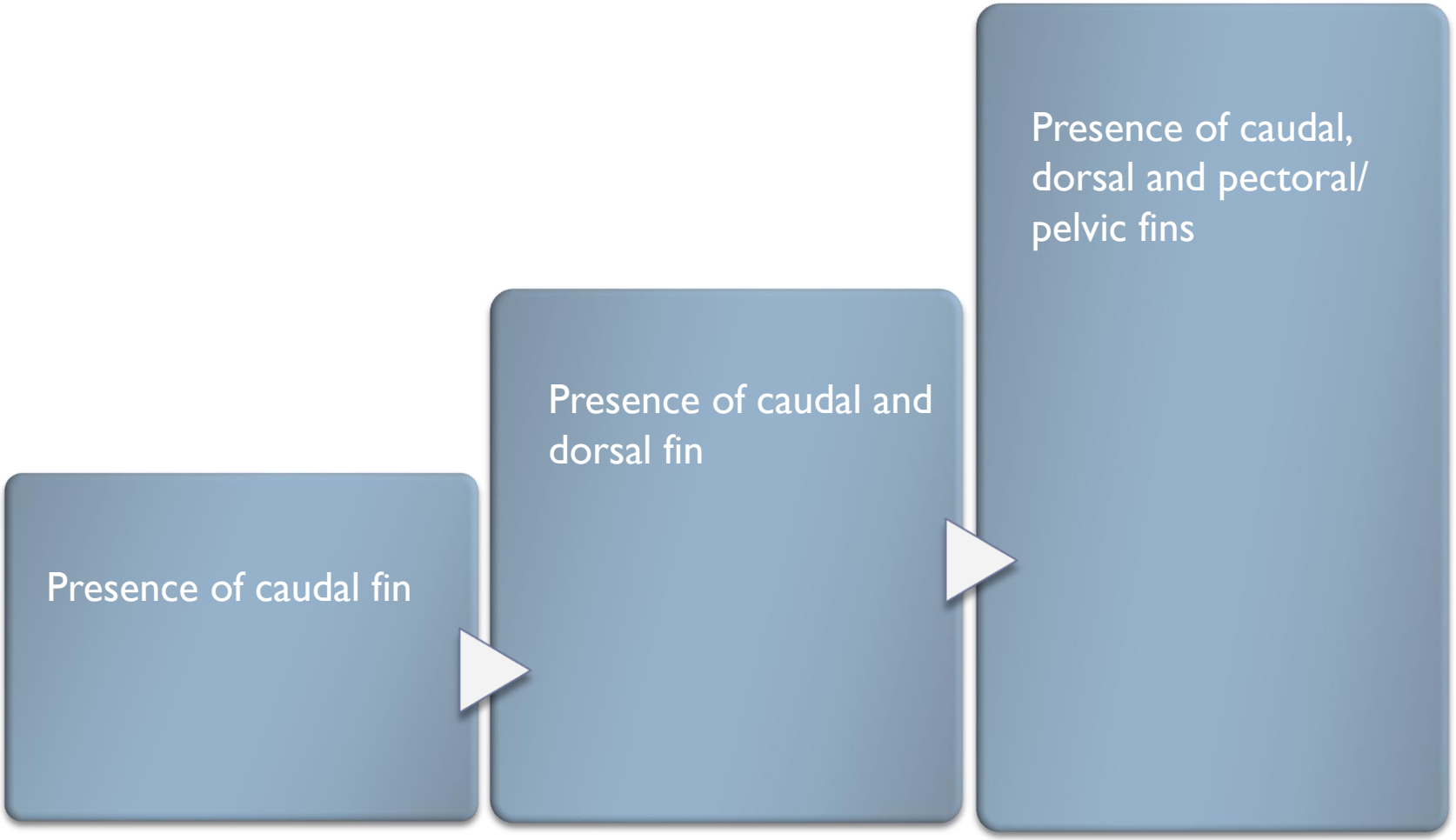
13 Categories

- **Anatomy**
- **Community**
- Population
- **Classification**
- Senses
- Reproduction
- Movement
- **Environment**
- Trophic relations
- Conservation
- **Behaviour**
- **Physiology**
- Longevity

LP Hypothesis
Progressive conceptualization scale with 3 levels



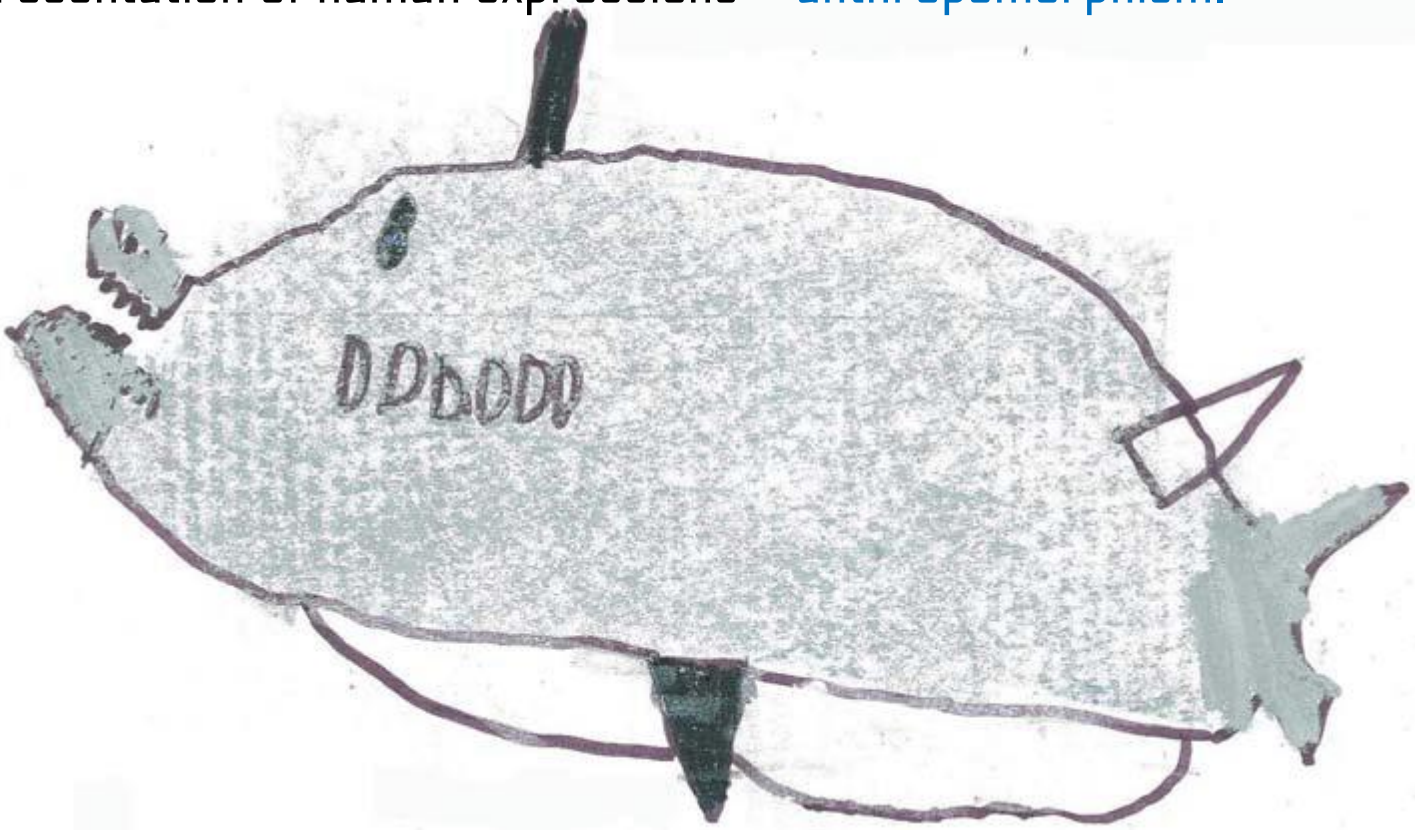
LP Hypothesis – Sharks' Anatomy



Initial level	Intermediate level	Reference level
Presence of caudal fin	Presence of caudal and dorsal fin	Presence of gill slits
Red coloured teeth	Fins related to propulsion, hydrodynamis and swimming	Presence of caudal, dorsal and pectoral/pelvic fins Fins related to maneuverability
Teeth related to chewing	Teeth and mouth related to feeding	Sharp teeth
Colour based sexual dimorphism		Periodic teeth replacement
Bony skeleton		Teeth morphology and function related to feeding
Disproportioned head		Cartilaginous skeleton
Red coloured mouth		Representation of half-open and closed mouth
Presence of blowhole		Countershading
Blowhole related to gas exchange		Presence of nostrils
Head detach from body		Proportioned head size
Human face expressions		
Water ingestion through the mouth		
Disproportioned eyes		

Category Anatomy – Initial level

- The presence of neotenic characteristics: head detached from the body, disproportionate eyes and/or the presence of rectangular teeth and the representation of human expressions – anthropomorphism.



Category Anatomy – Initial level

- The presence of blood on the teeth and mouth - negative vision of the shark.
- The teeth are associated with chewing, a process absent in sharks.
- The concept of a skeleton made of bone may be in close relation to the participants' personal and common knowledge.

Category Anatomy – Intermediate level

- The drawing and verbal representation of the sharks contemplates the presence of a more comprehensive, though not entirely accepted (from the biological and/or ecological standpoint), vision of sharks, such as the representation of the dorsal and caudal fins. The fins' function, though more contextualized, is only restricted to propulsion or hydrodynamism – it is not, however, associated with reproduction or aquatic stability.

Category Anatomy – Intermediate level

- The mouth is exclusively associated with feeding, without any reference to gas exchange processes. *"They use their mouth to eat".*
- The teeth are also associated with feeding processes, that is, to capture prey. *"To bite … to kill".*

Category Anatomy – Reference level

- The shark has a properly sized head (when compared to its body), including the representation of one or both eyes in proportion to the rest of its head, including the gill slits.

- Sharks have, at least, three different types of fins (caudal, dorsal and pectoral/pelvic), whose functions include manoeuvrability, in addition to swimming and/or propulsion.

Category Anatomy – Reference level

- The mouth, represented either semi-open or closed, includes sharp teeth. We see evidence of the concept of teeth with periodic replacement,

  "They (the teeth) are sharp and when one falls, another one appears" and their function is associated with predation and feeding.

Category Anatomy – Reference level

- This level also included the aesthetic perception of small holes in the rostrum area (nostrils), although with no real sense of its function (olfaction).
- Colour differences between the dorsal and ventral areas are considered, although without any real knowledge regarding their function (counter-shading and mimicry).

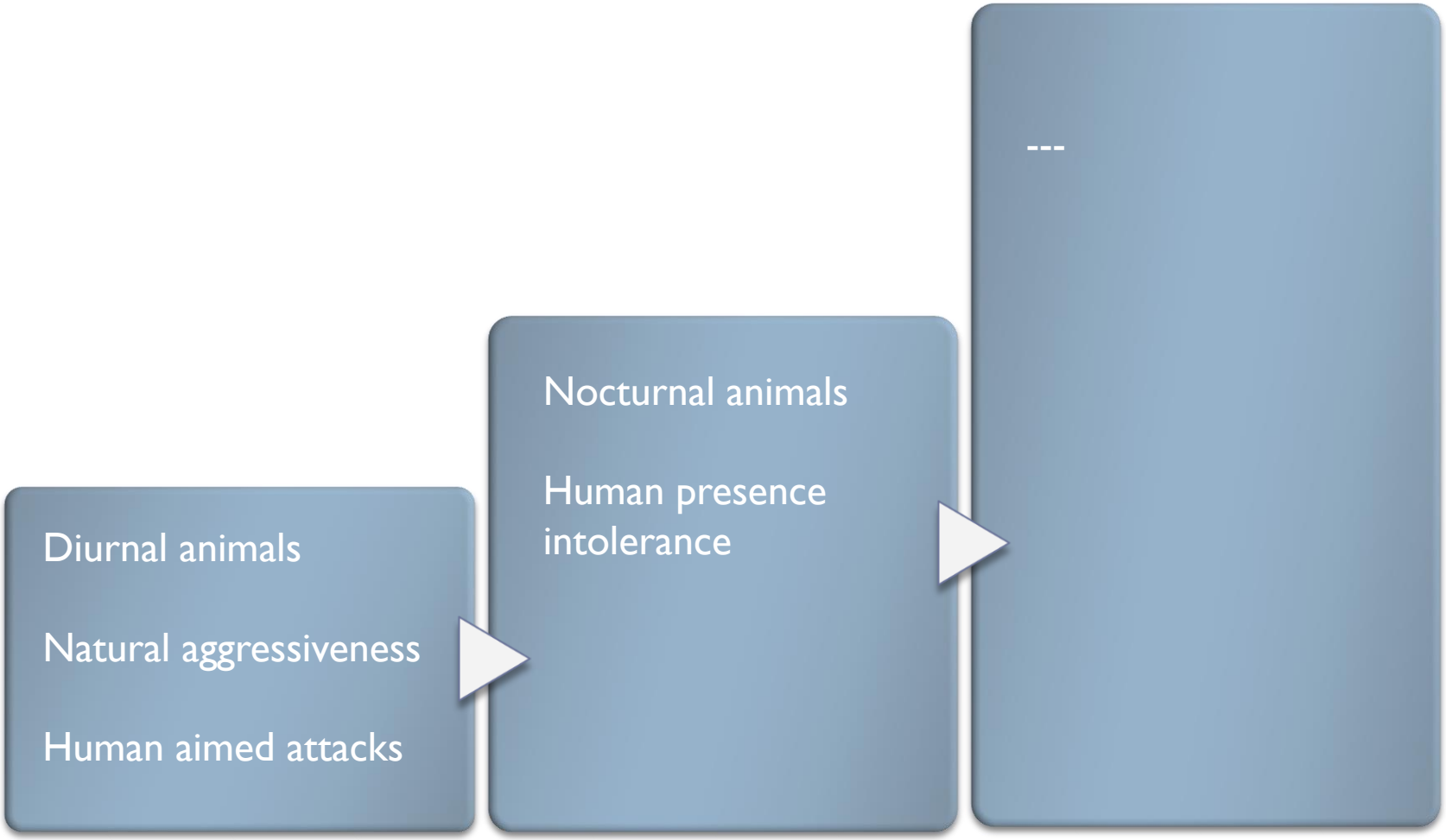
Category Anatomy – Reference level

- The skeleton is made of cartilage, denoting a scientifically accepted knowledge of this anatomical and physiological characteristic of elasmobranchs.

Young zoo visitors' obstacle to learning

- We found the combination of features 'close' to the human anatomy or daily basic knowledge (for instance, pet animals) was the most obvious obstacle to learning. These inhibit the discovery of new adaptations and biological realities concerning sharks' anatomical features.

LP Hypothesis – Sharks' Behaviour



Category Behaviour – Initial level

- Sharks are seen as diurnal animals, the period during which they show an increased activity and capture their prey. *"At night, they rest. They are more active during the day".*

- They are considered naturally aggressive animals, expressing this behaviour directly at humans. *"They can bite them (humans)... and eat them"* - Anthropocentric view of the shark.

Category Behaviour – Intermediate level

- Sharks are represented with a preferably overnight circadian rhythm, during which they are more active and capture their prey.

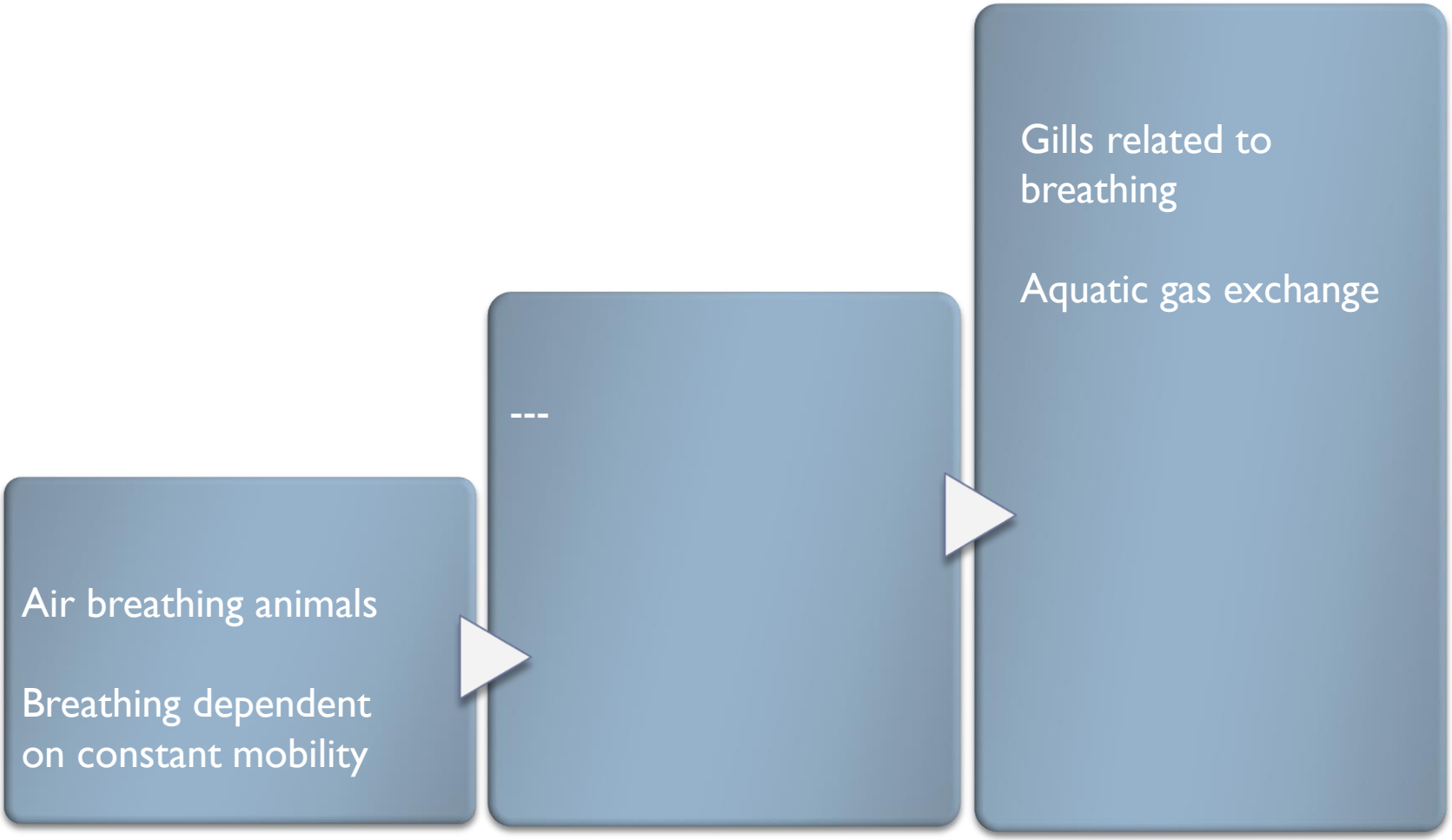
  "Sharks are more active during the night… it's when they prey".

  Though closer to reference biological and ecological knowledge, this representation still alludes to an innate intolerance for humans. Although not objectively, human-targeted attacks are still an approach conditioned by some anthropocentrism.

Category Behaviour – Reference level

- Also not expressed. Behaviour reference level should accept several circadian rhythms in sharks, since, as top predators with a largely opportunistic hunting strategy, they are usually most active at dawn, dusk and immediate subsequent hours.

LP Hypothesis – Sharks' Physiology



Category Physiology – Initial level

- The notion that sharks are air-breathers.

  "They come to the surface to breathe".

  Also, participants expressed that sharks have the need to be continuously moving in order to breathe.

  "Sharks need to keep moving forward or else they drown".

Category Physiology – Reference level

- A clear notion of specific morphological features (gill slits and gills) related to the breathing process,

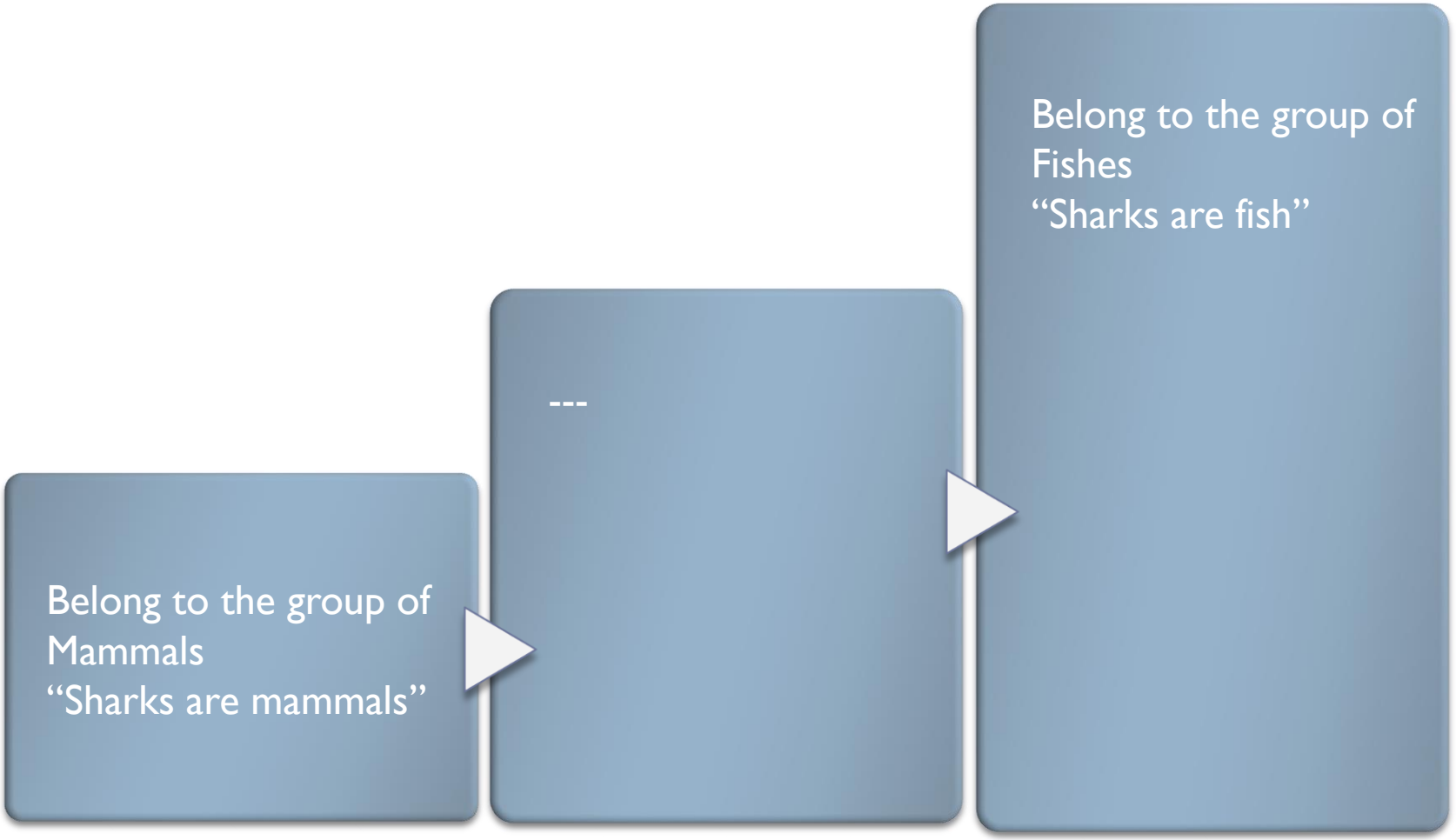
  "They breathe through these structures here … the gills" as well as knowledge related to the aquatic gas exchange process, depending on the water flow through the gills for oxygen/carbon dioxide exchange

  "the water passes (through the gills) and is as if the oxygen is removed".

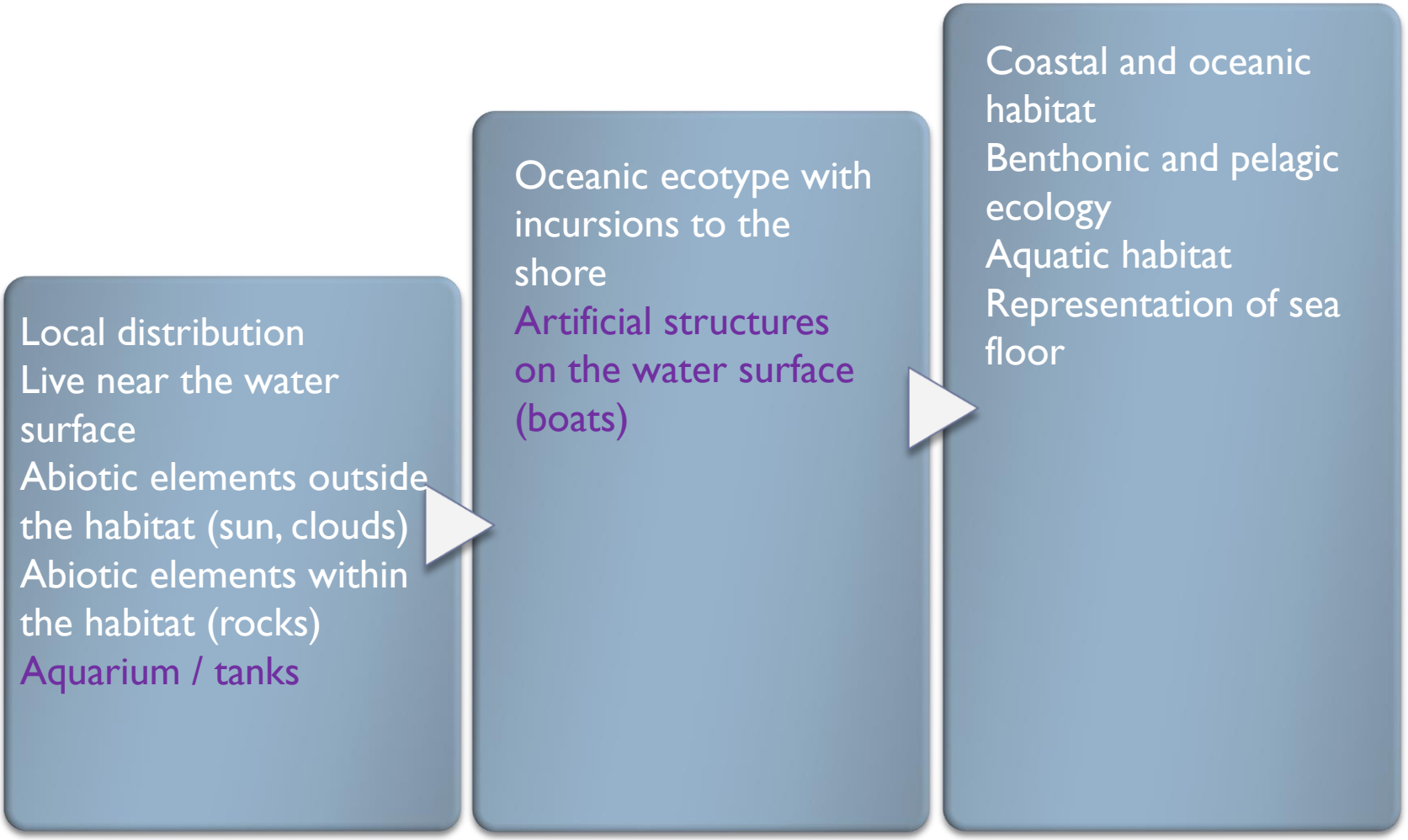
Young zoo visitors' obstacle

- A clear learning obstacle relates to the lack of knowledge of other breathing processes rather than those associated with mammals.

LP Hypothesis – Sharks' Classification

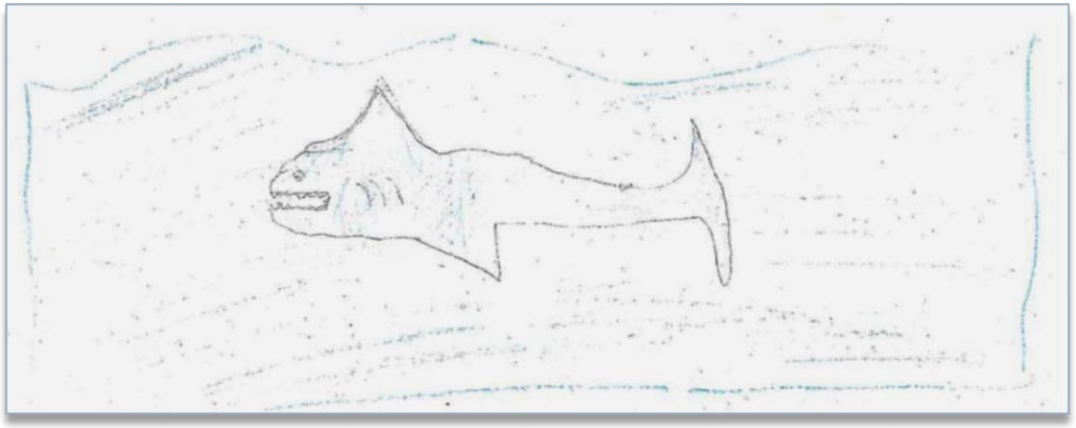


LP Hypothesis – Sharks' Environment



Obstacle – Utilitarian vision

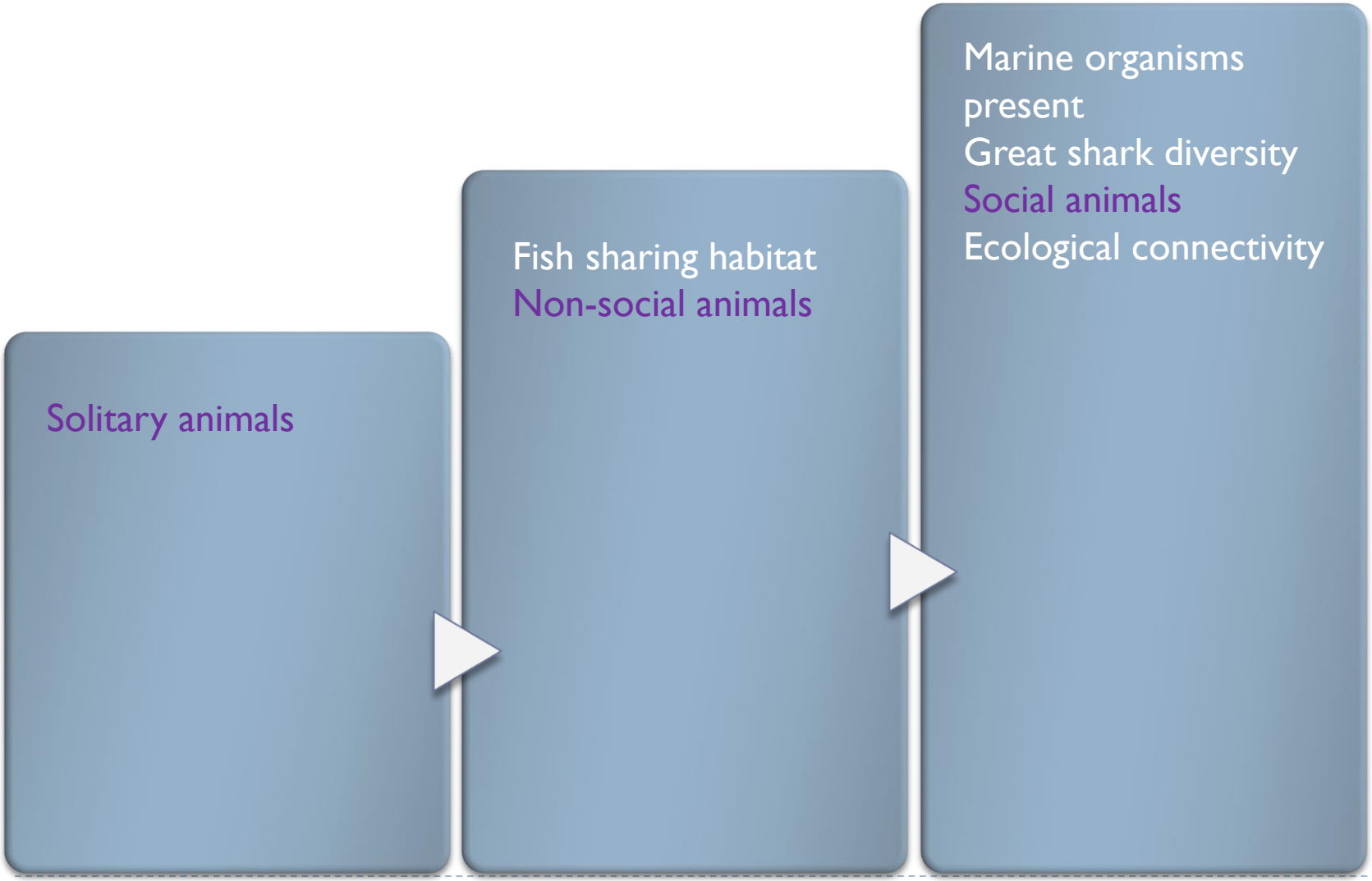
An artificial structure – aquarium.



Obstacle - Anthropocentric vision

The presence of the boat in the shark environment denotes a human centred vision.

LP Hypothesis – Sharks' Community



OBSTACLES? OPPORTUNITIES?

- How can these results assist us (researchers and teachers) in the rethinking of educational strategies that promote more effective environmental and science education in schools?

- How can they assist our children to develop empathy for animals and a sense of wanting to protect them before learning the complexities of biology, ecology and environmental science (Hug, 2010)?

- How can they help to generate empathy for non-human animals, and motivate concern for animal rights and welfare (Milton, 2002)?

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