

YOU ^{how do} **DESIGN ZOO EXHIBITS** **?**
for learning

Achieving Conservation:

New Cognitive Based Zoo Design Guidelines

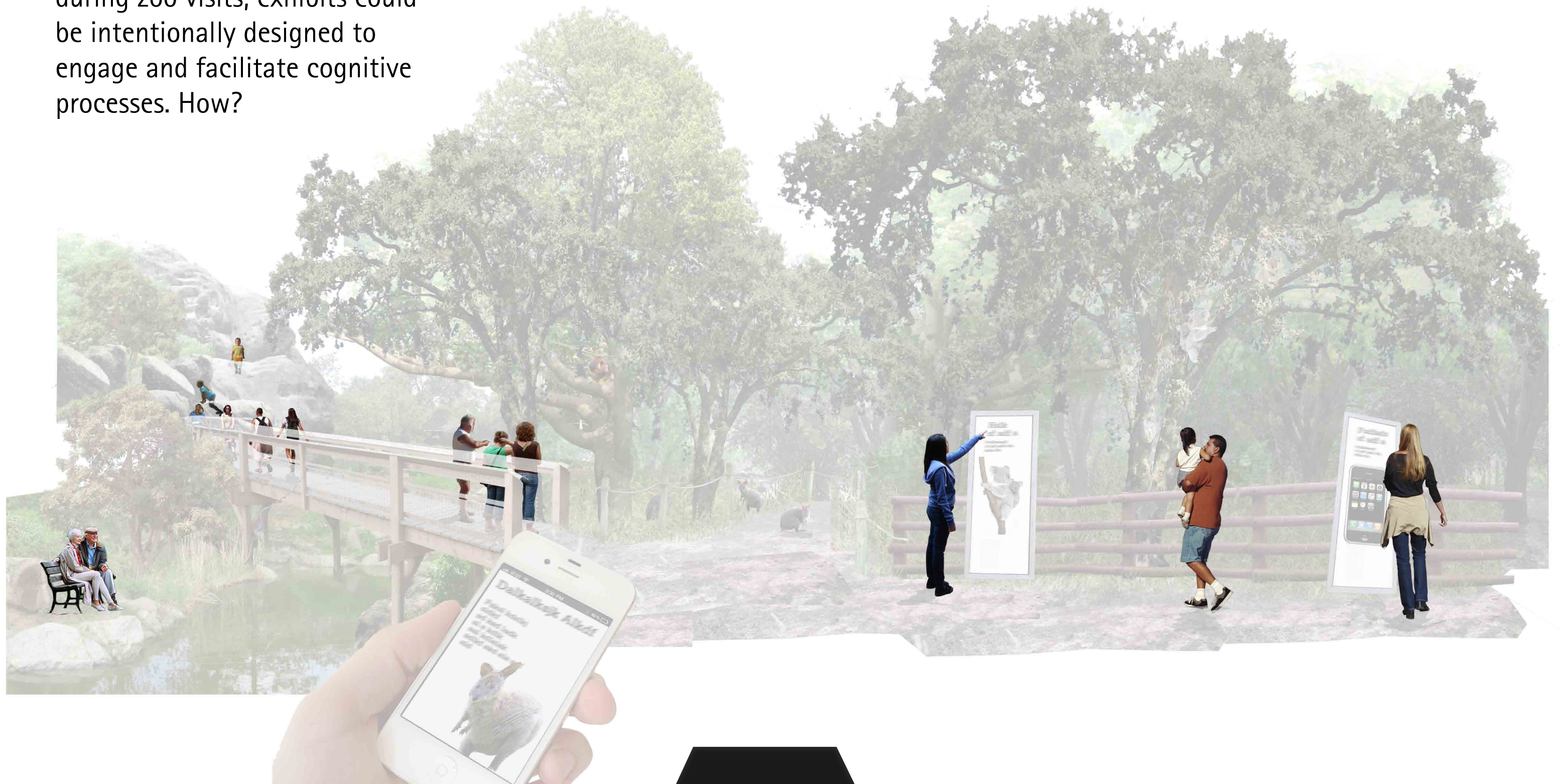
Russell Ploutz

russell.ploutz@gmail.com

This document is part of a master of Landscape Architecture thesis from Kansas State University. The full thesis can be accessed at <http://krex.k-state.edu/dspace/> under the title *Achieving Conservation: New Cognitive Based Zoo Design Guidelines*.

Copyright 2012 Russell Ploutz

Humans use learning processes called cognitive processes to think, learn and act. To improve thinking, learning and actions during zoo visits, exhibits could be intentionally designed to engage and facilitate cognitive processes. How?



By first understanding what motivates our learning and invokes cognitive processes, then realizing how learning styles and learning application varies from person to person, designers can improve design outcomes for thinking, learning and actions across visitor types.



Synthesizing literature on learning theories identified nine principles essential to zoo exhibit designs. Each of the nine principles integrate key concepts from learning theories which relate directly to zoo exhibit design guidelines intended to spark cognitive processes during zoo exhibit experiences.

Principles

1 Identity

Principle concepts

Explorer
Facilitator
Professional
Experience Seeker
Recharger

Guidelines

1.1 Explorer discovery
1.2 Facilitate the Facilitator
1.3 Professional information
1.4 Memorable experiences
1.5 Recharger reflection

2 Attention

Searching processes
Attraction characteristics
Cognitive-emotional arousal
Animal characteristics

2.1-2.5, 2.13 Promote sequential scanning
2.6 Focusing device
2.7-2.9 Cognitive-emotional learning
2.10-2.12 Unfamiliar animals

3 Inform

Directing attention
Providing examples
Providing direction

3.1 Direct attention
3.2-3.3 Interactive guides
3.4-3.5 Informing Identity

4 Recall

Prior knowledge
Cue recall
Recall and emotions

4.1 Common experiences
4.2-4.5 Unexpected feature recall
4.7 Match emotions with recall

5 Grasp

Abstract concepts
Concrete experiences

5.1,5.3 Reduce the abstraction
5.2, 5.4-5.5 Interactive experiences

6 Guide

Meaning making
Conceptual connections
Examples

6.1, 6.4-6.5 Guide thought
6.2 Conceptual connections
6.3 Examples and demonstrations

7 Apply

Application
Feedback
Rewards

7.1, 7.5-7.8 Repeat concepts
7.2 Interpret feedback
7.3-7.4 Extrinsic rewards

8 Transfer

Relate to daily lives
Coordinate learning
Divergent thinking

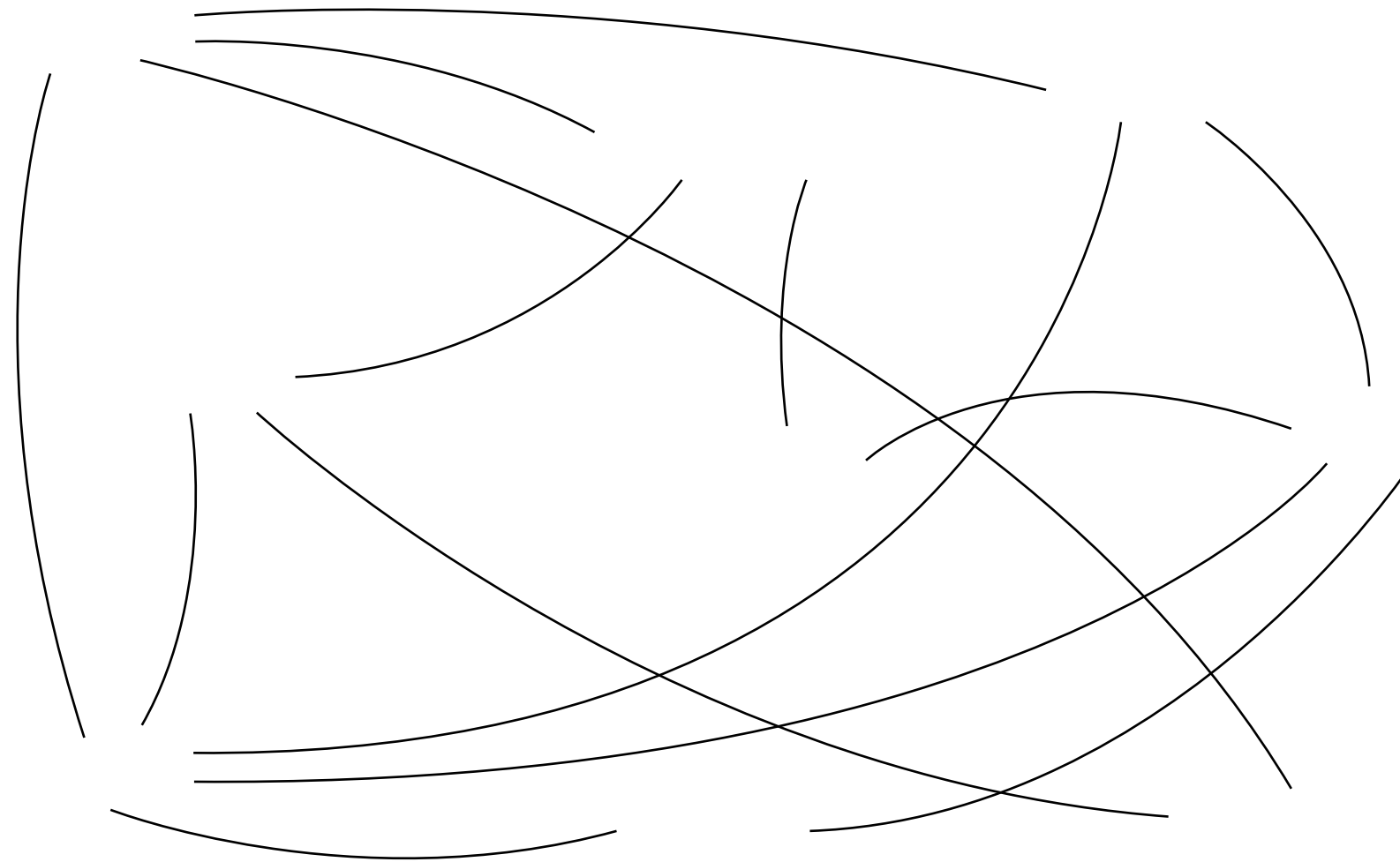
8.1-8.2 Bring learning into the zoo
8.3-8.4 Within zoo coordination
8.5 Encourage divergent thinking

9 Individual

Choice and control
Multiple Intelligences

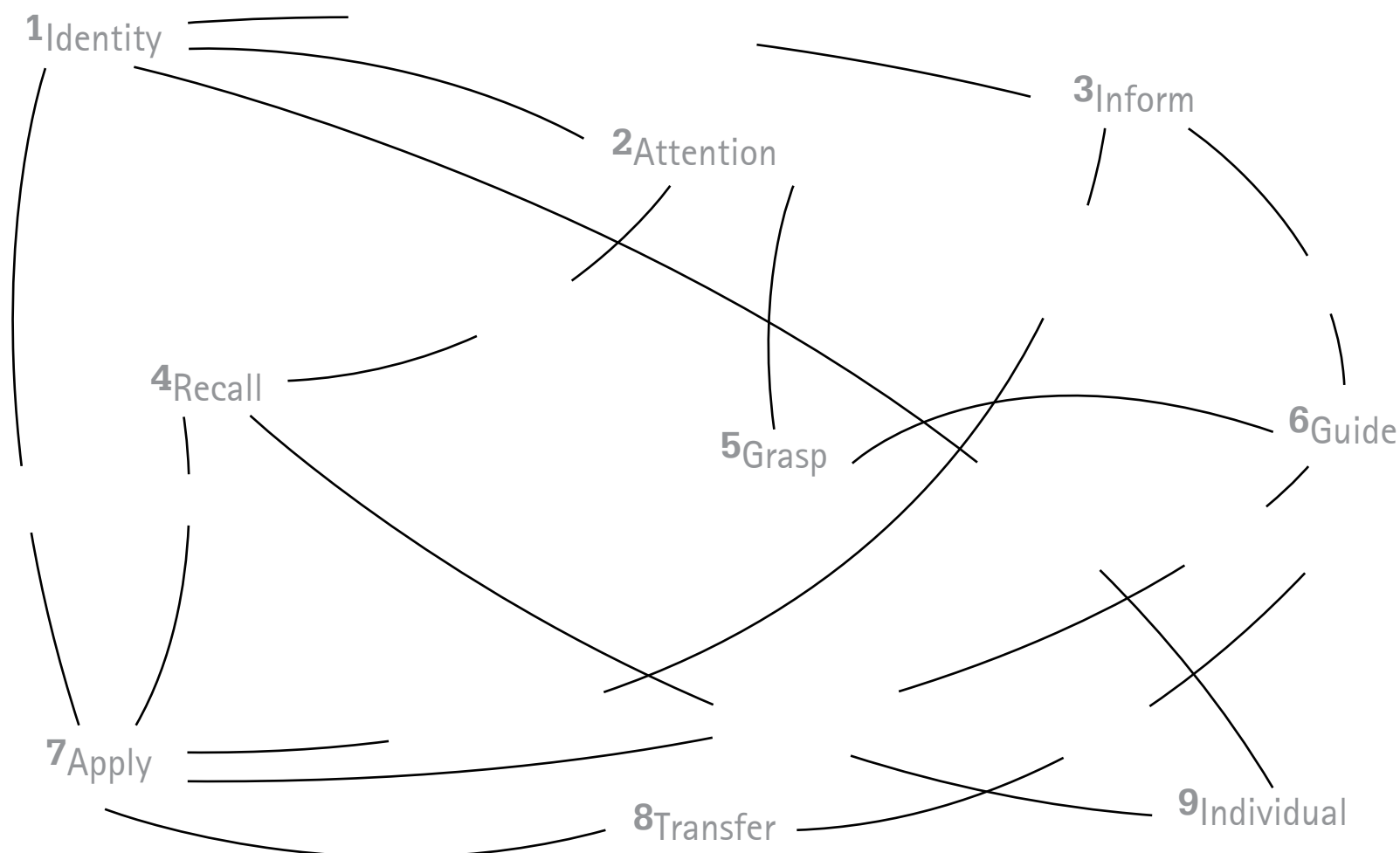
LEARNING PRINCIPLES

While the principles and their associated principle concepts can inform design, it is their interconnections and relationships which reflect the complexity of the learning process. An understanding of principle concepts in one principle requires a foundational knowledge of other principles to utilize the principle most effectively. This document facilitates these connections with vital links designed to understand associated interconnections and relationships.



EXAMPLE PROJECTS

To demonstrate the application of the principles and guidelines seven projects were envisioned illustrating exhibit experiences designed to engage our learning processes. The projects demonstrate how the principles and guidelines coalesce to influence exhibit form and generate the visitor experience.

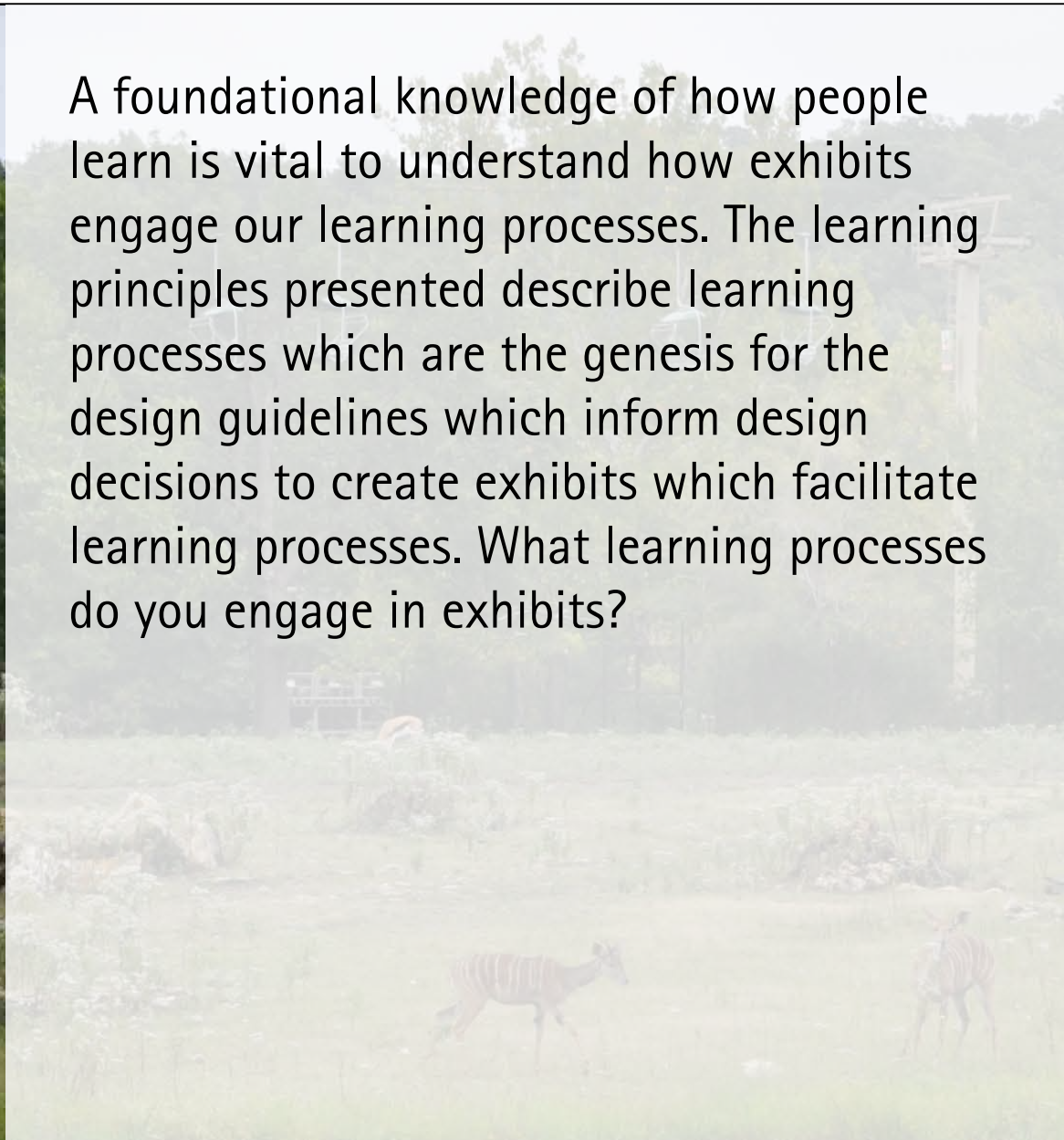


DESIGN GUIDELINES

The design guidelines developed from the learning principles assist designers in making informed design decisions. Designers can integrate the guidelines with their existing knowledge to augment their existing design processes as they to design more effective learning environments.

how do **YOU DESIGN EXHIBITS** ? for learning

A foundational knowledge of how people learn is vital to understand how exhibits engage our learning processes. The learning principles presented describe learning processes which are the genesis for the design guidelines which inform design decisions to create exhibits which facilitate learning processes. What learning processes do you engage in exhibits?



What influences our learning?



In zoos, the physical environment, the people we interact with, and our individual differences affect our learning.

How do we engage exhibits for learning?



We focus our attention creating an opportunity for learning to occur.

What do we recall during exhibit visits?



We recall prior knowledge and experiences to contextualize new situations and information resulting in new understanding.

How do we know how to learn?



When we know how to engage the exhibit the potential for learning increases.

How do we apply our knowledge?



As we exercise our learning through application and receive feedback our understanding increases.

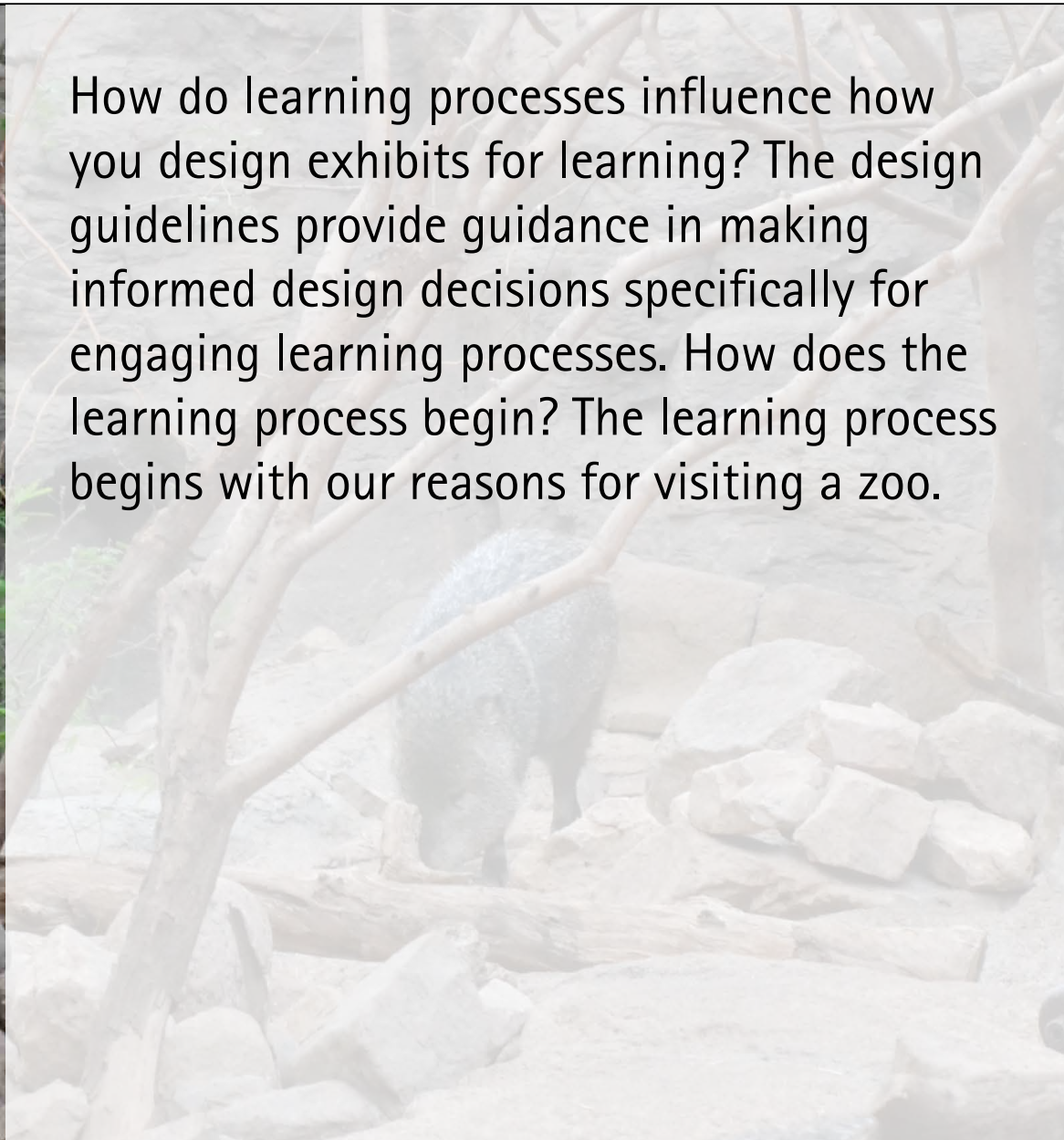
How do we use our learning in new contexts?



For our learning to persist we need to use our knowledge repeatedly and in new contexts.

how do **YOU DESIGN EXHIBITS** ? for learning

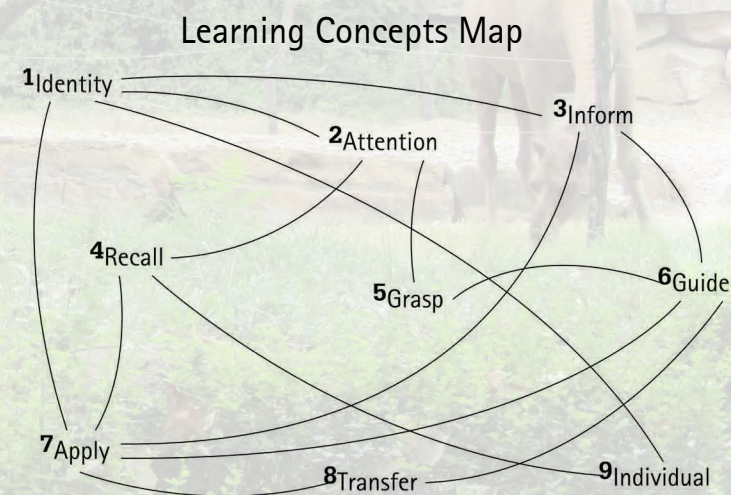
How do learning processes influence how you design exhibits for learning? The design guidelines provide guidance in making informed design decisions specifically for engaging learning processes. How does the learning process begin? The learning process begins with our reasons for visiting a zoo.



what do VISITORS DESIRE FROM ? zoos exhibits ?

Principle overview

Identities describe how we arrive at the zoo expecting to fulfill certain needs. These needs influence our behavior and how we understand the zoo experience. By understanding visitor's motivations, exhibit designs can more effectively integrate learning into the zoo experience. In this principle, the five visitor Identities explain motivations and how to satisfy the needs of each Identity.



Principle outline

Introduction

Why do you go to the zoo?
Identity as a filter
What is your Identity?

Explorer

Explorer
Needs

Facilitator

Facilitator
Needs

Professional

Professional
Needs

Experience Seeker

Experience Seeker
Needs

Recharger

Recharger
Needs

Guideline Summary

IDENTITY

Why do you go to the zoo?

We visit zoos with expectations from which we form goals that determine our needs for the visit. During the visit needs motivate our behavior as we attempt to satisfy goals for the visit. Visitor's general needs when visiting a zoo are for fun, recreation and socialization and in part learning (Falk 2009; Wagoner and Jensen 2010). If exhibits can fulfill the basic needs of the visit while effectively integrating learning then exhibit design could further the conservation mission of the zoo.

An Identity is "a complex sociological and psychological construct assembled from a myriad of sources, including a visitor's prior knowledge of and experience with the setting, perceived social relationships and expectations, the social and cultural meaning s/he attributes to the institution, and personal interests" (Falk 2006). An Identity is how we view ourselves and how we perceive others to view us (Falk 2009; Wagoner and Jensen 2010) which result in one's needs and expectations.

Identity as a filter

Identities are important to consider when developing a design concept because our Identity is the filter through which we understand the zoo visit. Our Identity informs where we direct our attention based on our interests and prior knowledge. It informs what we recall to contextualize the experience in creating meaning (Falk 2009). Identities predict both how we will act during the visit and also how we will remember the visit.

How do your thoughts and actions differ when you visit for work... with your children?

What is your Identity?

Researchers have identified five Identities: Explorer, Facilitator, Professional, Experience Seeker and Recharger (Figure 1.3). Identities are dynamic. For each visit we enact one or a blend of Identities depending on who we are with and why we are there (Falk 2009). Each of the five Identities are explained in greater detail sequentially or via hyperlink from below.

Explorers come to fulfill their curiosity.

Facilitators come to fulfill the needs of someone else.

Professionals come to increase their knowledge about the zoo.

Experience Seekers come to collect a unique experience.

Rechargers come for self-reflection and rejuvenation.

Explorer

Visitors who visit the zoo to fulfill their curiosity are Explorers (Figure 1.4). They are interested in general discovery of information and not necessarily concerned with whether other group members enjoy the zoo visit. Explorers are one of the largest groups of visitors in zoos (Falk and others 2007). They visit frequently therefore they have an understanding of how zoos are organized and what activities zoos have to offer other. They have a general interest in learning, but not necessarily on a specific topic. In learning they rely on their prior knowledge to determine how they attend, frame and make meaning (Falk 2009).



Explorer needs

During exhibits Explorers want new and surprising opportunities (Figure 1.5) and events such as temporary exhibits or in-depth programs. They want to push their intellectual boundaries, desiring greater challenge than what typically exists in current exhibits (Falk and others 2007). Explorers also want the ability to customize the exhibit experience because they don't like prescribed ways to experience the exhibit (Figure 1.6). Instead, they want to browse for interesting information and opportunities to exercise their minds through discovery. To assist them in browsing, Explorers need visual and intellectual clarity to determine what to engage (Falk 2009).

The exhibits *What Animal is That?* and *Where is the Animal?* meet the needs of Explorers in the design of the visitor activity and organization of visitor circulation.

Facilitator

Visitors who come to fulfill the needs of someone they care about are Facilitators. There are two types of Facilitators. Facilitating Parents focus on satisfying the needs of their children by translating and interpreting the shared zoo experience (Figure 1.7). The experience is centered around their child's fun and learning, not themselves. The other type is Facilitating Socializers who focus on fulfilling a companion's visit. They may not be interested in the content of the zoo; instead, they focus on interacting with their group. During the visit they take the Identity of their companion (Falk 2009).



Facilitator needs

Facilitators don't separate learning from fun; therefore, provide entertaining activities centered around learning. When designing the activities design with the Facilitator's prior knowledge, experience and interest in mind, since the Facilitator interprets the experience. The activities need to provide Facilitators with opportunities to socialize and interact with their companions (Figure 1.8). Exhibits need to stimulate intergenerational interactions and provide activities which engage both parents and children together (Falk 2009). The Four Lives and Who is Right? exhibits provide activities which encourage interaction between parents and children.

Exhibits need to provide Facilitators with tools to assist them in engaging their companions in learning (Falk 2009). Interpretation explaining how Facilitators can communicate the information to their companions provides Facilitators with orientation and techniques for engaging their children such as questions and directions. The briefing area of the What Animal is That? is an example of providing spatial orientation and direct instructions for interpreting the experience.

Professional

Visitors who come with a strong knowledge, interest in the zoo and a specific reason for the visit are Professionals. They are interested in advancing their own knowledge about their profession, hobby or study such as designers, photographers, or biologists (Figure 1.9). Professionals focus on accomplishing a specific task and they are conscious of the objective. They understand the zoo and are in-tune with its goals and activities (Falk 2009).



Professional needs

Professionals prefer an experience with minimal distractions and small crowds so they can focus on understanding the information in the exhibit. They are looking for in-depth information and references. In addition to the standard exhibit information, they desire premium programs such as behind-the-scenes tours (Figure 1.10), interaction with experts, lectures and seminars (Falk 2009), (Figure 1.11).

They do not follow the 'prescribed' visit experience. Instead they attend to what is important to them, which is typically different than other Identities because of their highly focused visit objectives (Falk 2009). The exhibit example What Animal is That? provides detailed information, customizable to their specific interests.

Experience Seeker

Visitors who come to 'collect' a zoo experience are Experience Seekers (Figure 1.12). They come for a new or famous exhibit which presents a unique experience. Experience Seekers are motivated by the idea of being there, not necessarily the content of the zoo. They are not interested in a deep understanding of the zoo's content but an overview (Falk 2009).



Experience Seeker needs

Since Experience Seekers are at the zoo primarily to 'collect' an experience they want a unique experience different from other local attractions (Figure 1.13, Figure 1.14). Exhibits can create experiences to capture the memory of the experience for later reminiscing (Falk 2009). Mementos can capture the experience with a physical object such as a photograph, merchandise or an object made at the zoo, similar to the crafts made in the Four Lives exhibit.

Experience Seekers need good orientation to navigate unfamiliar exhibit spaces. The exhibit can assist Experience Seekers in fulfilling their Identity by highlighting the most important attractions and information providing them with an overview of the zoo's content (Falk 2009).

Recharger

Visitors who come to reflect, rejuvenate, or bask in the wonder of the place are Rechargers. They are looking for a quiet place to relax or think (Figure 1.15). When they arrive at the zoo they likely go straight to a familiar place they know will meet their needs, since they are typically repeat visitors. Rechargers likely understand the content of the zoo; however, it is not what motivates their behavior and visit (Falk 2009).



Recharger needs

Rechargers are looking for quieter programs. Therefore, exhibits need quiet places separate from other noisier exhibits (Figure 1.16). In the Locate the Animal exhibit a place is specifically designed for Rechargers. In addition to quiet spaces, Rechargers are also searching for beautiful spaces where they can enjoy being in the presence of nature (Falk 2009). Learning can be integrated into the passive activity by providing a context for reflection and contemplation.

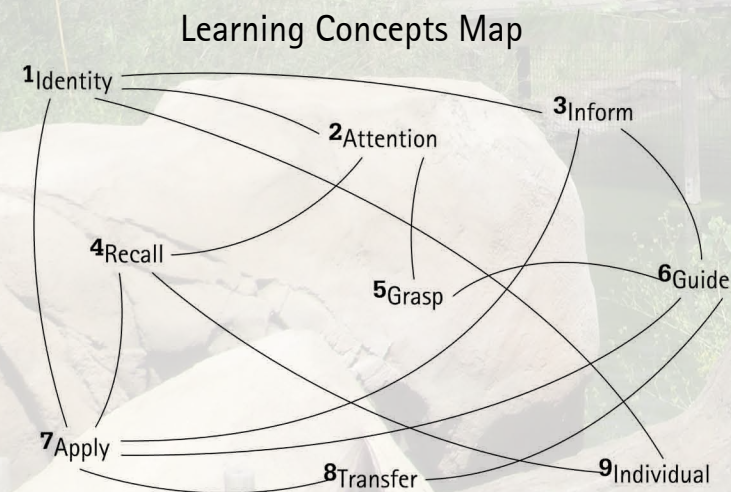
Identities summary and guidelines

When we visit zoos and exhibits we enact an Identity which describes our expectations and needs which motivates our behavior. Exhibit designs can integrate learning into the exhibit experience by using the following five guidelines as a starting point to foster visitor's motivation for learning. For us to enact our Identity in exhibits productively to learn we need to direct our attention and engage objects in exhibits, which is the topic of the next principle.

what captures **YOUR ATTENTION** ? in exhibits

Principle overview

If learning is to occur in an exhibit we need to engage which requires our focused attention. We use searching processes to direct our attention on physical characteristics of exhibits. This principle covers strategies for capturing visitor's attention to engage them in learning.



Principle outline

Introduction

Where do you direct your attention?

Searching Processes

- Orienting process
- Powerful stimulus
- Simultaneous scanning
- Sequential scanning

Strategies

- Attraction characteristics
- Focusing device
- Hooks

Cognitive-emotional arousal

- Cognitive-emotional arousal
- Distressing situations
- Cognitive-emotional management

Animals

- Attention to animals
- Animal selection
- Unfamiliar animals

Manage attention

- Manage attention
- Distractions

Guideline Summary

- Attention

ATTENTION

Where do you direct your attention?

For learning to occur, we must first determine what we are going to learn from, then we can engage. Once we engage the opportunity to learn is present (Gagne 1985) and the exhibit can facilitate learning processes.

Zoo exhibits are complex multisensory environments with many stimuli. When we enter into an exhibit we are unfocused and aware of a multitude of stimuli from the physical environment, other people and animals. Objects can capture our attention by directing our attention (Figure 2.1). If we determine an object is worth the effort to engage we focus our attention by ignoring other stimuli. We use three processes to scan for objects of interest - orienting, simultaneous scanning and sequential scanning. All three processes scan the environment for objects which capture our attention to determine which are worth the effort to engage (Bitgood 2010). The following three processes are described in more detail before describing characteristics which attract our attention.

Orienting process

An orientating process is an evolutionary reaction to a powerful stimulus such as a loud noise or a flash of light (Figure 2.2). A powerful stimulus can quickly redirect our attention; however, they must be carefully designed. Once we redirect our attention we rarely return our attention back to the previous object. Importantly, if the intensity of the stimulus is too powerful it can cause stress, distracting us from learning (Bitgood 2010).

A powerful stimulus can direct our attention away from other distractions in the exhibit and capture our attention on learning content. When the stimulus is at the beginning of an exhibit it can act as a hook engaging us in the exhibit. Powerful stimuli can also contribute to the learning experience by being part of the learning content. For example it could remind us of a problem by illustrating the problem dramatically, motivating us to think critically and/or act. This in turn provides the opportunity to provide important content about how to solve the problems related to the exhibit's conservation mission. In the Four Lives example project, a loud noise redirects visitor's attention to a specific element in the exhibit and also directs their cognitive processes in recalling and contextualizing the element. Guidelines 2.2 and 2.3 also provide guidance in using a powerful stimulus to support learning.

Powerful stimulus

The powerful stimulus needs to grab our attention but not distract us from learning. A powerful stimulus can potentially create a stressful situation when the intensity exceeds the audience's acceptable level (Bitgood 2010). One approach to lessen the impact of the stimulus is to warn us of the coming experience as in the Four Lives example project.



Once we have redirected our attention using an orienting process we rarely will return our attention to the object previously capturing our attention (Bitgood 2010). Therefore, exhibit designs should locate and time the stimulus to occur when we are in a position to redirect our attention onto learning (Figure 2.3). In the example project Four Lives a powerful stimulus is used to ensure visitors direct and focus their attention to content necessary for later activities in the exhibit. Also, a powerful stimulus could occur at the beginning of the exhibit or when communicating the primary exhibit message to capture our attention acting as a hook. In addition to carefully designing powerful stimuli into the sequence of the visitor experience, designers must ensure the stimuli do not distract other visitors in different areas of the exhibit. Other guidelines describing how to use a powerful stimulus are 2.1, 2.7 and 2.13.

Simultaneous scanning

In contrast to the reactionary orientating process in response to a powerful stimulus, a simultaneously scanning process is consciously controlled. We consciously scan the environment for something which 'pops out,' satisfying our needs for the zoo visit, then we choose to focus our attention on the object (Bitgood 2010). Environments requiring complex simultaneous scanning can potentially distract us as we may become disoriented by the multitude of possible objects to engage. Therefore, exhibits need to manage our attention as described in the following guidelines in this principle and guideline 2.13. One potential challenge in designing for a simultaneous scanning process is to focus our attention on a specific object may be difficult because objects in the exhibit compete for our attention (Figure 2.4).

When exhibits display multiple objects or pieces of information in the same area they can help visitors determine where and how to engage the exhibit using a hierarchy of items. The hierarchy assists visitors in determining important information by orienting them conceptually and physically (Falk 2000). See the Two Waterways project example. Alternatively, the spatial organization of the information could encourage a sequential searching process as in the What Animal is That? example project and guideline 2.5. Designers can create a hierarchy by varying attraction characteristics as explained later in the principle.

Sequential scanning

Another conscious process similar to simultaneous scanning is a sequential scanning. Sequential scanning is the process of scanning one object then moving to the next object until we find something of interest (Bitgood 2010).

An exhibit which encourages a sequential process can increase engagement and understanding by limiting distractions and presenting information as intended by the design concept. Since one object is presented at a time (Figure 2.5), potential distractions are reduced by minimizing the competition between elements (Bitgood 2010). Our understanding increases as we encounter objects in the most effective order for learning. For example, elements in exhibits can be arranged in a linear progression promoting the use of a sequential searching process. For example in the What Animal is That example project elements are spaced apart and in the Mimic the Animal views are limited minimizing the number of elements scanned. Managing our attention is also discussed in the guideline 2.13.

How we direct our attention during the searching processes of sequential scanning and simulations scanning is affected by the design of exhibit features. Exhibit features with certain characteristics have a greater chance of capturing our attention as described in the following pages.

Attraction characteristics

We are generally attracted to elements with high attraction characteristics. Attraction characteristics include elements which are distinct, familiar, or appear important or beneficial. Also, when objects have characteristics which contrast their surroundings such size (Figure 2.7), isolation, color (Figure 2.6), are multi-sensory or have other unique qualities we also direct our attention to them (Bitgood 2002). Our interests influence where we direct attention as does our prior knowledge because we actively seek out what is familiar and cognitively comfortable (Falk 2000; Falk 2006). When we perceive an element to benefit or satisfy our needs, our interest increases (Bitgood 2010). If we are interested in an object we generally spend more time with it and engage it. Increased engagement does not necessarily lead to greater learning, but "engagement requires deep processing of content" (Bitgood 2010).

The following strategies focusing devices, hooks, cognitive-emotional arousal and particular animal characteristics, in this principle Attention, employ attraction characteristics in specific ways to capture and focus our attention.

Focusing Device

Due to the many stimuli in the zoo we need guidance in determining which stimuli are important and where we need to direct our attention (Bitgood 2010).

Instinctively, we direct our attention to objects which contrast their surroundings with increased attraction characteristics. A focusing device can enhance the object's contrast encouraging us to focus our attention on the contrasting element (Bitgood 2010) such as spot lighted features (Figure 2.8), sounds or framed views (Figure 2.9). Other strategies such as directional arrows (Figure 2.10) and signs can more explicitly direct our attention. Focusing devices are used in the example projects What Animal is That? and Two Waterways and guideline 3.1.

Hooks

In exhibits elements, activities and situations can act as hooks. Hooks initially capture our interest and lead to engagement. Hooks act as a gateway; pique our interest to explore content in the exhibit. Powerful stimuli, cognitive-emotional arousing situations, such as visceral experiences and rewards can act as hooks (Figure 2.12) such as in the Help the Animal and Mimic the Animal example projects.

How we engage exhibits can also act as a hook. Exhibit elements and activities can engage certain cognitive processes for words, images or music, as described by Multiple Intelligences in the Individual principle, engaging particular learning processes leading to exploration of other content (Figure 2.11) such as in Where is the Animal? example project. Additionally, rewards for participation, as described in the Apply principle, can motivate engagement increases exploration of other elements beyond the initial objects such as in the Four Lives example project.

Cognitive-emotional arousal

We are also interested in elements and situations which stimulate thought and/or affective responses resulting in cognitive-emotional arousal. Situations evoking emotional-cognitive arousal motivate engagement and increase mental focusing (Bitgood 2002).

One strategy to stimulate cognitive-emotional arousal is to use cognitive dissonance. Elements which we do not understand can cause us to attempt to make sense out of the situation. For example, exhibits can illustrate a problem causing us to concentrate on solving the problem as in the Help the Otters and Who is Right? example exhibits. Another example is conceptually conflicting elements which cause us to contemplate the relationship resulting in engagement of cognitive processes (Figure 2.13) for example in the Four Lives example exhibit.

Distressing situations

Another strategy is to use distressing elements which cause us use cognitive processes in considering the issue associated with the element (Figure 2.14) as described in guideline 4.5. Examples employing this strategy include graphic photographs of the bushmeat crises (Stoinski et al. 2002) or environmental destruction (Steinbrener and Dempf 2002). The guidelines 2.8 and 2.9 provide direction in using cognitive-emotional arousal.

When exhibits contain a distressing element the exhibit should notify visitors of coming experiences which could be distressing, especially parents with children. For less intense situations subtle cues can indicate coming experiences such as questions or exhibit elements foreshadowing the experience as in the example project Four Lives.

Cognitive-emotional management

When invoking a negative emotional state using guideline 2.7, the experience needs to end on a positive note (Gwynne 2007) because negative emotions distract us, slowing learning. Instead, change our emotional state to one of curiosity (Chaffar 2005). The Oregon Zoo suggests a balance of 20:80 with 80% being positive (Oregon Coast Aquarium 2010). For example, an exhibit illustrating a degraded habitat can end with the visitor experiencing a healthy landscape improved by conservation actions, explaining to visitors environmental improvement is possible as illustrated in the example project Help the Otters. Strategies for evoking positive emotions are described in Guideline 7.7 Evoke a Positive State. Another strategy is to end the exhibit with a positive conclusion as in the Four Lives example project.

When piquing our cognitive-emotional state, the attention should center on learning content. For example, the situation could illuminate an environmental problem motivating us to learn more about solutions to the problem as in the example exhibits Help the Otters, Four Lives and Who is Right? The situations presented should closely integrate the animal or impacts and effects on the animal as feasibly possible.

Attention to animals

In addition to different characteristics of design elements animals also influence how we direct our attention. Animals have the ability to capture our attention in dramatic ways. Our attention increases when we are familiar with an animal or encounter a large or active animal (Moss and Esson 2010). Animals should be used to strategically direct our attention and engage us in learning especially, if the goal is conservation.

Centering an exhibit experience around animals we expect to see (Figure 2.15), or animals we have prior experiences with and/or knowledge of engages us in learning. Our learning increases by relating the exhibit content to a familiar animal because it provides a known context from which we can use our prior knowledge (Myers Jr., Saunders, and Garrett 2004) further described in guideline 5.2. For example in Four Lives, Help the Otters the exhibits are about common animals elephants and otters. Or, key concepts in the exhibits could center around familiar animals such as gorillas and kolas in Primate Adaption and What Animal is That? Another strategy is to allow visitors to choose the animal to focus on during the exhibit for example Where is the Animal?

Animal selection

Species selection should consider animals which communicate the intended exhibit message most effectively and fulfill the zoo's mission. Selecting animals which facilitate learning during the visitor activity or are integral to the exhibit story and experience is a key consideration. Obvious application of the guideline is in examples centering around a specific animals, following the guideline 2.10, such as in the Four Lives and Help the Otters exhibits included elephant and otter which are common zoo animals.

However, unconventional animals may be better suited for communicating concepts not directly concerning a specific animal. For example the Two Waterways exhibit begins by experiencing microscopic organisms describing the eutrophication processes. Also, in the Who is Right? example exhibit everyday cattle are included to illustrate their relationship with wolves. In using the guideline the animal selected to communicate the concept may require using an unfamiliar animal as described in guideline 2.12. The Concept Hierarchy Diagram and Cognitive Activity may provide design techniques to determine which animal is best for the exhibit.

Unfamiliar animals

To increase interest in unfamiliar animals it is important to tell an interesting and engaging story about the animals or to engage us in an activity which directly connects visitors with the animal or, redirect interest from a familiar animal by first centering the story around a familiar species and then connect the story to an unfamiliar species (Moss and Esson 2010; Myers Jr., Saunders, and Bexell 2009). To get visitors interested in unfamiliar animals in the What Animal is That? example project the first example is a koala.

The type of animal displayed needs to help us learn the exhibit message. To communicate concepts unconventional or underutilized animals may be better suited for learning concepts. This is not new; in Conway's visionary article *How to Exhibit a Bullfrog* (Conway 1968) he described a wetland exhibit centered around a bullfrog. Many have echoed a call for a greater emphasis of greater diversity of living organisms such as reptiles, plants, invertebrates and microorganisms (Robinson 1996; Hancock 2001). For example, in the project example Two Waterways visitors begin the encounter by experiencing algae and other microorganisms living in a stream.

Manage attention

In exhibits there are many opportunities for us to direct our attention and engage the environment. Exhibits can manage our attention by controlling the amount of stimuli we encounter during the exhibit experience. The exhibit can manage our attention by reducing competition between elements, increasing the physical and visual access between the visitor and object, and avoiding redirecting attention away from the intended content (Bitgood 2010). See the examples in the What Animal is That? and Who is Right? example projects. Guidelines 2.4 and 2.5 provide additional strategies for managing attention using attraction characteristics.

Managing attention is important because we rarely go out of our way to engage exhibit features if we don't have direct visual and physical access even when an object is of high utility. To ensure important elements have an equal chance of capturing attention, configure the pathways to bring us directly in contact with exhibit features (Figure 2.18) and provide a clear line-of-sight to the feature (Bitgood 2010).

Distractions

If we are distracted from attending to the exhibit then we may miss learning opportunities and also not achieve our goals for the day resulting in an unsatisfied visit (Bitgood 2010).

Minimize competition

When we encounter multiple objects at the same time we scan the environment searching for an object to direct our attention. Reducing our need to scan many objects we decrease distractions from many stimuli. Exhibits can reduce the competition between elements by limiting our line-of-sight to one or a few elements at a time increasing the chances we focus our attention on the primary information (Bitgood 2010). See using guidelines 2.4, 2.5 and 2.13.

Reduce outside stimuli

Reducing distracting stimuli which redirect our attention away from the content in the exhibit can improve learning. For example, loud sounds from other parts of the exhibit or outside the zoo can distract from learning (Bitgood 2010). Guideline 2.3 provides a design strategy to remediate the distracting effect.

Additional distractions

We can also be distracted by non-exhibit related conversation. Exhibits can redirect the conversation through questions and framing the exhibit with relevant topics. We may also become distracted when we are physically and mentally fatigued and from time limitations. This can be reduced by providing information about the time requirements of each exhibit (Bitgood 2010).

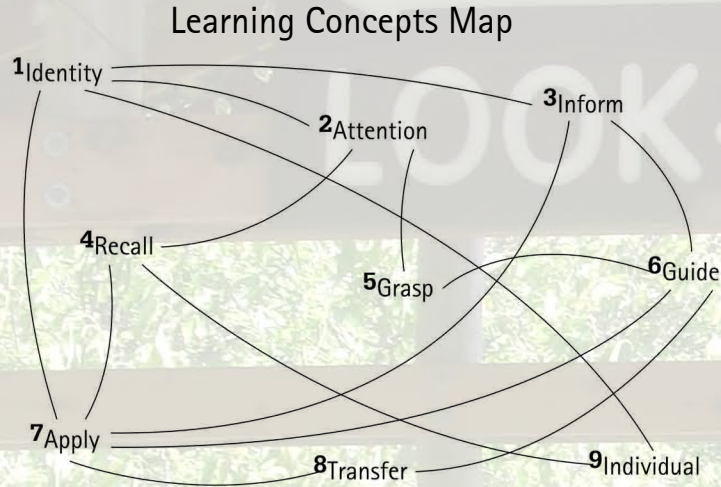
Attention summary and guidelines

We use orienting, sequential and simultaneous searching processes to direct and focus our attention on elements which contrasts their backgrounds. Strategies employing attraction characteristics in exhibits can facilitate searching processes to direct our attention productively for learning. Once we direct our attention we need to know how to learn while we are engaged which is the topic of the next principle, Inform.

do you **KNOW HOW TO LEARN ?** in exhibits

Principle overview

We need to know what opportunities exist for learning in the exhibit and how to engage the exhibit. Exhibits can suggest how to engage exhibits without compromising choice and control and engaging visitor's Identify. This principle discusses strategies for how to inform by directing attention and using examples.



Principle outline

- Introduction**
 - How do exhibits assist you in engaging?
 - Orientation
- Strategies**
 - Direct Attention
 - 3.1 Direct attention
 - Informing with an example
 - 3.2 Provide an example
 - Interactive guides
 - 3.3 Interactive guides
 - Providing direction
 - 3.4 Maintain choice and control
 - 3.5 Informing Identity
- Guideline Summary**
 - Inform

INFORM

How do exhibits assist you in engaging?

We come to zoos partly to learn (Gwynne 2007; Reading and Miller 2007; Clayton 2009) therefore exhibits can capture our desire to learn by informing us how to engage the exhibit. Once we are interested in learning we need to know how to learn (Gagne 1985). Exhibits can inform us where to direct our attention and effort towards learning by explaining how we can engage and learn from the exhibit.

Orientation

When we enter into exhibits we need to know what is expected of us – how we can act and what we can engage. Our learning increases when we know what to do in exhibits by increasing our physical orientation and reducing distractions of spatial disorientation. Similarly, exhibits can also increase our learning via conceptual orientation. By informing us how we can physically and conceptual navigate exhibits our learning increase because we are more comfortable in the exhibit (Falk 2000).

Physical orientation

Physical orientation provides us with an overview of the spatial layout of the environment to orient us to the exhibit. Once oriented, we know where to go in the exhibit and what is in the exhibit. Signs and maps provide physical orientation but also logically organized spaces and an easily navigated circulation system (Falk 2000).

Conceptual orientation

Conceptual orientation provides us with an overview of the intellectual content. Conceptual orientation helps us organize, relate and order what we see and encounter, helping us to make meaning in exhibits. Strategies providing conceptual orientation include linking and clustering concepts to explicitly describe relationships between concepts. Additionally, hierarchies can help us quickly understand information and interpret the situation to make meaning (Falk 2000).

Exhibits can increase our orientation specifically for learning by employing the strategies of directing attention, informing with examples and providing direction described in the following pages.

Directing attention

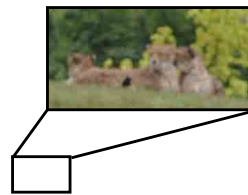
Exhibits can inform us where to direct our attention on learning content by providing visual cues (Figure 3.3) or by directing our engagement in an activity by instructing our actions (Figure 3.2). Obviously, instructions on a sign or an arrow pointing to the subject of interest can focus our attention (Figure 3.4) creating conceptual connections. However, subtler strategies can also inform us where to direct our attention such as questions, increased attraction characteristics or focusing devices as described by guideline 2.6 Focusing Device. The example projects Help the Otters and Two Waterways employ the guideline in assisting the visitor in completion of an activity. Also, the Who is Right? project provides explicit directions.

Informing with an example

Inform us by demonstrating how to learn by providing an example of how we are to learn. The example provides a concrete example helping to contextualize the information. One potential design strategy is using guideline 5.2 Familiar Examples. Then create opportunities for us to learn following the example as in the *What Animal is That?* and *Mimic the Animal* example project or as in the *Two Waterways* where visitors observe an example. While we are learning remind us of the example for reference as described in guideline 7.5 Recall Learning.

Interactive guides

Devices can inform us where to direct our attention and provide information used in engaging the exhibit. These devices can be fixed in position and content (Figure 3.5) or such as a sign at an interpretation node. Or, the devices can be mobile guides such as handouts (Figure 3.6) and dynamic content (Figure 3.6) such as a smart phone app carried throughout the exhibit as in the What Animal is That? example projects. These devices could be field guides or games which engage cognitive process by informing how we focus our attention (Koran Jr., Koran, and Foster 1989) as in the Where is the Animal? example exhibit.



Providing direction

When informing how to engage an exhibit avoid direct instructions, unless necessary such as how to use a smart phone app. Instead ask visitors to complete a task during the exhibit experience, preserving their choice and control, as described in the Individual principle. To increase visitor engagement in the exhibit, design the exhibit requiring visitors to participate in the activity to fully experience the exhibit such as in the role playing activity in the Four Lives example project. Another strategy could be to provide multiple options to engage the exhibit such as in the example projects Where is the Animal? and What Animal is That? where visitors select the animal associated with the visitor activity.

To increase our desire to engage the exhibit while informing us of learning opportunities frame instructions around our Identity, orienting us to our Identity. Since we are seeking chances to enact our Identity, the instructions can appeal to our Identity motivating us to learn, as described in the Identity guidelines, by explaining how we can satisfy our Identity during the exhibit experience. For example, in the Where is the Animal? example project instructions for how to use a phone app explain how Facilitators can engage their younger companions. Also in the exhibit one exhibit creates a place for Rechargers by informing not only Rechargers but Explorers and Facilitators.

Inform summary and guidelines

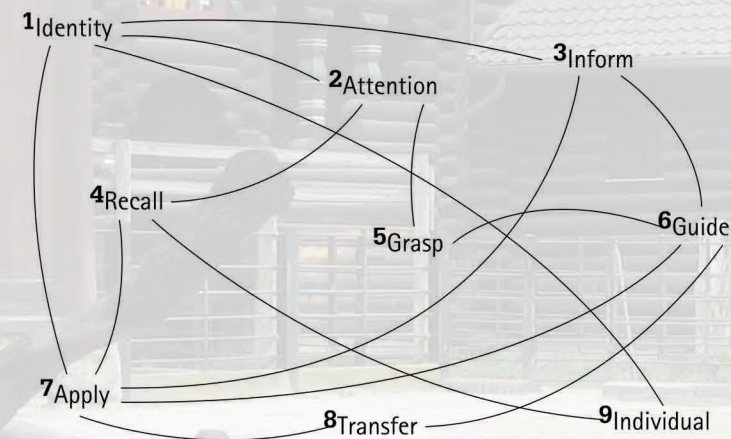
We need to know how to engage learning opportunities in exhibits, capturing our curiosity and desire to learn. Exhibits can employ strategies for directing our attention and providing examples while providing directions explaining how to engage exhibits. Once we know how to engage exhibits a fundamental learning process, recall of prior knowledge, needs facilitation which is the topic of the next section.

do you **RECALL PRIOR KNOWLEDGE ?** in exhibits

Principle overview

We use prior knowledge to understand new experiences and information. Exhibits can stimulate recall of prior knowledge through questions, design elements and the overall exhibit context. This principle explains how and when to strategically stimulate visitor's prior knowledge in facilitating learning processes.

Learning Concepts Map



Principle outline

Introduction

What do you recall in exhibits?

Prior knowledge

Prior knowledge

Common experiences

4.1 Common experiences

Cue recall

Cue recall

4.2 Question recall

4.3 Element recall

Context

4.4 Context recall

Unexpected feature

4.5 Unexpected feature recall

Other considerations

Recall before new situations

4.6 Initial recall

Concept Hierarchy Diagram

Recall emotions

4.7 Match emotions with recall

Guideline Summary

Recall

RECALL

What do you recall in exhibits?

Once we engage an exhibit, we use prior knowledge and experiences to contextualize new information and situations. Exhibits can facilitate the cognitive process of recalling existing information by prompting us to remember knowledge and prior experiences. We then can combine the recalled prior knowledge with new information to modify existing knowledge resulting in new understanding.

Prior Knowledge

Designing for our prior knowledge is important because we use our prior experiences as a frame of reference for understanding new situations and in approaching and solving problems. Exhibits can encourage us to recall specific information and experiences to facilitate how we think about the exhibit experience. If exhibits can relate information to our prior knowledge our learning increases because prior knowledge is readily available for use in the new situation (Gagne 1985).

Learning in zoos primarily supports, confirms and reinforces our prior knowledge. The most satisfying exhibits are ones which resonate with our prior experiences and provide new information which enriches our existing world view (Falk 2009). Additionally, prior knowledge influences our interests and attention in exhibits as we use our choice and control in directing our attention informed by our Identity which filters the information (Figure 4.2). Therefore, visitor satisfaction in exhibits can improve by stimulating visitor to recall prior knowledge and facilitating them in relating to the information as described in guideline 8.1 Made Relevant to Daily Lives. However, designing for visitor's prior knowledge is challenging because everyone's existing knowledge is different and unique.

Common experiences

Even though we all have different knowledge we have common experiences from living in the same culture. Exhibits can stimulate recall by targeting these common experiences ensuring the largest audience recalls information as intended by the design. The exhibit can connect to similar experiences from our lifestyles, such as riding and driving cars. Or, it can recall common knowledge using symbolic figures (Figure 4.3) such as metal barrels or familiar symbols association with a concept such as the recycling symbol in the Help the Otters example project.

The exhibit can stimulate recall of these common themes in our lives, relating the exhibit to our daily lives (Figure 4.2) as described in guideline 8.1.

Strategies cueing recall include using questions, design elements, exhibit contexts and unexpected features described in the following pages.

Cue recall

Questions can encourage us to recall knowledge for use in understanding the exhibit (Figure 4.5). A question prompts us to recall information about what we already know, becoming a starting point for contextualization and thought (Koran Jr. and Koran 1983) for example in Who is Right? and Four Lives example projects. Questions also direct our attention also described in guideline 3.1 and increases understanding by directing thoughts similar to guideline 6.4 and 8.5. The example project Two Waterways employes this guideline.

Exhibit elements can similarly stimulate recall. We associate information and experiences with objects and situations such as a metal barrel in the Help the Otters example projects. Also, exhibits can present cultural and natural features (Figure 4.6) to prompt recall assisting understanding as in Two Waterways example project. Also, a specific type of design elements, unexpected features, can cue recall described later in this principle. To ensure visitors see the element, increase the attraction characteristics described in the Attention principle.

Context

Similar to questions and design elements the context influences what we recall about the animal (Figure 4.8 & Figure 4.9). We recall information about the cumulative experience of the cultural and natural features, themeing, landscape and animals in exhibits to understand our surroundings (Figure 4.7).

How does the information you recall change in the two situations?

One strategy using context to strategically employ recalled prior knowledge is juxtaposing two similar landscapes. The two situations encourage visitors to recall different information about similar landscapes as demonstrated in the Two Waterways and Help the Otters example projects. Another strategy is to use the context to suggest a meaning such as in the Four Lives example project.

Unexpected feature

Design elements and exhibit contexts which we currently would not expect in an exhibit arouse our cognitive-emotional state and cause us to recall associated information to make sense of the perplexing situation. The juxtaposition of elements cues the recall of seemingly unrelated information and encourages us to use the information in unison (Figure 4.11).

An unexpected element can guide our thoughts as we experience the exhibit. Elements which seem disconnected with the content of the exhibit contrast each other conceptually, creating a conflict in understanding. This cognitive dissonance causes us to reframe the situation to resolve the discrepancy guiding meaning making, as described in guideline 6.2. For example, the elements can illustrate dilemmas causing us to consider balancing conflicting issues (Figure 4.10). This skill is important in helping us understand different viewpoints and question our values (Myers Jr., Saunders, and Garrett 2004). The example projects Four Lives, Help the Animal and Who is Right? employ this strategy. A similar design strategy is described in guideline 6.4.

Recall before new situations

Before experiencing new information stimulate recall of prior knowledge so that it is readily accessible for use in understanding the new situation. Use the previous guidelines 4.2-4.5 to stimulate recall of foundational concepts of the exhibit message (Gagne 1985). Basic concepts of biology and ecology typically are needed to understand the exhibit conservation message composed of multiple concepts. For example, to understand the need for habitat conservation one needs to understand ranges of animals and breeding populations. The example project Who is Right? applies this guideline to begin the exhibit. Also, when applying learning use this guideline with guideline 7.5 Recall Learning described in the Apply principle.

A design process technique useful to determine what prior knowledge the exhibit needs to stimulate is a Concept Hierarchy Diagram (Figure 4.12). The Concept Hierarchy Diagram is used to organize and structure the concepts needed to understand the overall message for the exhibit (Miles 1982). The identification and organization of the concepts helps present the information with conceptual clarity.

Recall emotions

When we recall information the emotions we had when the memory was made is also recalled (Chaffar and Frasson 2005). In deciding the intended information for recall, consider the emotion associated with the information. For example, if the exhibit suggests a negative emotion with the exhibit situation or design elements (Figure 4.13) the information recall will be negative in nature.

When a negative emotion is recalled use the guidelines 2.7 -2.9 to strategically leverage the emotions towards learning by increasing motivation and stimulating cognitive-emotional arousal. The guidelines also explain how to controlling the distracting effects of the negative emotions which potential limit learning. The example projects Four Lives illustrate the use of the guidelines when evoking negative emotions. Other guidelines concerning emotions are 6.5 and 7.6.

Recall summary and guidelines

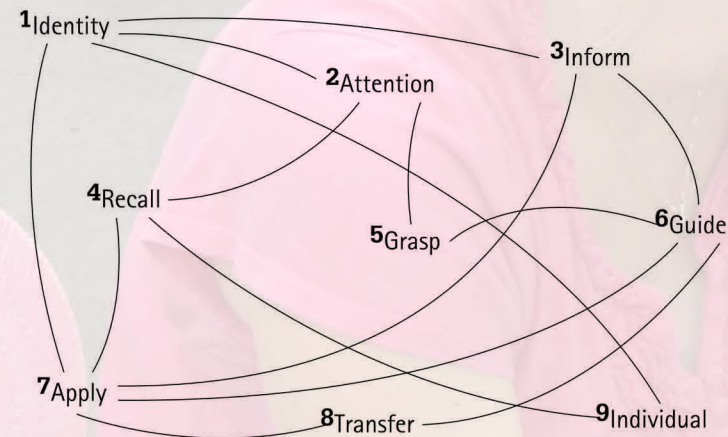
We use prior knowledge to contextualize new situations. Exhibits can stimulate us to recall prior knowledge and experiences using questions, design elements, exhibit context and unexpected elements to facilitate learning processes. In addition to the information we recall, how we encounter the information influences how we learn which is the topic of the next principle, Grasp.

how do you **EXPERIENCE CONCEPTS** ? in exhibits

Principle overview

We use different cognitive processes to understand ideas and experiences by grasping information and the environment around us through concrete experiences and abstract concepts. This principle discusses strategies for how to engage visitors most effectively with abstract concepts and concrete experiences during learning process.

Learning Concepts Map



Principle outline

Introduction

How do you experience concepts?

Strategies

Link the abstract to the experience

5.1 Link abstract to concrete

Link the abstract to familiar examples

5.2 Familiar examples

Reduce the abstraction

5.3 Reduce the abstraction

Concrete experience

5.4 Concrete experience

Visceral experience

5.5 Visceral experiences

Guideline Summary

Grasp

GRASP

How do you experience concepts?

Once we direct our attention and recall information we perceive, or grasp, information as we engage the exhibit. We can grasp information in two ways, concretely and abstractly. Through hearing, seeing, and feeling we grasp information as a concrete experience, the here and now, such as encountering an animal or experiencing an ecological process in action (Figure 5.1). We also grasp information in exhibits as a representation of reality which is an abstract concept such as models and signs communicating ecological processes (Figure 5.2). Both types of information are equally important in the learning process because we use concrete experiences to understand abstract concepts and vice versa as a cyclical process (Kolb 1984). The following strategies explain how to link abstract and concrete experiences, how to design exhibits to facilitate the cyclical learning process and how to use concrete experiences most effectively to create meaning.

Linking the abstract to the experience

Abstract concepts can be difficult to understand because we may not have prior knowledge of concrete experiences to understand the abstract concepts. In zoos, many of the important conservation issues zoos are communicating in their messages require an understanding of ecological concepts. Learning of these abstract concepts increases in zoos by making connections with concrete experiences (Myers Jr., Saunders, and Garrett 2004).

When exhibits present abstract concepts create a physical (Figure 5.3) or intellectual connection (Figure 5.4) to a concrete experience. The concrete experience provides a context to understand the concept such as a physical example or hands-on activity. The two experiences also create a conceptual connection as described in guideline 6.2. The example project Mimic the Animal creates a physical connection with a gorilla suit to an abstract concept. When linking concepts ensure the connection does not increase the abstraction as described in guideline 5.2.

Linking the abstract to familiar examples

Another strategy similar to guideline 5.1 linking abstract concepts to concrete experiences is to use familiar examples. Familiar examples could be prior knowledge of a local landscape or a familiar animal to make the connection between abstract concepts and concrete experiences. When making the connection, use a specific animal and relate the abstract concepts to visitor's prior experiences and knowledge outside the zoo (Myers Jr., Saunders, and Garrett 2004). The animal provides a concrete experience from which to contextualize the abstract concepts increasing understanding by making a conceptual connection as described in guideline 6.2 Conceptual Connections. The example project Mimic the Animal uses familiar animal examples and the two example projects Two Waterways and Who is Right? use a familiar local landscape.

Reduce the abstraction

Many of the ecological and biological concepts needed to understand animals and conservation are difficult to grasp due to the complexity of processes and systems along with the extremes in scale from massive global process to miniscule molecular functions. These concepts typically can only be represented through abstraction. To facilitate the learning of the processes reduce the abstraction of the concepts.

When demonstrating the processes using abstract concepts provide concrete examples and connections to link abstract concepts to concrete experiences, as described in guideline 5.1 and by adding and referencing concrete experiences as described in guidelines 5.4 and 5.5 while reducing the abstraction. The examples provide a context for understanding the concepts through personal experiences (Figure 5.7). Abstraction can also be reduced by using a less abstract concept. For example, an abstract number is reduced using a symbol representing a number (Figure 5.6), which may engage the Logical Intelligence. The example projects Mimic the Animal reduce the abstraction of biological process of time, evolution and Two Waterways illustrate ecological process of water quality.

Concrete experience

The previous strategies improve our learning of abstract concepts which are in many of the messages in zoos by using concrete experiences. The zoo is an excellent learning environment of these abstract concepts because of the many concrete experiences in zoos. Two strategies, interactive and visceral experiences, are discussed for designing concrete experiences.

Interactive exhibits provide opportunities to experience concepts first hand. In exhibits, we can interact with live animals experiencing them with all our senses as a concrete experience. Interactive interpretation also provides opportunities for engaging multiple senses and exploring information physically which increases learning (Lindemann-Matthies and Kamer 2006). The example projects *Where is the Animal?* and *Mimic the Animal* describe different interactive experiences. These types of experiences allow us to test ideas physically by manipulating abstract concepts in the environment during concrete experiences (Kolb 1984) such as in the *Two Waterways* exhibit.

In designing the interactive experiences the guidelines from the Apply principle can integrate learning processes of application to increase the interactivity of the experience. Also Multiple Intelligences, as described in the Individual principle, provide guidance in engaging different types of visitors in the experiences.

Visceral experience

A specific type of concrete experience which creates an instinctual response and resonances deep within us is a visceral experience. The experience engages our affective domain, the emotional aspects of the brain, which can motivate us to learn and care about animals. Strategies such as close personal encounters with animals and multi-sensory situations can create a visceral reaction (Figure 5.8). See the projects Four Lives and Two Waterways for examples. When the experience is at the beginning of the exhibit it can focus us during the exhibit and act as a hook, described in the Attention principle. The example project Help the Otters and Mimic the Animal employ this design strategy. A visceral experience can also be used as a powerful contextualizing experience of abstract concepts as illustrated in the Mimic the Animal project.

Emotions are an important part of learning because it helps engage the cognitive domain by increasing memorability and motivation to care and learn about animal along with helping to develop attitudes and values (Littleddyke 2008). Emotions can also be evoked using the guidelines 2.8 and 4.5, and other guidelines describe strategies for using emotions most effectively 4.7, 6.4 and 7.7.

Grasp summary and guidelines

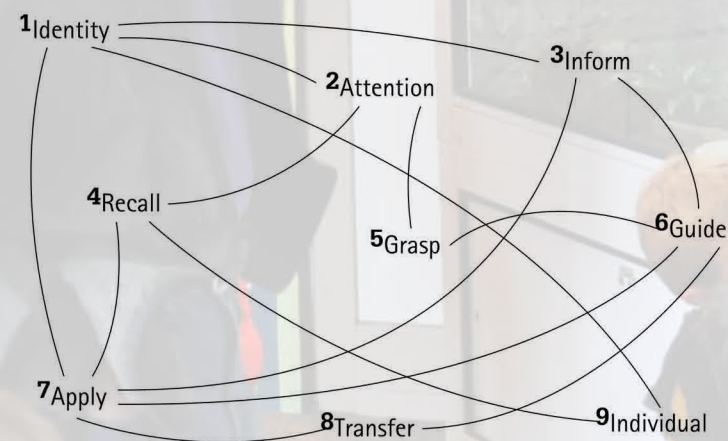
We understand the world abstractly and concretely using cognitive processes. Exhibits can use both types of experiences by synchronizing how visitors grasp the exhibit to reduce the abstract nature of concepts and capitalize on the many concrete experiences in zoos. From these experiences we need to make meaning from them which is the topic of the next principle Guide.

how do you **CREATE MEANING** ? in exhibits

Principle overview

We need guidance in understanding the environment around us because we may not know how to make meaning from the experience. This principle discusses strategies for increasing how visitors make meaning by designing for conceptual connections, providing examples, and guiding thought.

Learning Concepts Map



Principle outline

Introduction

What have you learned in exhibits?

Strategies

Relate to existing knowledge

6.1 Relate to existing knowledge

Conceptual connections

6.2 Conceptual connections

Examples

6.3 Examples and demonstrations

Guide thought

6.4 Guide thought

Memories and emotion

6.5 Memories and emotion

Guideline Summary

Guide

GUIDE

What have you learned in exhibits?

"The dominant motivation for humans is meaning-making. The need to make meaning of the physical setting is innate" (Falk 2000).

After we grasp information we need to transform the information into knowledge by making the information meaningful. We recall our prior knowledge, which is filtered through our Identity to understand the information. The exhibit can facilitate our processes of understanding by guiding us in making meaning from the exhibit experience leading to increased understanding. The following strategies of conceptual connections, examples, and guiding thought explain how to guide meaning-making in the following principle.

Relate to existing knowledge

Exhibits can guide us in creating meaning by connecting the situation, information or activity to our prior knowledge and experiences, increasing our understanding. The experience can relate information we have learned outside the zoo or activities in our daily lives to facilitate the contextualization process, further described in the Transfer principle. One strategy is to connect the exhibit with the local landscape (Figure 6.2). Other similar guidelines relating the exhibit to prior knowledge are guideline 7.7 and 8.1. To assist in using the guideline, a Concept Hierarchy Diagram can identify how the information conceptually relates to other information visitors might know.

Conceptual connections

Exhibits can inform us of conceptual connection between concepts by highlighting elements cueing us to the relationship between them. For example, the relationship between signs and the exhibit and between elements in exhibits can be highlighted by increasing attraction characteristics and by explicitly describing the relationship helping to conceptually connect information (Figure 6.3). Also, in the example project Mimic the Animal conceptual connections are made between abstract concepts of evolution with animal observation using visitor activities. Additionally, connections can also be indirectly suggested by spatially grouping concepts together (Falk 2000) possibly also using guideline 2.4. To make connections other design guidelines 2.6, 3.2, 3.3 provide design strategies. In addition to single messages in exhibits the overall zoo messages can be conceptually connected to different exhibit experiences and different exhibits further described in guideline 8.3.

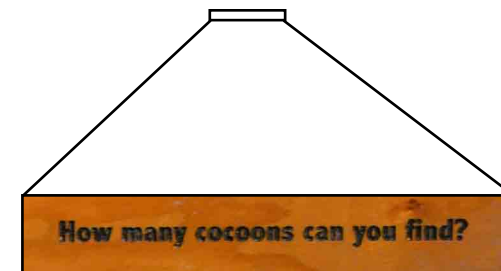
Examples

Exhibits can facilitate meaning by providing concrete experiences using examples and demonstrations. Examples are concrete experiences of the use or application of information in the exhibit. The examples inform us how to engage the information through action as described in guideline 3.2. One example is found in the Help the Otters project where the visitor activity is an example of enacting behavior. Exhibits can also illustrate how to learn information by providing cognitive strategies for remembering and understanding experiences such as by making comparisons. This strategy is employed in the example project What Animal is That? which explains how to learn to identify animals. Exhibits can also provide examples of how to use information both in the exhibit and outside the zoo by demonstrating behavior or the functioning of processes (Figure 6.4) such as in the Two Waterways example exhibit. Visitors can also participate in these activities to understand through a concrete experience by applying learning, as described in the Apply principle and demonstrated in the example project Mimic the Animal.

Guide thought

In addition to conceptual connections and examples, exhibits can assist us in making meaning by guiding cognitive processes used to contextualize the situation. Exhibits can suggest the information we are to recall and how we are to use the information in the new situation as in the example project Help the Otters. Through questions (Figure 6.5), design elements and the context, exhibits can suggest how to recall information but also how we think about the information and apply it in contextualizing and engaging the exhibit activities further described in the Apply principle. See the project examples Who is Right?, Two Waterways and Four Lives for exhibit situations.

A variation of this guideline is guideline 8.5 Encourage Divergent Thinking which specifically guides thought in making connections to information outside the exhibit. The visitor activity can also guide thoughts as in the example project Where is the Animal?



Memories and emotion

When using the previous strategies to guide us in creating meaning be cognizant of our emotional state because as we create memories we embedded our emotional state with the information. When we recall the memory the same emotion is evoked (Chaffar and Frasson 2005). The exhibit needs to embed positive emotions with messages intended to be recalled outside the zoo because positive emotions improve problem solving (Chaffar and Frasson 2005) which is important during visitor activities described in the Apply principle. The example project Help the Otters employs the guideline by ending on a positive note. Also Two Waterways evokes a positive emotion using the guidelines 2.8, 4.7, and 7.6.

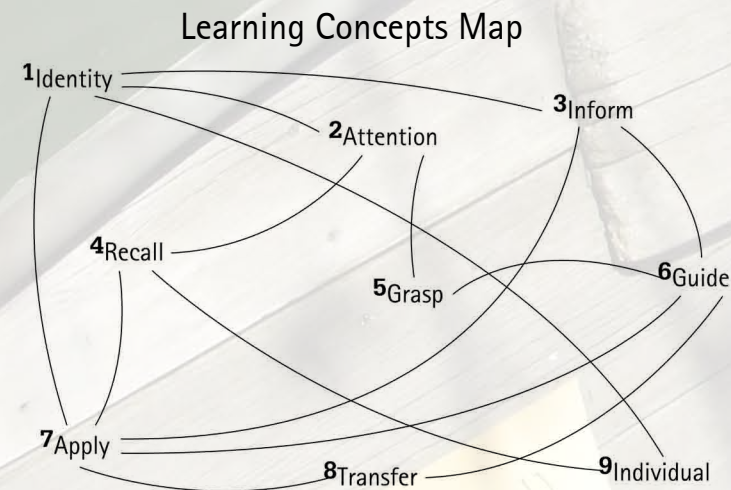
Guide summary and guidelines

We can create more meaning when the exhibit guides visitors in creating meaning. These guidelines describe how to guide us in making-meaning from the exhibit using conceptual connections, examples and guiding thoughts. Once we understand the information we need to apply our learning which is the topic of the next principle, Apply.

how do you **USE YOUR KNOWLEDGE ?** in exhibits

Principle overview

When we use our prior knowledge in exhibits our understanding and ability to transfer knowledge into new contexts increases. After we apply our knowledge exhibits can provide feedback on our performance by evaluating the activity. This principle discusses strategies for applying knowledge and skills learned in exhibits.



Principle outline

Introduction

How do you exercise learning?

Application

Application

7.1 Application of learning

Feedback

Feedback

Interpret feedback

7.2 Interpret feedback

Rewards

7.3 Intrinsic rewards

7.4 Extrinsic rewards

Strategies

Before application

7.5 Recall learning

7.6 Integrate prior knowledge

During application

7.7 Evoke a positive state

7.8 Repeat concepts

Cognitive activity

Guideline Summary

Apply

APPLY

How do you exercise learning?

After learning information and concepts we need to apply our learning to support and reinforce learning through contextualization in different situation (Gagne 1985). Exhibits can encourage us to use the information contained in the exhibit with our prior knowledge while experiencing the exhibit. Once we apply our knowledge, the exhibit can provide feedback demonstrating our learning, increasing our confidence. Application of learning can be as simple as a flip sign (Figure 7.1) or more complex such evaluating a situation or identifying features in the landscape. In all the example projects visitor activities require more complex application of learning because it is critical in the learning process. The following principle describes how to encourage application of learning, how to provide feedback, and other design considerations before and during application.

Application

In zoo exhibits we use our prior knowledge and information presented in exhibits to understand the environment around us. This interpretation of the exhibit is application of our learning and knowledge. Application is the use of our knowledge to solve tasks such as answering a question, using interactive interpretation, discussing ideas, or completing an activity. Exhibits can assist visitors in understanding more of the exhibit by encouraging application of knowledge. Application of information provided in signs, activities and animal experiences during a task helps visitors contextualize the information by understanding how the information is useful, making the information meaningful.

Visitors can apply their learning not only while engaging interpretive elements such as in the Four Lives example project of cooking and gardening but also during activities in the entire exhibit experience. For example in the project examples Two Waterways, What Animal is that?, and Where is the Animal? To design these types of visitor activities a design process helpful in guiding design is the creation of a Cognitive Activity described at the end of this learning principle.

When encouraging visitors to apply their learning inform them how to engage the exhibit so that visitors can perform most effectively. While informing frame the directions through their Identity so that visitors are motivated to participate in the activity as it will satisfy their needs for the zoo visit as described in guideline 3.5 Informing Identity. Also, integrate prior knowledge to facilitate the contextualization processes as described in guideline 7.6.

Feedback

Once we applying our learning we need to know if our performance was correct through feedback. Feedback supports and reinforces learning because it assists in contextualizing learning by guiding how to use the information. Feedback also increases our confidence in learning by demonstrating to us our learning (Gagne 1985). Feedback can be either built-in to the activity or provided by an outside source.

Outside source

Feedback can be provided by an outside source such as a docent or the interpretation element itself (Gagne 1985). A type of outside feedback could be a reward. In the Four Lives example project visitors receive exhibit money for completing tasks in the village.

Built-in

When the act of performance provides feedback it is built-in to the activity. Built-in feedback maintains our ability to interpret and evaluate our performance because the result of our action is the feedback (Gagne 1985). In the Four Lives example project, the visitor experience is the consequences of visitor's actions as a result of choosing a pathway. In the example project *Where is the Animal?* also provides built-in feedback when using clues to find an animal. Also, in the *Who is Right?* example project visitors comparing their response to other visitors as feedback, described in the next page.

Interpret feedback

When providing feedback, feedback needs to support learning and respect our choice and control in free-choice learning environments. Exhibit feedback needs to allow us to interpret our performance by not dictating a right or wrong answer. Instead, exhibits should suggest a correct meaning by assisting us in interpreting the experience (Irvine, Saunders, and Foster 1996). One possible strategy for increasing visitor's ability to interpret feedback is to create exhibit activities which provide built-in feedback such as in the Four Lives and What Animal is That? example projects.

The example exhibits Four Lives allows visitors to interpret the resulting situation as good or bad. Also, in the Who is Right? example project allows visitors to create solutions which they can evaluate based on other visitors responses.

Rewards

Feedback given after completing a task which improves our feelings and reinforces our actions is a reward. A reward that is a material object is an extrinsic reward. Whereas, an intrinsic reward is not an object but is a feeling such as pride, joy and confidence felt after completing a task (Price, Vining, and Saunders 2009).

Exhibits should provide intrinsic rewards over extrinsic rewards if behavior change is the objective of learning because intrinsic rewards continue to motivate us, influencing our behavior, after the zoo visit. Whereas, when extrinsic rewards are removed outside the zoo they no longer reinforce behavior (Price, Vining, and Saunders 2009). The example projects Help the Otters and Where is the Animal? provide an intrinsic reward.

Extrinsic rewards can create interest in learning which motivates us to engage activities for example in the beginning of the Four Lives example exhibit of making exhibit money. However, when the reward is removed the targeted behavior diminishes. It also lowers the intrinsic motivations associated with the behavior. If using extrinsic rewards, the reward needs to relate to the educational and conservational goals of the exhibit. In addition to extrinsic rewards acting as feedback, extrinsic rewards can also act as hooks to pique interest in engaging the activity (Price, Vining, and Saunders 2009) for example in completing tasks such as in the Four Lives example project.

Before application

Prior to encouraging us to apply our learning, stimulate recall of learning and evoke a positive state to improve our application of learning.

Before we apply our learning stimulate recall of previously learned information and prior knowledge (Figure 7.2) for example in the Four Lives, Two Waterways and Who is Right? example projects. Once we recall the information it is readily accessible for use in the activity (Figure 7.3), (Gagne 1985). To determine the prior knowledge to recall refer to the Concept Hierarchy Diagram and information coordinated in other exhibits.



Also, evoke a positive emotional state before application of learning to encourage more flexible and original problem-solving and decision-making (Chaffar and Frasson 2005). The projects Who is Right? and Two Waterways illustrate this design strategy. To create a positively charged atmosphere in the exhibit, stimulate the recall of information associated with positive emotions as described in guidelines 2.8, 4.7 and 6.5.

During application

While we are applying our learning encourage us to use prior knowledge and repeat concepts to increase learning during our performance.

Encourage us to use our prior knowledge and experiences when participating in activities. First, stimulate recall of prior knowledge as described in the Recall principle and guideline 7.5 because we use our prior knowledge to contextualize and make meaning from the environment. Then prompt us to integrate in with new learning. Suggest ways for integrating prior knowledge in the activity to facilitate the meaning making process. One strategy could be to relate it to our daily lives as described in guideline 8.1. This guideline is used in the Four Lives exhibit.

Also, provide opportunities for us to apply learning in new and different contexts in the same exhibit, other exhibits, when using zoo amenities, and during repeat zoo visits. Repeated practice in different contexts increases retention and transfer of learning (Gagne 1985). The example project Mimic the Animal provides an example. The guideline 8.4 provide guidance in coordinating the zoo learning content.

Cognitive activity

One design technique used to develop the visitor activities integrating application of learning into the example projects is to identify the cognitive activities in the exhibit. A cognitive activity is the intended thought processes visitors use to engage the exhibit experience and activity which are stimulated and facilitated by the exhibit design. The following potential cognitive activities are designed into some of the project examples.

Weighing Factors

The cognitive processes of evaluating information using criteria to determine a course of action is used in the Four Lives and Who is Right? example exhibits.

Recognizing Features

The cognitive processes of remembering different types of animal behaviors and characteristics from information presented in the exhibit and then associating the recognized behaviors and features to a specific animal species is used in the Where is the Animal? and What is that Animal? example exhibit..

Comparing Differences

The cognitive processes of contrasting two situations identifying similarities and differences to deduce the causes for the differences using information from the exhibit and their prior knowledge is used in the Two Waterways example exhibit.

Apply

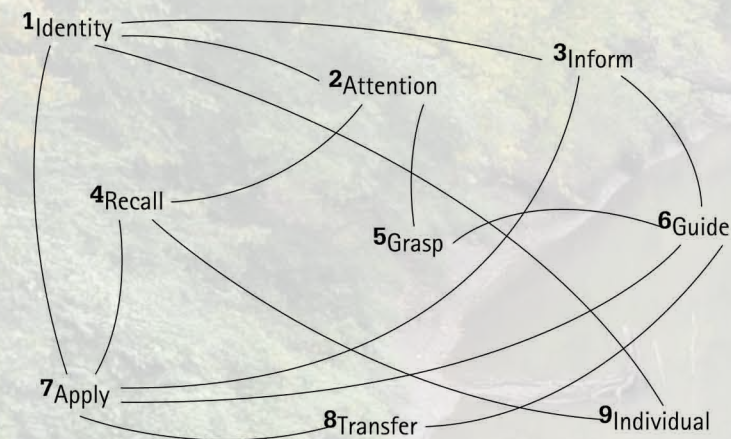
When we exercise our learning, understanding increases because it supports and reinforces our knowledge. Exhibits can engage us in applying learning during activities and provide feedback on our performance. However, application is not only important in the exhibit but also applying learning outside the zoo, contributing to conservation, which is the topic of the next principle, Transfer.

how have you **USED LEARNING IN EXHIBITS ?** outside of exhibits ?

Principle overview

When we use our knowledge in new and different contexts we transfer knowledge to new situation increasing learning. Also, when we apply learning outside the zoo we contribute to conservation. This principle discusses strategies for encouraging visitors to transfer information in the exhibit to other situations both in and outside the zoo.

Learning Concepts Map



Principle outline

Introduction

How do exhibits extend beyond the zoo?

Strategies

Relate to daily lives

8.1 Make relevant to daily lives

Learning outside the zoo

8.2 Bring learning into the zoo

8.3 Orchestrate learning

Coordination learning

8.4 Within zoo coordination

Divergent thinking

8.5 Encourage divergent thinking

Guideline Summary

Transfer

TRANSFER

How do exhibits extend beyond the zoo?

We enter into the zoo "with a wealth of prior experience and knowledge and leave with the seeds of knowledge and meaning that only subsequent experience can reveal and sustain" (Falk 2000). Learning in zoos is not complete until we apply it outside the zoo in new situations. When we encounter concepts in new contexts our understanding increases as it reinforces what we know through repetition and contextualization as we transfer knowledge (Gagne 1985). Strategies to encourage the transfer of knowledge into new contexts of relating to daily lives, coordinating learning and divergent thinking are described in the following principle.

Relevant to daily lives

Zoo exhibits can relate the experience to our daily lives in achieving the conservation mission of zoos (WAZA 2005). Content which relates to our daily lives gives us the tools to live our lives more pro-environmentally. The content also helps us connect it to our existing knowledge as it helps us understand the information through contextualization. Experiences which resonate with our prior experiences and knowledge are more fulfilling experiences because they reinforce and support what we already know (Falk 2009).

When designing the exhibit to relate to our daily lives stimulate us to recall information using the Recall principle, so prior knowledge is readily available for use. Design a connection between the common experiences as in guideline 4.1 to daily lives to reach the broadest audience. One example is in the Four Lives example project relating the food we eat to other people. Also, the example projects Who is Right? and Help the Otters also relate the exhibit situation to our daily lives by guiding us in considering the information in the context of our lives.

Learning outside the zoo

In addition to providing relevant information to our daily lives connect the information to learning outside the zoo. First, stimulate recall of information from school or common experiences following the Recall guidelines. Then guide us in creating a conceptual link between the presented information and existing knowledge following the Guide principle. An example is illustrated in the Who is Right? project.

We learn throughout our lives in school and at work but also from zoos, museums, science centers and other media such as television and newspapers. Learning is a continual process accumulating overtime from many sources. Zoos are but one part of a community's educational infrastructure which can work together towards improving the planet. Institutions whose goals are similar to zoos can collaborate messages helping us to understand information in different contexts by assisting visitors in bringing learning into the zoo as described by guideline 8.2. One example is in the project Two Waterways which ends with visitors remembering a similar message in a television commercial. Another example is the project Who is Right? in which visitors connect the information to a museum visit.

Coordinate learning

A coordinated educational agenda between exhibits in the zoo can synchronize messages among exhibits to help make conceptual connections. The educational messages can be coordinated between exhibits by repeating concepts in different contexts, formats and communication methods as described by Guideline 7.8. Visitors can encounter the same general message in different contexts and situations in exhibits and guest amenities to receive a holistic message (Figure 8.3). For example in the Four Lives example project the same message is presented, applied and recall in different situations. Concept Hierarchy Diagrams can assist in coordinating learning. The exhibit can also deliver the same messages in different formats and mediums such as signs, activities or demonstrations, audio, video, keeper chats, numbers and words to name a few possibilities. While repeating information the different formats can engage different Multiple Intelligences to reach a diverse audience.

Divergent thinking

Exhibits can encourage our thoughts to diverge on different information to make new conceptual connections by recalling new information. We combine the new information to make connections with information and experiences outside of the exhibit. A question, design element or exhibit context as describe in guidelines 4.2, 4.3 and 4.4 could stimulate prior knowledge related to the information in the exhibit but not presented in the exhibit (Koran Jr. and Koran 1983). The new information can then be used to understand the information in the exhibit. By positioning the recall device at the end of an exhibit we can reflect on the experience by relating it to others both in and outside the zoo. One example in the Who is Right? example project occurs when visitors create solutions to the problem in the exhibit. The device could also stimulate action by asking visitors to relate the experience to their behavior outside the zoo. For example in the project Two Waterways a sign, lawn and house stimulate divergent thinking about visitor's daily lives by relating the exhibit message to the suburban context. Additional design guidance could come from a similar guideline 6.4 however this guideline facilitates a more specific cognitive process of divergent thinking.

Transfer summary and guidelines

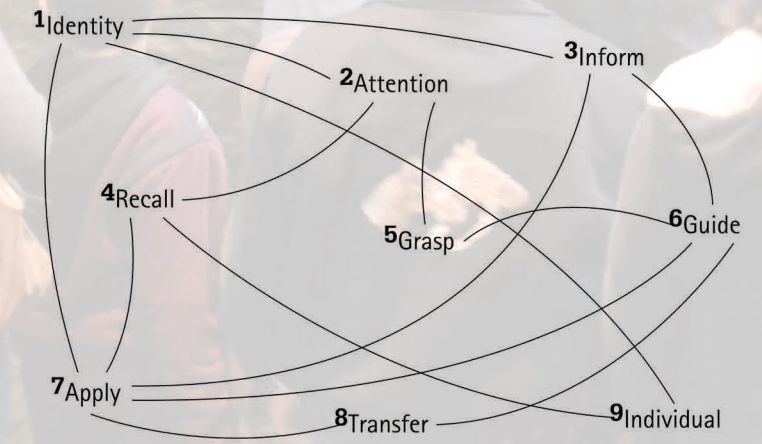
For our learning to persist and contribute to conservation we need to use our knowledge outside of zoos. Exhibits can connect us to learning outside the zoo and vice versa by coordinating learning and connecting learning experiences. One final consideration in the learning process is how learning is different for all individuals which is the topic of the next principle, Individual.

how do you **LEARN DIFFERENTLY** ? than others ?

Principle overview

Learning is unique to the individual (Kolb 1984; Gardner 1985) because we have different experiences and cognitive preferences resulting in visitors desiring different types of engagement. This principle discusses strategies for designing for personal differences by maintaining visitor's choice and control and engaging different Multiple Intelligences.

Learning Concepts Map



Principle outline

- Introduction**
 - How do you want to learn?
- Choice and control**
 - Choice and control
 - Dynamic information
- Multiple Intelligences**
 - Multiple Intelligences
 - Linguistic
 - Musical
 - Logical
 - Spatial
 - Kinesthetic
 - Naturalistic
 - Intrapersonal
 - Interpersonal
- Principle Summary**
 - Individual



Figure 9.0
How do you think they learn differently?

INDIVIDUAL

How do you want to learn?

Learning is unique to each of us. We all have different prior experiences and knowledge used to contextualize and understand new information. Additionally, we have learning styles employing different processes and strategies for learning and problem-solving (Kolb 1984; Gardner 1985). Our learning increases when we use our preferred learning styles and can integrate our prior experiences during application of learning as described in, guideline 7.1.

Choice and control

Since we learn differently we want to engage elements differently. In exhibits we expect freedom to choose and select what and how we engage exhibits because the zoo is a leisure activity. Maintaining our choice and control in exhibits is critical in capturing learning opportunities in zoos because when the experience is too structured, removing our autonomy, our intrinsic motivations to learn decrease.

Exhibits need to give us the tools to use our choice and control productively (Falk 2000; Falk 2006) for example in the Where is the Animal? example project. One strategy to assist visitors in choosing how to engage the exhibit is guideline 3.5 Informing Identity and the other guidelines from the Inform principle. For example in the What Animal is That? example project visitors have many options for engaging the exhibit.

Because we want choice and control exhibits cannot force us to engage elements. However, exhibits can encourage us to participate by design the exhibit experience to be fully experience by engaging the activity as described in guideline 7.1 and the example project Four Lives.

Dynamic information

We not only want choice and control over how we engage the exhibit but also the information we engage. Since we are all unique ranging in age, ability levels and interests and prior knowledge (Figure 9.3) designing exhibits is very challenging to satisfy a diverse audience. Designing information for different people is also difficult due to visitor's Identity as described in the Identity principle because Identity influences the use of prior knowledge and interests.

If the content and activities in exhibits can be dynamic in responding to match our needs learning increases because the information is more desirable as it matching our ability levels and prior knowledge. For example, *Where is the Animal?* and *What Animal is That?* example projects respond to different visitor's ability levels with the exhibit content and visitor activity by allowing the visitor to choose the content and activity. Design strategies to create dynamic experiences include guidelines 3.3 Interactive Guides.

Multiple Intelligences

We all have different ways of thinking and engaging the environment around us. One system for classifying these different abilities is the theory of Multiple Intelligences developed by Gardner with eight different learning styles. Most people possess all of them in varying amounts and combinations, and use them in unique ways specific to them (Gardner 1985).

Exhibits can use Multiple Intelligences as hooks, as described in the Attention principle, to capture our attention on activities and information. After we engage then we can expand our interest to other exhibit areas and topics (Landells 2004). Exhibits can also center visitor activities and cognitive activity on specific Multiple Intelligences, as described in the Apply principle. In doing so, our learning increases as we engage exhibits in our preferred ways. The eight Intelligences of Linguistic, Musical, Logical, Spatial, Kinesthetic, Naturalistic, Intrapersonal, and Interpersonal are described in detail in the following pages.

Linguistic

The Linguistic Intelligence is the ability to use words and language in speaking, listening and writing (Figure 9.5).

People strong in this Intelligence are sensitive to sounds, rhythms and the meanings of words. They are skilled at remembering words, explaining concepts and using language. They are also good at using language to persuade others to act and use language for reflection (Lazear 1986; Campbell, Campbell, and Dickinson 2004). In the zoo, visitors use the Linguistic skills to read signs, listens to zoo staff and in talking to their companions.

The example exhibit Who is Right? and Four Lives engages the Linguistic Intelligence by encouraging visitors to communicate with each other in coming to a consensus. Design strategies appealing to the Linguistic Intelligence may also appeal to the Intrapersonal and Interpersonal Intelligences as they both integrate communication with people. When the communication is between people the activity may also appeal to Facilitators.

Musical

The Musical Intelligence is the ability to recognize tonal patterns, environmental sounds and rhythms. People strong in this Intelligence are sensitive to pitch, rhythm and timbre and the emotional qualities of music and sounds. They use music and sounds to remember and learn non-musical information (Figure 9.6). Their strengths are in discerning different instruments and sounds; recognizing melodies; and when sounds are out of tune (Lazear 1986; Campbell, Campbell, and Dickinson 2004). In zoos the visitor experience is full of many sounds from visitor conversations, animal vocalizations, environmental noises, and mood setting music.

In the Four Lives example project visitors play musical instruments in the village and in the What Animal is That? exhibit visitors recognizing animal calls. The activity engaging the Musical Intelligence may also appeal to Explorers and Experience Seekers who want a unique zoo experience and allowing for creativity.

Logical

The Logical Intelligence is the ability of inductive and deductive thinking/reasoning, numbers, and recognition of abstract patterns. People with this Intelligence are skilled in solving problems and making rational decisions by using logical reasoning to make connections between information. They enjoy metaphors, discerning relationships (Figure 9.7), performing complex calculations, and scientific reasoning. The strength of Logical thinkers is their problem solving ability. They look for consistency in models and logical series (Lazear 1986; Campbell, Campbell, and Dickinson 2004). In the zoo, visitors use logic to draw conclusions between observations, presented information and their prior knowledge.

Example projects Mimic the Animal and Where is the Animal? engage the Logical Intelligence by encouraging visitors to observe their surroundings to understand the landscape and find animals. The activities engaging the Logical Intelligence may also appeal to Facilitators who assist their children in using their Logical Intelligence. The activity may also appeal to Professionals who have greater understanding of the content and critically think about the information and the exhibit.

The design guideline 6.3 Examples and Demonstrations may engage the Logical Intelligence by presenting models. Also, guideline 6.2 Conceptual Connections may also appeal to logical thinkers by assisting them in understanding conceptual relationships.

Spatial

The Spatial Intelligence relies on the sense of sight and being able to visualize an object (Figure 9.9), create internal mental images and navigate space. It is the ability to recognize relationships of objects in space, create graphic representation, manipulate images, and an active imagination. They express clearly seeing images in the mind and skills at drawing and designing but also geometry, navigation and visualizing landscapes from plan (Lazear 1986; Campbell, Campbell, and Dickinson 2004). In zoos visitors use their Spatial Intelligence extensively to understand interpretive graphics, observation of animals, and imagination. Visitors also use the Intelligence to navigate zoo exhibits (Figure 9.8).

The graphics in the Mimic the Animal example project engages the visual graphics aspects of the Spatial Intelligences. Whereas the navigation aspects of the Intelligences are engaged in the project example *Where is the Animal?* and *What Animal is That?* as visitors navigate the exhibit landscape to find and identify animals. The activity may also appeal to Explorers because visitors explore the landscape as they navigate space. The activity may also engage the Logical Intelligence as they determine how they move through space. Other activities in the zoo engaging the Spatial Intelligence may also engage the Logical Intelligence with visual graphics to understand graphics such as models.

Kinesthetic

The Kinesthetic Intelligence relies on the brain's motor cortex which controls bodily motion. It is the ability to control voluntary movement, control of pre-programmed movements, awareness through the body, connection between the mind and body and mimetic abilities (Figure 9.10). People with this Intelligence enjoy role-playing, dancing, creative movements, and games. They express skills in fine tasks with their hands and tasks requiring good coordination. People with this Intelligence use movement as a way to remember and learn information (Lazear 1986; Campbell, Campbell, and Dickinson 2004). The zoo visit is a physical activity and increasingly zoo exhibits (Figure 9.11) and interpretations integrate interactive activities.

The hands-on activities engaging the Kinesthetic Intelligence are a concrete experience facilitating learning. In the example project Mimic the Animal visitors participate in physical activities by mimicking animals. Also, in the Where is the Animal? example exhibit visitors climb rocks and trees while navigate space to locate animals as engaging the Spatial Intelligence. The activities may also appeal to Explorers, Professionals and Experience Seekers as visitors participant in hands-on activities.

Naturalistic

The Naturalistic Intelligence relies on our innate Biophilic qualities as humans and the ability to observe patterns in nature (Figure 9.12). People with this Intelligence express big picture thinking, observation skill, perceiving relationships by classifying, protection for nature, and environmentally friendly behavior (Campbell, Campbell, and Dickinson 2004). People come to zoos to observe, engage and be surrounded by nature.

The concrete experiences in zoos with landscapes and animals may engage the Naturalistic Intelligence. For example in the example projects Two Waterways, What Animal is That?, Primate Adaption and Where is the Animal? encourage visitors to observe the landscape.

Activities engaging the Naturalistic Intelligence may appeal to Rechargers if the activity involves peacefully sitting observing the landscape also engaging the Intrapersonal Intelligence. Professionals may also engage their Naturalistic Intelligence using their advanced knowledge to read the landscape.

Intrapersonal

The Intrapersonal Intelligence relates to inner states of being, self-reflection, metacognition, and awareness of spiritual realities. It is the ability to understand one's self by engaging their inner states of being, self-reflection and metacognition. People use this Intelligence to set goals, identify and expressing emotions, reflect on the wonder and purpose of life (Figure 9.13) and understand their learning. They express their skills by reflecting on important issues in life and deep psychological and philosophical issues, analyze themselves and have the courage to express their own opinions (Lazear 1986; Campbell, Campbell, and Dickinson 2004). In zoos parents believe the setting provides an opportunity for their children to learn morals respecting nature and understand their place in the world.

Rechargers may be interested in activities engaging the Intrapersonal Intelligence because they can have quiet places for reflection and contemplate of nature such as in the example project What Animal is That?. Another example project Who is Right? and Four Lives could engage the Intrapersonal Intelligence as visitors are encouraged to understand other people's feelings.

Interpersonal

The Interpersonal Intelligence relies primarily on person-to-person communication and an understanding of personal relationships. It is the ability to take the view point of others; understand others feelings, opinion, and beliefs; working cooperatively; sensitivity to others moods, motivations, and feelings; and verbal and non-verbal communication. A person with this Intelligence enjoys collaborative learning (Figure 9.14), conflict management, learning through service and appreciates personal differences, multiple perspectives and solving local and global problems. They express skills in social relations, making contacts with other people and get along with different types of people (Lazear 1986; Campbell, Campbell, and Dickinson 2004). In zoos many of the learning experiences contain socialization.

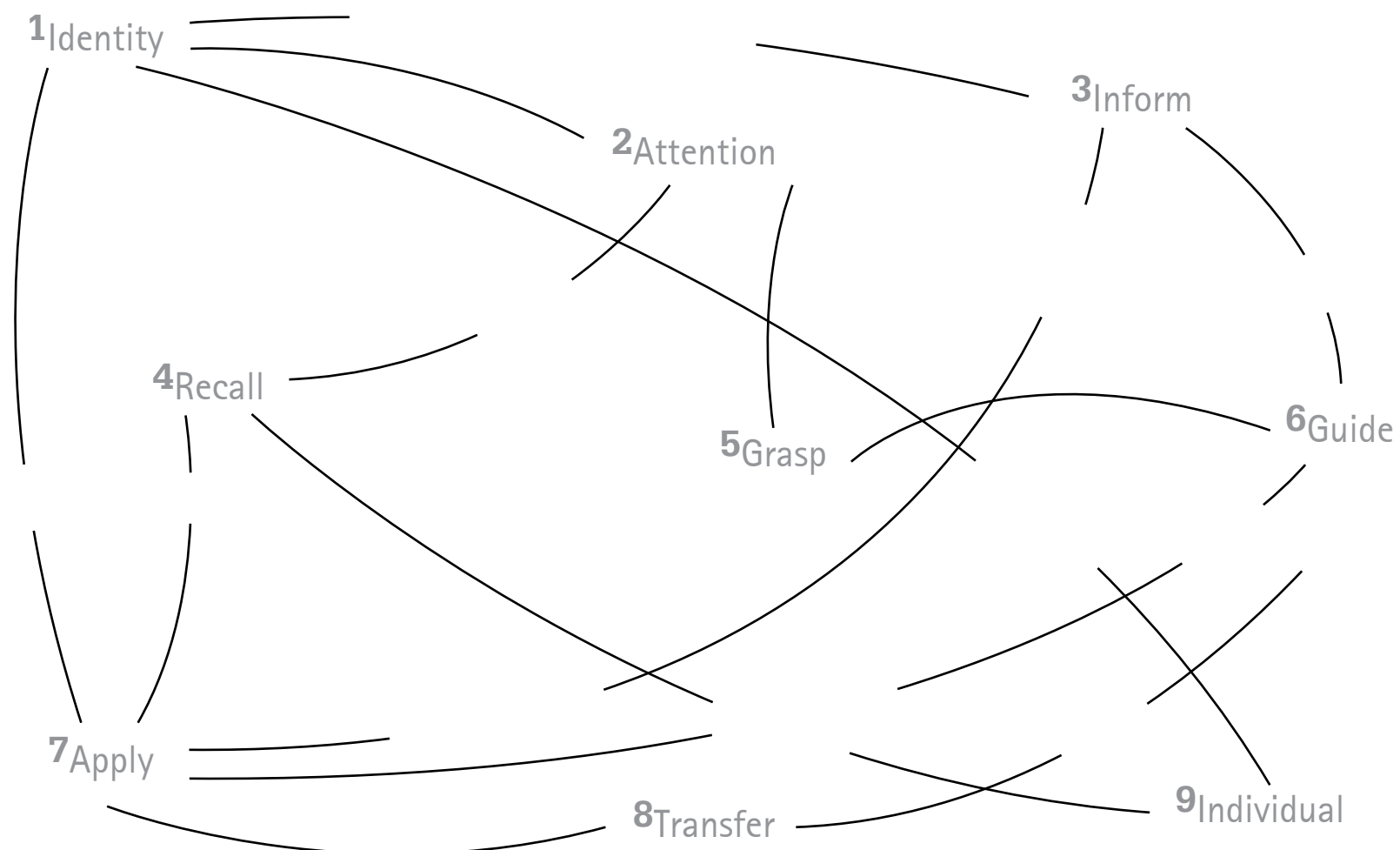
Activities engaging the Interpersonal Intelligence may appeal to Facilitators if the activity requires visitors to work together. The activity may also appeal to people with a strong Linguistic Intelligence if the activity requires using language to communicate. The example projects Four Lives engage the Interpersonal Intelligence as visitors work together to develop a solution and make a decision.

Individual summary

We all learn differently and use different processes. The eight Multiple Intelligences provide guidance in how exhibits can engage different cognitive processes. Not only do cognitive processes vary from individual to individual but also our prior knowledge and ability levels. Because of individual differences, we want choice and control in how we engage exhibits.

EXAMPLE PROJECTS

With an understanding of learning from the learning principles grounding the design guidelines, of seven hypothetical zoo exhibits illustrate the application of the design guidelines in the following example projects.



do they
RECALL PRIOR EXPERIENCES
in the exhibit ?



HELP THE OTTERS

Begin with visceral experience

Visitors encounter otters in both a healthy and unhealthy environment. They identify the problem and develop a solution to fix the problem by cleaning the otters' exhibit.

As a family enters into a new otter exhibit, the children run down the trail quickly approaching the low wall on the edge of the otter exhibit. They look eye to eye across at each the otters (Figure 10.1) as the otters swim under the logs and rest on the mud bank. An otter playfully approaches the window and looks across at the boy, then dives into the water. He tells his father, "I am as good a swimmer as the otter."

The children were excited to see the otters and quickly passed by the other elements along the pathway in their excitement. To focus visitors on the exhibit information, the anticipated animal, otters, are experienced before encountering information in the exhibit as a concrete experience (guideline 5.5). Additionally, the boy's intimate experience creates an emotional connection with the animal motivating caring and learning. The otters were selected to communicate information about water quality issues because many people are familiar with animals (guideline 2.10, 5.2) which act as a hook.

The Mimic the Animal example project also uses a visceral experience to begin an exhibit. A variation on beginning an exhibit is in Who is Right? example exhibit with a strong cognitive-emotional experience.

Stimulating recall with an element

The family then passes along a river bank and view the stream in profile with otters swimming next to a metal barrel (Figure 10.2). The boy says, "That water does not look very safe" as he points to a large metal drum in the river bank. As they walk away he says, "There is no way I would drink the water. I bet the otters would not want to drink the water either."

Visitors recall that the barrels could contain toxic substances which could be leaking into the water (guideline 4.3) because chemical are typically associated with large drums especially with warning labels, (guideline 4.1). A sign then prompts visitors to consider if they would drink potentially polluted water by asking 'would you drink the water' causing them to recall information about clean water and evaluate the water for drinking (guideline 4.2, 8.1). Another question, 'do otters drink water,' switches visitors thought to the otter's perspective (guideline 6.4). The situation increases cognitive-emotional arousal with both the unexpected features (guideline 4.5) and the questions asking visitors to evaluate the water for drinking.

Solve the problem

Further along the river is a tree overhanging the river with a tire swing. In the water and along the bank float plastic bottles (Figure 10.3). The boy says, "I would not use the swing to swim in the water because of the trash." His father replies, "I don't think the otters like it either" as he looks a sign by the swing.

The tire swing encourages visitors to recall experiences swimming and compare their experience with the otter (guideline 4.3). The sign asks 'would otters like to swim in the stream' (guideline 4.2) which works in tandem with the tire swing by making the message of polluted water visible and encourages contemplation (guideline 4.4).

The exhibit concept is based on the cognitive activity of encouraging visitors to make a connection between their preferences for clean water to otters. The same activity is repeated in the context of eating, swimming and drinking. Making this cognitive and emotional connection helps provide motivation for cleaning and protecting waterways (guideline 2.9).

This experience is critical in the final experience in the Help the Otters exhibit. A similar situation observing the landscape to determine a problem is in Two Waterways.

Unexpected situation prompts recall

The narrow river opens up to a hard-packed sand beach as the river bends. From up the bend, bottles float down the stream and wash-up onto the beach (Figure 10.4). The boy turns from the sign and points to the otter on the far steam bank and tells his father, "We should recycle this trash," as he picking up bottles and heads toward a green trash can.

The views are framed (guideline 3.1) so that the otters and trash are in the same area helping to make the connection that otter live in the same water. The boy knows from prior experiences that trash is dangerous to animals (guideline 4.5). A sign asking 'what can you do about the trash in the steam' prompts them to develop a plan for helping the otter (guideline 6.4). The exhibit suggests a possible solution with a green trash can with the recycling symbol on the side (guideline 4.1).

The cognitive-emotional arousing exhibit situation encourages visitors to engage the cognitive activity of comparing the clean stream at the beginning to the polluted water and identify the problem (guideline 2.9). They are then encouraged to apply their learning with the question and recycling can (guideline 6.3) in developing a solution to the pollution and enact that solution. Visitors can recycle the trash or report the problem to docents in the exhibit who explain the situation and facilitated visitors in developing a solution.

The previous exhibit situations set the stage for this situation.

Positive conclusion

After the beach the water is clear and the banks are free from plastic bottles. In the water otters swim playfully in the stream (Figure 10.5). The boy tells his father the otters are having happy because there is no trash and we can all help the otters as he points to the sign.

The exhibit ends with a positive situation providing hope that waterways can be cleaned to improve animal habitat (guideline 2.8). A sign thanking previous visitors for cleaning the stream supports their feeling that they can make a difference by working together. The positive emotion of helping the animals by picking up the bottles is associated with the memory of happy otters (guideline 6.5) so that when they encounter trash in waterways they can remember the positive experience with otters.

The final exhibit scenario is more meaningful due to the prior exhibit situation.

how do they
KNOW HOW TO LEARN
from the exhibit ?



WHAT ANIMAL IS THAT?

Briefing area example

Visitors use a smart phone app to identify animals in the exhibit. Throughout the exhibit they reference the app in identifying and locating animals.

A family walks into the exhibit and the mother approaches a sign, taller than her, explaining how to download an app for her smart phone (Figure 11.1). As her family walks around the sign she downloads the app. After it loads she asks her children, "What animal is in the exhibit." In front of her she points to a grey creature sleeping in the branches of the tree and her daughter announces, "It is a koala!"

The strong attraction characteristics of the large sign increase the chances visitors will read the sign by being isolated and large to ensure many visitors see the option to download the app explaining how to engage the exhibit (guideline 3.2). After informing visitors of the use and purpose of the app, the exhibit encourages visitors to use the app (guideline 7.1). The exhibit facilitates their application by directing and focusing their attention on the koalas by using a spot light as a focusing device (guideline 2.6). The light increases the contrast between the tree and surround dense canopy and undergrowth to assist their simultaneous scanning process. A familiar animal is used as an example to engage visitors (guideline 2.10). This initial situation manages visitors attention by focusing it on specific elements and reduces distractions by using a minimal number of elements (guideline 2.13).

This situation is directly connected to the next situation. A similar situation acting as a briefing area occurs in What Animal is That? example project.

Informing with an example

The daughter, now ahead of the group, tells them she was right as she points to another large sign. Her mother walks up and as she reads the sign explains how to use the information provided by the app to recognize the physical characteristics of animals to identify the species (Figure 11.2). After the sign the daughter then says they should take the right pathway instead of the middle or left paths because the phone explains they can see pademellons.

The sign reveals the answer and explains how this first small exhibit is an example to practice how to engage the exhibit (guideline 6.3). The sign informs visitors how to use the smart phone app through an example using the kolas (guideline 3.2). Also, the instructions explain how parents can engage their children in the activity, giving them the tools to enact their Identity (guideline 3.5). The initial exhibit sequence of informing sign, practice exhibit and answer sign stimulates a sequential scanning pattern to manage visitor's attention. The large signs and spacing creates a hierarchy facilitating the sequential scanning process (guideline 2.4, 2.5). After the practice situation, visitors are ready to explore the exhibit identifying animals they may not be familiar with because they are informed and oriented with the example (guideline 2.12).

A similar briefing area is described in Where is the Animal? example project.

Dynamic interactive guide

As the family walks through the exhibit a small grey animal hops across the pathway and joins a group of them browsing in the meadow near the path. The daughter says "I think I found them. It is small and grey and has many friends." The mother looks down at the phone and responds, "Does it have a short tail without a lot of fur. It must be a pademelon! (Figure 11.3)"

When visitors spot an animal they can use the smart phone app to reference the different physical and behavioral characteristics of the animal to determine the species (guideline 3.3). They may also hear different animal sounds, see footprints, or evidence of animals which are referenced on the phone to identify the animal engaging their Naturalistic and Musical Intelligences. The phone also offers a dynamic set of information about the animals from basic to detailed information appealing to different visitors (guideline 1.3).

To facilitate visitor's use of the phone app, alerts on the phone pop-up when they move into new ecosystems where they can potentially find new animal informing them of possible encounters. Additionally, iconic features in the landscape such as rock cliffs or tall trees assist visitors in recognizing the new ecosystem (guideline 2.6), (Figure 11.4).

Another exhibit example with a similar visitor activity is in *Where is the Animal?* example exhibit.

Fulfilling Identity

The father points, "There in the tree, it looks like a giant squirrel." Then the daughter asks, "Do you think they eat nuts like squirrels?" The father replies, "I bet they eat more than that because they are bigger than squirrels (Figure 11.5)."

As a facilitator, the father is scanning the exhibit for the animal instead of satisfying his prior knowledge as a construction worker by looking at the detailing of the bridge, because he wants to interact with his children by engaging them in the exhibit activity. The experience is filter through his Facilitator Identity influencing where he directs his attention and how he creates meaning. When one daughter asks what the red kangaroo eats he compares the red kangaroo to what he and more importantly his children know, squirrels. He explains their diet using his knowledge and experience with squirrels.

The activity of locating animals using the smart phone appeals to visitors with a Facilitator Identity (guideline 1.2) because the activity provides opportunities for interaction. As visitors identify animals only one person can use the phone at a time requiring them to communicate the animal features to other visitors, possibly engaging their Linguistic and Interpersonal Intelligences. Visitors can also work together pointing out animals in the landscape to the group as more experienced visitors help less experience visitors in interpreting the features in forming a consensus on the identified animal species.

Similar exhibit situations encouraging visitors to engage one another are in the example projects Four Lives and Who is Right?

Network of pathways

In the exhibit many of the animals roam freely residing in their preferred ecosystem, ranging from cliffs, forest, meadow and wetland. Some animals are restricted to contained enclosures, living in jewel boxes scatter throughout the landscape or behind nearly invisible piano wire barriers. The pathways split and merge forming a network of trails resulting in an infinite number of unique animal encounters where visitors can choose the route which appeals to their interests. Some pathways are narrow limiting circulation to a single-file line whereas others are wide allowing for casually strolling groups. These larger pathways lead to the entrances and exits of the exhibit providing visitors with physical orientation, supplemented with small directional signs. The entire experience provides concrete experiences with animals living in natural habitats (11.6).

The diverse experiences and the multiple opportunities for discovery appeal to visitors with an Explorer Identity (guideline 1.1). At key points in the exhibit signs inform visitors of the opportunity for investigation such as around the cliffs where climbing is encouraged (guideline 3.5). As visitors navigate the exhibit they use their Spatial Intelligence.

Another exhibit employing a network of circulation pathways is in the Four Lives example project.

Variety of experiences

As visitors approach one dividing pathway a sign explains that one trail is a dead-end and informs visitors that they need to be quiet on the trail to not disturb the animals. The instructions on the sign appeal to Rechargers who are searching for a secluded place to relax (guideline 3.5). It also discourages other Identities who may distract Rechargers such as noisy Explorers or Facilitators. At the end of the path, a bench overlooks a pond and waterfall with views to the animals (guideline 1.5), (Figure 11.7). The Rechargers may engage their Intrapersonal Intelligence as they reflect or the exhibit could stimulate reflection of by providing a context or design elements which spark thoughts (guideline 6.4)

The situation does not require visitors to act accordingly but suggests their behavior, maintaining visitor's choice and control (guideline 3.4). Throughout the exhibit visitors are not required to engage in the activity of identifying animals. Instead the exhibit encourages visitors to participate in the activity by appealing to different Identities. This maintains visitor's choice in what they want to engage and control over how they engage the exhibit.

how do they
EXPERIENCE CONCEPTS
in exhibits ?



MIMIC THE ANIMAL

Begin with concrete experience

Visitors mimic animal's behavior during different activities as they learn about the evolution and adaption of primates.

A group of visitors enter into an exhibit and across the depression from the family is a gorilla chewing on a branch. The boy says, "Look at how strong the gorilla is. He almost pulled the branch off the tree." In the background another gorilla climbs in the trees from branch to branch (Figure 12.1).

The exhibit is about adaptation and evolution. Visitors first have a concrete experience closely encountering the gorillas (guideline 5.4) which acts as a hook. The experience is later referenced in the exhibit when abstract concepts are linked to the concrete experience with the gorillas (guideline 8.4). Also, the experience is recalled when abstract concepts are centered around a familiar animal such as the gorillas (guideline 2.10, 5.2).

This first experience is recalled in later exhibit situations. A similar project starting with a close animal encounter is in the Help the Otters project.

Linking

The family walks around some shrubs to an activity area. A father helps his son put on a gorilla suit and tells him, "You now have the strength of the gorilla (Figure 12.2)." The boy then stands on a rock and reaches up to grab tree branches. He shouts to his father, "I can hardly reach the branches because my muscles are in the way."

After the concrete experience with the gorillas, visitors first understand different physical abilities caused by anatomical differences by wearing a gorilla suit (Robinson 1996), engaging visitors Kinesthetic Intelligence. In the testing area, the gorilla suit helps visitors understand the physiology of gorillas by mimicking gorillas while wearing a suit which limits their normal movements due to increased muscle mass (guideline 5.5). As the boy climbs on rocks and trees experiencing the limited range of motion firsthand, he experiences the abstract concept of different anatomy effecting mobility from the concrete experience. The activity of wearing the suit becomes an example of the information in the exhibit (guideline 6.3). To focus visitor's attention on the activity, views to the gorillas and other exhibit elements are limited in the testing area, encouraging a sequential scanning process (guideline 2.5).

In this experience the previous situation is recalled. Another exhibit linking abstract concepts to a concrete experience in in the example project Two Waterways.

Concrete contextualization

After taking off the suit, the boy approaches a glass viewing area where a gorilla is lying on the grass. He looks wide-eyed at the gorilla and tells his father, "The gorilla is stronger than I am (Figure 12.3)."

This concrete experience with the gorilla (guideline 5.5) provides a second opportunity to contextualize the experience of wearing the gorilla suit. The up close encounter with the real animal facilitates visitors in making conceptual connections to the information learned in the activity to their observations of the animal (guideline 6.2). As the visitors reflect on the situation they reflect on the strength with greater appreciation of the gorilla after understanding how their anatomy differs, engaging their Intrapersonal Intelligence.

After this initial activity of wearing the gorilla suit to learn about how anatomy relate to physical ability. The second half of the exhibit focus on repeating the concept in different situation (guideline 7.8) and adding another conceptual layer, evolution and time. The Concept Hierarchy Diagram assisted in the design process in identifying and organizing the concepts.

This situation contextualizes the previous situation. A similar visceral experience used to contextualize information is in the Help the Otters exhibit.

Abstract concepts

From the window the father walks over to a sign explaining primate evolution. They walk along the panel winding through the exhibit (Figure 12.4). Outlines of different primate species are on the timeline. They stop in front of a bright yellow outline of a monkey with limbs extended. Beyond the sign a monkey swinging from one branch to another and the father tells the boy, "Look at its long arms (Figure 12.5)."

The timeline describes the evolution and adaptation of primates through time. The vast evolutionary timescale's abstraction is reduced by converting it to a linear distance (guideline 5.3). On the sign, the different primates from the past are spaced-out corresponding to units of time with extant species for examples to compare the extinct to the living species making an abstract conceptual connection (guideline 5.1). The graphic sign engage the Spatial and Logical Intelligences demonstrating relationships and patterns.

To assist visitors in connecting the sign with the animal example, the outlines of the animal have increased attraction characteristics which are a bright color directing visitor's attention. Visitors can then make conceptual connections between the abstract sign and the concrete living animal making a physical conceptual connection (guideline 5.1).

The information presented in this situation is applied in the following situation. A similar situation using animals to reduce the abstraction is in the Two Waterways example project.

Linking experiences

Next to the viewing area tree branches extend over the trail forming a network above them. The boy points to a sign and challenges his father to a race as a monkey. The father takes the higher wider spaced branches while the boy takes the lower ones. They swing from branch to branch racing to the end. The boy tells his father, "Slow down your arms are longer, like the monkey's (Figure 12.6)."

The climbing activity provides a firsthand experience of how limb length affects climbing ability to make a connection to understand the advantages of long arms, evolutionarily (guideline 5.4) by engaging the Kinesthetic Intelligence. The instructional sign encourages visitors to race each other in climbing like a monkey (guideline 3.2). The climbing activity assists visitors in linking experiences of watching the monkey and climbing like a monkey.

Visitors make conceptual connections between arm length using the abstract concepts from watching the monkey and reading the sign to the concrete experiences of comparing each other's climbing ability (guideline 6.2).

The activity is a concrete experience of the previous experience.

**How do they
USE THE INFORMATION
to explore ?**



WHERE IS THE ANIMAL?

Briefing area

Visitors select an animal to find in the exhibit. Throughout the exhibit, visitors use clues explaining information about the animal to locate the animal in the exhibit.

A family enters into a thatched building where a park ranger greets them. The ranger explains that they can select an animal to find in the exhibit using clues. The girl points to a picture of the lemur from the movie Madagascar and decides to search for the Ring-tailed lemur. Her father says they will find it together. The son interjects, "I can find the hardest animal before you can find the lemur," and selects the small ring-tailed mongoose. After selecting the animals the family enters into the landscape in search of the first clue (Figure 13.1).

In the briefing area zoo staff informs visitors of the exhibit activity, orienting them to the exhibit. Visitors have the choice to select the animal of their choice (guideline 3.4, 2.10). The information is dynamic in that visitors choose the animal to find which have varying degrees of challenge appealing to different skill levels, Identities and age groups. The activity acts as a hook interesting visitors by engaging different Multiple Intelligences and appealing to different Identities.

A similar exhibit briefing area situation is in the What Animal is That? example exhibit.

Maximum choice and control

Upon entering into the landscape the boy remembers the ranger told him ring-tailed mongooses eat insects and remembers past experiences gathering bugs under rotting trees. In the shrubs he sees a dead tree and veers onto the mulched path into the underbrush following a narrow dirt trail. His sister and father continue briskly down the path in search of the lemur while his mother meanders looking at the plants, unconcerned with finding an animal. At the tree, he finds a small sign with a picture of a ring-tailed mongoose. It says 'I have claws to find bugs.' As he deciphers the meaning of the clue he sees people in the tree and thinks they may use their claws climbing trees for bugs (Figure 13.2).

The boy uses the clue on the sign, which acts as a static interactive guide (guideline 3.3) to inform how he engages the exhibit in determining a course of action. Not only can visitors engage the exhibit activity but visitors can choose to participate in the locating the animal activity or they can stroll through the exhibit enjoying the animals, plants and place. They also decide their level of engagement in the exhibit maintaining their choice and control (guideline 1.1).

Visitors may have a hard time selecting where and what to engage because of the undefined pathways and many not know what to expect in the exhibit. Too much choice can overwhelm visitors distracting them from learning. To minimize disorienting visitors, they are informed of the activity and provided with physical orientation such as a map.

A similar example project using an interactive guide and providing a variety of experiences is the What Animal is That?

Built-in feedback

While the boy climbs the tree he sees some insects climbing into a tree hollow. In the hollow doesn't find an animal but another clue, 'I have claws not for climbing but for digging.' He climbs higher into the tree house and finds another clue saying 'I like bugs living near slow moving water.' He looks out from the tree house at the exhibit and sees a swampy area next to the river (Figure 13.3).

He uses the first clue about claws to form a hypothesis using his knowledge and understand of other animals with claws (guideline 6.4), applying his learning. When he finds the next clue, in the tree hollow, his hypothesis is tested and he finds it incorrect. The second sign provided built-in feedback on his use of the first clue. If he would have found the animal he would have also received feedback confirming his hypothesis (guideline 7.2). To test his hypothesis he must interact with the exhibit through navigation (guideline 5.4).

A similar exhibit providing built-in feedback is in Four Lives example project.

Intrinsic reward

The boy then walks across the rope bridge and climbs down the tree to the water's edge. As he climbs over the rocks he sees an animal with long claws quietly digging in the mud. He silently fist pumps trying not to startle the animal. After watching the animal for a few minutes he goes to find his parents to bring them back to show them the animal he found without their help (Figure 13.4).

He feels pride and satisfaction in accomplishing the task alone (guideline 7.3). His confidence in using his Logical, Spatial and Naturalistic Intelligences increase as he interprets the clues and navigates space while understand more about the ring-tailed mongoose behavior.

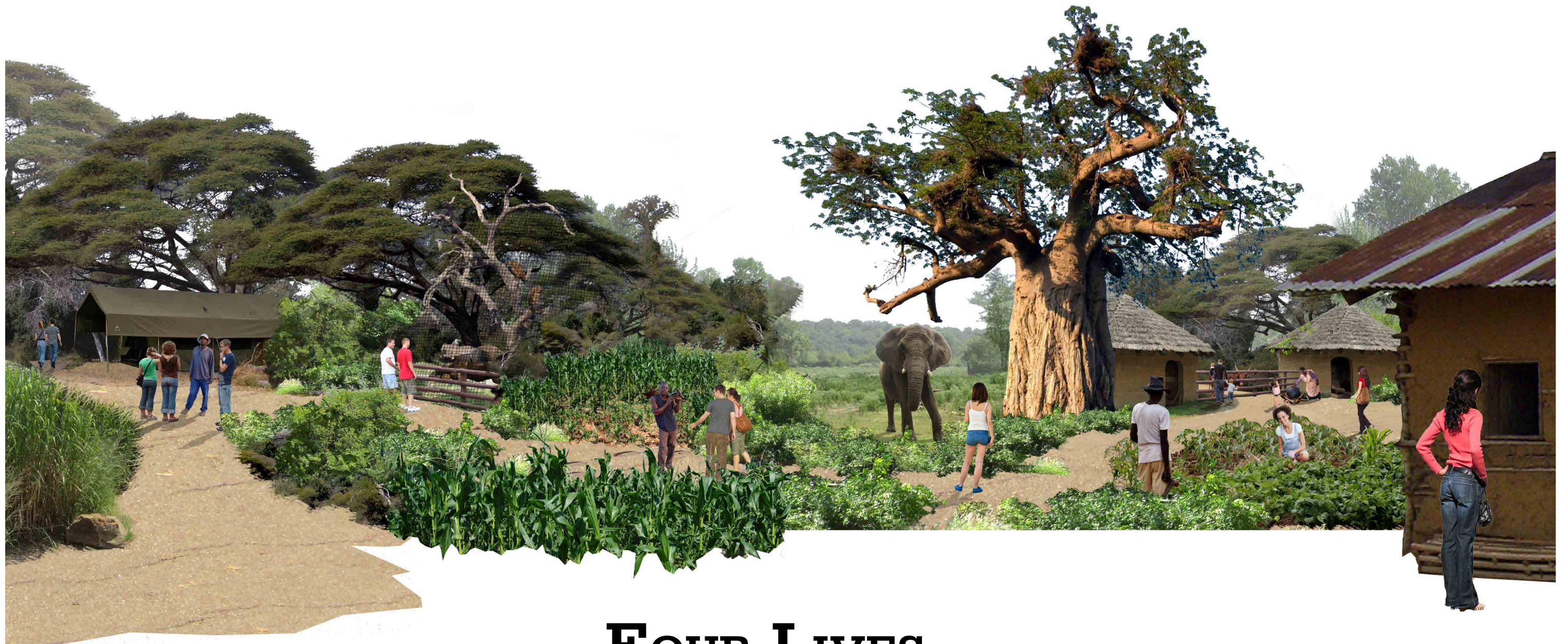
A similar exhibit acting as an intrinsic reward is the Help the Otters example project.

Locate the animal

The entire exhibit concept is centered around the cognitive activity of locating the animal. The activity of using clues to find the animal requires visitors to understand the concepts on the clues and apply their understanding to navigate the exhibit in search of the animal (guideline 7.1). Visitors need to understand the clues and transfer the concepts to what they observe in the environment. The activity appeals to Explorers as they move through the exhibit encountering unexpected experiences (guideline 1.1). The exhibit also appeals to Facilitators as they work as a group to locate the animal (guideline 1.2).

A similar exhibit with a great diversity of experiences and a network of pathways is the What Animal is That? example exhibit.

how do they
USE THE INFORMATION ?
to navigate



FOUR LIVES

Selecting exhibit experience

Visitors role-play different people in an African ecosystem with elephants. Through the experience they make decisions which influence their experience.

A family walks into an African town where a local villager greets them. He explains that they can help elephants by making exhibit money during the exhibit (Figure 14.1). They can either be a Farmer in the next village, a wildlife officer at the ranger station, or help a man in the bush. The family decides to be farmers.

The exhibit centers around elephants and their relationship with humans (guideline 2.10). The exhibit begins by informing visitors of how they can experience the exhibit. Visitors are not required to participate in the role playing activity, maintaining their choice and control, but encouraged to participate in the enhanced exhibit experience. Visitors receive extrinsic rewards in the exhibit to drive the decision making process and act as hooks to increase visitor's interest in participating in the activity. In designing the reward, the reward relates back to conservation since they give the money back to conservation efforts (guideline 7.4).

Other examples of briefing areas are in the example exhibits Who is Right?, Where is the Animal? and What Animal is That?

Comparing lifestyles

The family leaves the town walking into the African bush. They approach a fence of acacia branches containing native cattle. The girl points at the sign and explains, "These are not like the cows at home (Figure 14.2)."

The farmer role-playing experience begins by encouraging visitors to compare their lifestyles to the African villagers (guideline 8.1). A sign stimulates recall of prior knowledge by asking 'where does your milk and hamburgers come from.' The question prompts visitors to recall prior knowledge for comparison in the exhibit situation (guideline 4.2). Then another sign guides thoughts with a similar question 'what do villagers eat (guideline 6.4)'. This initial experience begins to help visitors compare their lives to others' lives in understanding why people make the decisions in relation to animals.

Another exhibit situation relating the exhibit to visitors daily lives is in the Who is Right? example exhibit.

Extrinsic reward

After walking past the corral the family enters into the Boma village. A villager greets them, who explain they can make money by helping in the village. The girl decides to help one of the local women prepare a traditional dish. She tells the girl how to grind the corn and that her husband grew the corn in a local field. After cooking the dish the girl enjoys the food and the woman says, "I am not the only one who likes corn - elephants also like corn (Figure 14.3)." When visitors leave the village they are told they can help a villager working the fields at the end of the trail.

Visitors participate in activities designed to engage their different Intelligences where they learn about the culture of the local people. As visitors are completing the task, the actors working in the exhibit provide visitors with feedback on their application of learning in completing the tasks by receiving exhibit money (guideline 7.1). The activities may appeal to Experience Seekers since they are unique experiences (guideline 1.4).

This situation builds on the previous situation in illustrating the commonalities in their lives in preparation for future situations.

Visceral experience

After leaving the village, the family walks through the savanna weaving between grasses and acacia trees. Around a bend the trail widens and to the right of a baobab tree is an elephant. A cloud of dust drifts from the elephant as he tosses dirt on his back. The girl quietly proclaims, "Look how beautiful she is (Figure 14.4)!"

The exhibit is designed to evoke a visceral experience in visitors (guideline 5.5) by crafting views of where elephants will most likely be seen and by creating a beautiful scene with baobab trees (guideline 2.6). The concrete experience hopefully inspires visitors to care about the animal by making an emotional connection with the elephants. This emotional connection is important later in the exhibit experience when they have to make a decision, guided by the Concept Hierarchy Diagram and Cognitive Processes Diagram.

This exhibit situation is critical in later exhibit situations.

Recall learning

The family then walks into a field of corn. As the rows spread out before them, the girl says, "This must be the field where the village grows their corn." The straight stalks then changes to pointed stumps in a field turned to mud. Large round impressions cross the pathway where a man is surveying the damage. He asks them, "Are you here to work the fields? If you are you cannot because the crop is destroyed." The girl asks, "What happened to the field?" He tells them it was an elephant and he no longer needs help so they can return to town (Figure 14.5).

When visitors first enter the field, a sign stimulates them to recall information from the village about corn (guideline 4.2, 4.4). The girl makes a conceptual connection between the living plant and the cooking activity by apply information about corn in a new context (guideline 7.5, 8.4). Then when they enter into the trampled field the actor explains one side of the conflict between people and elephants. Elephant footprints encourage visitors to conclude the elephants were in the field. If visitors did not make the connection the trained actor facilitates visitors in making the connection. As visitors interact with the actor they engage their Interpersonal Intelligence.

The exhibit experience relates to a prior exhibit experience.

Warn of a distressing situation

The family leaves the field and enters into the bush where vultures gaze from above. Then in the distance, gunshots echo beyond the trees to their left. In the direction is a dead elephant where other vultures stand on the animal (Figure 14.6).

The poached element is an unexpected feature which increases cognitive-emotional arousal (guideline 4.5). This visceral experience is the counter point to the earlier experience at the beginning of the exhibit when they were viewing elephants (guideline 8.4). Multiple measures are taken to warn visitors of the potentially distressing situation (guideline 2.7). First, the powerful stimulus of the gunshot used to direct visitor's attention on the content (guideline 2.1) is strategically used at a point in the exhibit when visitors must experience the situation. Visitors need to gather the experience in preparation for making a decision (guideline 2.3) balancing this situation with previous ones. The decibel level of the noise needs to direct attention but not startle audiences (guideline 2.2). Also, the gunshot is a subtle clue of the coming situation. Second, another sign suggests poachers are in the area, informing the visitors of the potentially distressing situation. A final measure taken to warn visitors is a direct warning from a sign explaining the graphic content and provides an alternative route if the situation is too power for some visitors (guideline 2.2).

The situation is counter to a previous exhibit situation. Other similar exhibits potentially creating a distressing situation are in the Help the Otters and Who is Right?

Making a decision

After the vultures the family comes upon a camp. In the camp a man approaches them, walking past a pile of elephant tusks. He tells them he has some work for them tracking elephants. One of the boys suggests they should help the man. However, the girl doesn't want to endanger the elephants and reminds them of the dead elephant and the beautiful elephant seen earlier in the day. Then the man says, "Elephants are not helping anyone, if anything they are diminishing the farmer's and the villagers' lifestyle by destroying crops. You can either help me down that path or go back to town the other way." After discussing their options the family takes the trail back to town (Figure 14.7).

The actor in the exhibit is trained in helping groups work together to make a decision (guideline 1.2). He encourages them to recall information and experiences from earlier in the exhibit (guideline 7.5) and potential experiences from their prior life experiences (guideline 7.7). As part of the information recalled he encourages recall of emotions by referencing the emotional situation from earlier in the exhibit (guideline 4.7). He helps visitors consider the situation from others point of view to understand the dilemmas facing the local people in surviving in the landscape while coexisting with elephants engaging visitors Interpersonal, Intrapersonal and Linguistic Intelligences, as they apply their learning in choosing a pathway (guideline 7.1).

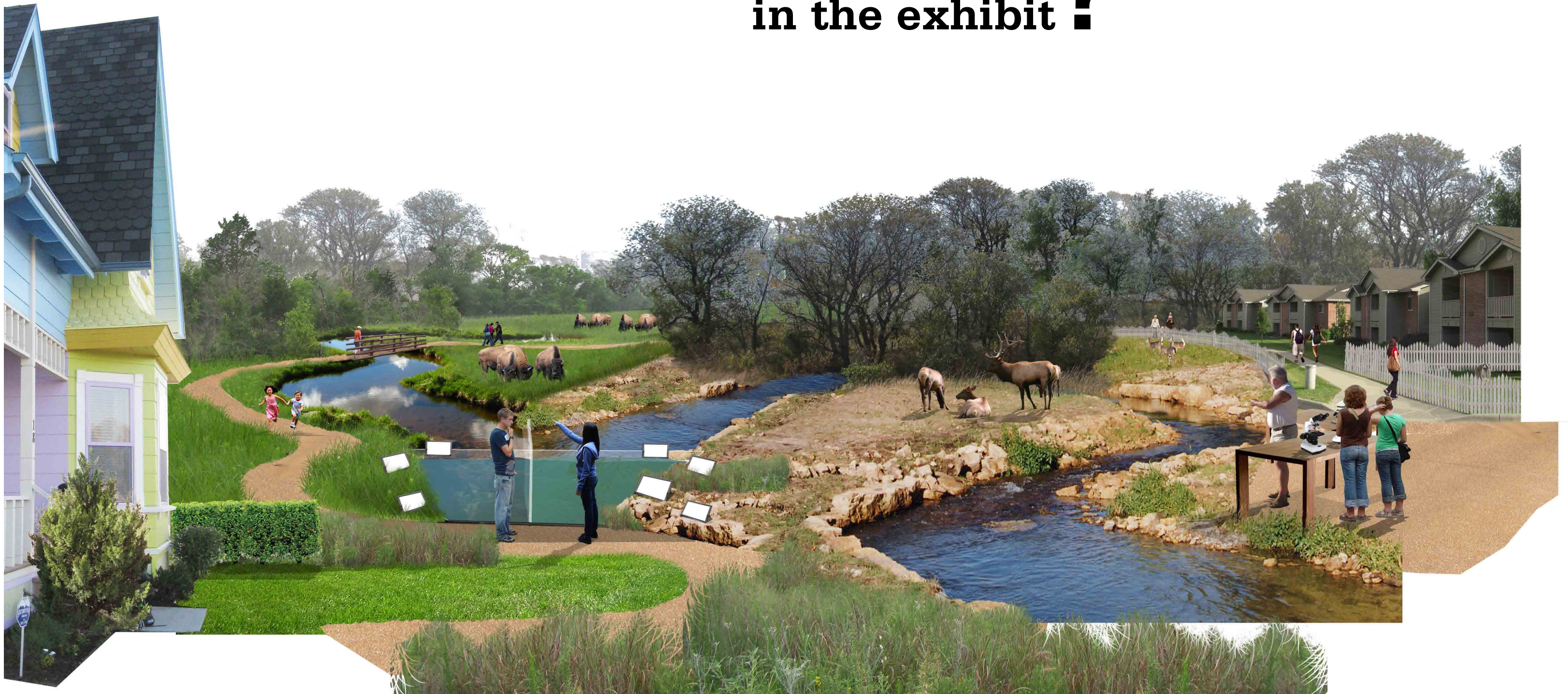
Previous situations in the exhibit are recalled in making the decision.

Consequences of actions

After the family decides which pathway to take they receive feedback on their decision during the cognitive activity (guideline 7.1). The exhibit provides built-in feedback from the experience as visitors encounter in the next situation which could be positive or negative. For example, if visitors choose to help the poacher the pathway leads to the visitors arrested as poachers, suggesting an incorrect application of learning. If visitors take the second pathway towards town they see the elephants in a safe environment on a way back to town (guideline 2.8). Visitors are free to interpret the feedback because the exhibit does not explicitly tell visitors if they selected the correct pathway (guideline 7.2).

The exhibit experience is dictated by the of the decision they make as feedback. Another exhibit with built-in feedback is Where is the Animal?

**how do they
DIRECT THEIR ATTENTION
in the exhibit ?**



Two WATERWAYS

Reduce the abstraction

Visitors experience two similar landscapes with different animals and land management systems resulting in differences in water quality. The exhibit culminates with visitors identifying factors influencing water quality.

As a family enters into an exhibit, the girl runs to a microscope where a docent pulls water from the stream behind the table. While she is examining the water, the docent explains the contents in the water are a result of excessive runoff. She then calls for her mother, "Come look at the creatures swimming in the murky water (Figure 15.1)." The docent then gives her clean water from a healthy stream to examine.

In the exhibit visitors learn about the effects of poor water quality. First visitors use microscopes to watch algae (guideline 2.11), dirt and other suspended materials in the water before learning about the causes (guideline 5.4). Visitors compare the two water samples to understand the differences in water at the microscopic scale. The concrete experience of seeing the microscopic organisms reduces the abstraction of the small scale (guideline 5.3).

Another exhibit reducing an abstraction is Mimic the Animal.

Observation of the landscape

The family follows the stream to a suburban landscape with houses, driveways and bright green lawns with raccoons and other urban wildlife (Figure 15.2). The daughter pushes a button and rain falls onto the landscape, quickly flowing into the adjacent rural landscape. Deer, elk and other animals live in the many gullies and bare earth, continuing down to the stream below (Figure 15.3). Through the exhibit signs and interpretives explaining erosion and the factors contributing to poor water quality.

The exhibit provides a concrete experience of the water flowing off the suburban landscape, familiar to their daily lives (guideline 8.1) increasing cognitive-emotional arousal. The suburban and rural exhibit context (guideline 4.4) reduces the abstract process of runoff (guideline 5.3) by demonstrating an example at full scale with water directly eroding the landscape (guideline 6.3).

A similar exhibit reducing abstraction is in the Mimic the Animal example exhibit.

Comparison

As the family walks through the landscape the grasses suddenly change to tallgrass prairie with buffalo. The girl again makes it rain but this time the drops fall onto tall grasses. The water moves more slowly across the landscape. Throughout the prairie, signs and interpretives explain erosion and the factors improving water quality (Figure 15.4).

The second landscape is a concrete example of a landscape with healthy water quality. Visitors encounter the two landscapes (guideline 4.4) one after the other with a sharp contrast to assist visitors in noticing the break between the habitats increasing the attraction characteristics. This example with good water quality demonstrates examples how to improved areas with poor water quality (guideline 6.3) embedding how to improve the landscapes with a positive memory of the animals (guideline 6.5). The emotionally positive situation also prepares visitors to apply their learning in the next exhibit situation (guideline 7.6).

This exhibit situation is counter to the previous situation which together are critical in the next situation. A similar exhibit situation evoking a positive situation is Help the Otters.

Understanding the landscape

The family walks through the tall grass until they rejoin the stream. As they follow the stream, the path begins sloping down. From the depressed position they can see the two different landscapes in front of them. The girl runs up to the glass at the bottom of the slope and her mother reads a sign 'why is the water two different colors.' The girl says, "The green water is caused by the little animals swimming in the water." Her mother turns from a sign and asks, "Where is their extra food coming from?" The daughter points to a bright green lawn near the houses at the top of the hill (Figure 15.5).

Visitors see the two streams conjoin in profile. The differences in water color are highlighted by a sharp contrast. The first question informs the family they are to compare the two landscapes (guideline 3.1). Then the second question stimulates recall of learning about eutrophication at the beginning of the exhibit by directing their attention to the water (guideline 4.2, 7.5). Additional questions guide them in using their new knowledge (guideline 7.1) to understand the potential reasons for changes in water clarity (guideline 6.4). The exhibit facilitates the processes by directing their attention to the lawn with contrast by increasing attraction characteristics (guideline 2.6) as they use a simultaneous scanning process. Also, a hierarchy of signs helps visitors understand the important and easy questions (guideline 2.4).

The information from the two previous situations are in this situation.

Divergent thinking

As the family leaves the stream, the prairie sharply changes to bright green lawn, a question asks, 'How to take care of your lawn?' The daughter asks her father, "Do you put fertilizer on the yard (Figure 15.6)?" The father replies, "We use less after watching that TV show."

The question and lawn (guideline 4.1, 4.2, 4.4) cue the family to make the connection between fertilizing their lawn to the exhibit experience (guideline 8.5). As they leave the exhibit the conceptual connections are made to other situations and information guided by the exhibit situation which they are familiar with in their daily lives (guideline 8.1). The visitors connect the information to a public service announcements on television asking people to reduce water and fertilizer usage (guideline 8.3).

Another exhibit encouraging divergent thinking is in the Who is Right? example project.

how do they
RESPOND TO THE SITUATION?
in the exhibit?



WHO IS RIGHT?

Create an introductory context

Visitors encounter two sides of the conflict between wolves and ranchers. At the end of the exhibit, visitors form an opinion and develop solutions to the problem.

A girl with her family enters into an observation area overlooking wolves. As they enter the space a sign on the wood railing asks 'what do wolves eat.' She walks up to the railing and picks up the binoculars hanging from the railing. She zooms in on the wolves eating some large animal and asks, "What are the wolves eating? They are too far away (Figure 16.1)." As they leave the observation area another sign asks 'what types of meat do wolves eat.'

Before the exhibit visitors prior knowledge of wolves is recalled (guideline 4.6) using an exhibit map which points visitors to direct the binoculars at specific elements such as the eating wolf (guideline 3.1). Then two questions in the observation area work together creating a scenario which poses a question to visitors to contemplate and search for an answer to during the exhibit (guideline 6.4). The first question encourages recall of basic prior knowledge about wolves possibly learned in school (guideline 4.2, 8.2). The situation observed supports the typical answer to the question, meat, and is a question in itself due to the unclear view. Next, the second more focused question asks for a specific answer.

Animal selection

The family then walks down the hill into tall trees where cattle are grazing in a meadow. Near the edge of the path is a rancher who explains that the wolves are attacking his cattle and he relies on ranching for his livelihood (Figure 16.2).

The exhibiting of the humble cow is an unlikely pick for an animal in a zoo exhibit however is critical in understanding the exhibit message because it physically illustrates the exhibit message (guideline 2.11). First, cattle are the flash point in the conflict between wolves and humans. This concept needs to be highlighted and experienced to understand the relationship. Secondly, people are increasingly becoming disconnected with nature and our food supply. Many urban dwellers may have not experience where their food comes from first hand, providing a concrete experience (guideline 5.2, 8.1).

Another example project including non-traditional animals is in Two Waterways.

Reinforcement

The group then enters back into the forest where they encounter wolves. A wolf sign says 'I don't like eating cattle.' The daughter tells her mother, "In school we learned about wolves and they live in packs which work together to hunt deer (Figure 16.3)." Then in a clearing near the wolves, she sees the animal the wolves were eating when she was using the binoculars. As family looked at the wolves eating, her mother reads the sign in front of them explaining the diet of wolves and their behavior. She asks her daughter if she remembered how differently wolves lived with Native Americans compared to us today from the history museum (Figure 16.4).

The exhibit presents the wolves' side of the conflict, potentially confronting misconceptions about wolves by demonstrating wolves eating deer (guideline 4.5) increasing cognitive-emotional states (guideline 2.9). The exhibit also provides an answer to the beginning of the exhibit (guideline 7.5). The exhibit message is coordinated with other institutions and stimulates visitors to make connects to other experience (guideline 8.3) as the visitor recall learning from the museum (guideline

This experience is the answer to the question posed at the beginning of the exhibit.

Form an opinion

After the wolves the group encounters a herd of elk. A sign explains elk have less area to live because of development and competition with cattle (Figure 16.5). Visitors then climb up a hill to another observation area overlooking the wolves, cattle and elk. Signs explain how the wolf has been reintroduced and growing into a breeding population but are creating conflicts. An interactive sign ask visitors to vote on who they believe is correct in the conflict - the rancher who wants the wolves gone, the elk who wants more space to live, or the wolf who wants to live. After visitors vote then the interactive interpretation element shows how other visitors have voted.

From their position they can see all the players in the situation helping to remind them of the prior experiences (guideline 7.5). Visitor vote on a situation which they potentially communicate together to come to a conclusion, engaging their Linguistic Intelligence. After visitors have voted on the situation (guideline 7.1) they see how other visitors have voted. Seeing how others voted demonstrates to visitors how as a collective group they can make a difference using their combined voice helping to overcome perceived social obstacles in changing their behavior, becoming feedback (guideline 7.2). The activity engages the Intrapersonal Intelligence by both helping the understand other view points in the feedback but also in making the opinion requires visitors to think of others.

The previous exhibit situations influence how visitors vote.

Creative solutions

After voting the family then develops ideas which could solve the problem. Interpretation explains how wolves have repopulated an environment from which they have been removed when given the opportunity (Figure 16.6).

In preparation for creating a solution a positive emotional state is evoked by providing hopeful information about reintroductions (guideline 7.6). The positive state helps visitors develop more creative solutions as they apply their learning (guideline 7.1). The elevated position of the activity gives visitors views back to the entire exhibit encouraging recall of prior learning experiences (guideline 7.5). With the prior learning recalled, the activity also encourages divergent thinking as they develop ideas to combine and synthesize information (guideline 8.5). The ideas relate to their daily lives by asking how they can make a difference and develop solutions they can participate in especially if the exhibit is located in natural range of wolves (guideline 8.1). To manage visitor's attention the information spaced apart with fewer elements (guideline 2.13).

This situation builds on the previous situation. Another example of divergent thinking is in the Two Waterways example project.

REFERENCES

- Ajzen, Icek. 1991. "The Theory of Planned Behavior." *Organizational Behavior and Human Decision Processes* 50 (2): 179-211.
- Ardoin, Nicole. 2009. "Behavior Change Theories and Free-Choice Environmental Learning." In *Free-Choice Learning and the Environment*, edited by John H. Falk, Joe E. Heimlich and Susan Foutz, 57-73. Lanham, MD: AltaMira Press.
- Bell, Philip, Bruce Lewenstein, W. Andrew Shouse, and A. Michael Feder. 2009. *Learning Science in Informal Environments: People, Places, and Pursuits*. Washington, D.C.: The National Academies Press.
- Bernard, Eric. 2012. Image used with permission.
- Bitgood, Stephen. 2010. "An Attention-Value Model of Museum Visitors." *Center for Advancement of Informal Science Learning Newsletter* (15).
- Bitgood, Stephen. 2002. "Environmental Psychology in Museums, Zoos, and Other Exhibition Centers." In *Handbook of Environmental Psychology*, edited by Robert B. Bechtel and Arza Churchman, 461-480. New York: John Wiley & Sons.
- Bloom, Benjamin S., Max D. Engelhart, Edward J. Furst, Walker H. Hill, and David R. Krathwohl. 1984. *Taxonomy of Educational Objectives: The Classification of Educational Goals*. Vol. 2. New York: Longman Inc.
- Buffington, Jared. 2012. Image used with permission.
- Campbell, Linda, Bruce Campbell, and Dee Dickinson. 2004. *Teaching and Learning through Multiple Intelligences*. Boston: Pearson Education.
- Chaffar, Soumaya and Claude Frasson. 2005. "The Emotional Conditions of Learning." Clearwater, FL, USA, AAAI Press, 2005.
- Clayton, S. 2009. "Zoo Experiences: Conversations, Connections, and Concern for Animals." *Zoo Biology* 28 (5): 377.
- Coe, Jon C. 1985. "Design and Perception - Making the Zoo Experience Real." *Zoo Biology* 4 (2): 197-208.
- Coe, Jon C. 1996. "What's the Message? Education through Exhibit Design." In *Wild Mammals in Captivity: Principles and Techniques*, edited by Devra G. Kleiman, Mary E. Allen, Katerina V. Thompson and Susan Lumpkin. 1st ed., 167. Chicago: The University of Chicago.

- Coe, Jon C. and Ted Beattie. 1998. "Twenty-First Century Management Systems for Twenty-First Century Zoo Exhibits." Bethesda, MD, American Zoo and Aquarium Association, 1998.
- Coe, Jon C. and Greg Dykstra. 2010. "New and Sustainable Directions in Zoo Exhibit Design." *In Wild Mammals in Captivity: Principles and Techniques for Zoo Management*, edited by Devra G. Kleiman, Katerina V. Thompson and Charlotte K. Baer. 2nd ed., 202-215. Chicago: The University of Chicago Press.
- Conway, William G. 2007. "Entering the 21st Century." *In Zoos in the 21st Century: Catalysts for Conservation?*, edited by Alexandra Zimmermann, Matthew Hatchwell, Lesley A. Dickie and Chris West, 12-21: Cambridge University Press.
- Dallas World Aquarium. 2012. Field Guide, accessed January 5, 2012.
- Dierking, Lynn D., Leslie M. Adelman, and Jackie Ogden. 2004. "Using a Behavior Change Model to Document the Impact of Visits to Disney's Animal Kingdom: A Study Investigating Intended Conservation Action." *Curator* 47 (3): 322-343.
- Falk, John H. 2009. *Identity and the Museum Visitor Experience*. Walnut Creek, CA: Left Coast Press, Inc.
- Falk, John H. 2006. "An Identity-Centered Approach to Understanding Museum Learning." *Curator: The Museum Journal* 49 (2): 151-166.
- Falk, John H. 2009. "Investigating the Role of Emotion in Science Center Visitor Learning." *Visitor Studies* 12 (2): 112.
- Falk, John H. 2000. *Learning from Museums: Visitor Experiences and the Making of Meaning*. Walnut Creek, CA: AltaMira Press.
- Falk, John H., Eric M. Reinhard, Cynthia L. Vernon, Kerry Bronnenkant, Joe E. Heimlich, and Nora L. Deans. 2007. *Why Zoos & Aquariums Matter: Assessing the Impact of a Visit to a Zoo Or Aquarium*. Silver Spring, MD: Association of Zoos & Aquariums. http://www.aza.org/uploadedFiles/Education/why_zoos_matter.pdf.
- Fraser, John and Jessica Sickler. 2009. "Measuring the Cultural Impact of Zoos and Aquariums." *International Zoo Yearbook* 43 (1): 103-112.
- Fraser, John and Dan Wharton. 2007. "The Future of Zoos: A New Model for Cultural Institutions." *Curator: The Museum Journal* 50 (1): 41-54.
- Gagne, Robert Mills. 1985. *The Conditions of Learning and Theory of Instruction*. 4th ed. New York:

CBS College Publishing.

Gardner, Howard. 1985. *Frames of Mind : The Theory of Multiple Intelligences*. New York: Basic Books.

Gardner, Howard. 1999. *Intelligence Reframed*. New York: Basic Books.

Gwynne, John A. 2007. "Inspiration for Conservation: Moving Audiences to Care." *In Zoos in the 21st Century: Catalysts for Conservation?*, edited by Alexandra Zimmermann, Matthew Hatchwell, Lesley A. Dickie and Chris West, 51: Cambridge University Press.

Hancocks, David. 2001. *A Different Nature: The Paradoxical World of Zoos and their Uncertain Future*. Berkeley and Los Angeles, California: University of California Press.

Heimlich, Joe E. 2010. "Environmental Education Evaluation: Reinterpreting Education as a Strategy for Meeting Mission." *Evaluation and Program Planning* 33 (2): 180-185.

Hutchins, Michael. 2003. "Zoo and Aquarium Animal Management and Conservation: Current Trends and Future Challenges." *International Zoo Yearbook* 38 (1): 14-28.

Irvine, Kate, Carol D. Saunders, and John Scott Foster. 1996. "Using Evaluation to Guide the Development of Behavior Change Programs." *Visitor Studies* 8 (1): 47-56.

Jackson-Gould, Janet S., Sharon Kramer, John Gwynne, Jon C. Coe, Howard Litwak, James F. Peterson, Linda Taylor, Catherine Tompson, and Rosemary Harms. 1991. "Current Approaches to Zoo Interpretation." *The Journal of Museum Education* 16 (2): 8-14.

Kolb, David A. 1984. *Experiential Learning*. Englewood Cliffs, New Jersey: Prentice-Hall, Inc.

Koran Jr., John J. and Mary L. Koran. 1983. "The Roles of Attention and Curiosity in Museum Learning." *Journal of Museum Education* 8 (2): 14-17.

Koran Jr., John J., Mary L. Koran, and John S. Foster. 1989. "The (Potential) Contributions of Cognitive Psychology to Visitor Studies." *Visitor Studies: Theory, Research and Practice* 2: 72-79.

Kraak, Tom. 2008. "Zoos in Transition: Research about the Future of Zoos." *Topos* 18 (3): 52-55.

Krathwohl, David R. 2002. "A Revision of Bloom's Taxonomy: An Overview." *Theory into Practice* 41 (4): 212-218.

Landells, Erin. 2004. "What on Earth are Multiple Intelligences and do I have them?" Mosman, New South Wales, Australasian Regional Association of Zoological Parks and Aquaria, .

- Lazear, David. 1986. *Seven Ways of Knowing: Teaching for Multiple Intelligences*. Second Edition ed. Palatine, Illinois: IRI/Skylight Publishing, Inc.
- Leonard, David C. 2002. *Learning Theories A to Z*. Westport, Connecticut: Greenwood Press.
- Lindemann-Matthies, P. and T. Kamer. 2006. "The Influence of an Interactive Educational Approach on Visitors' Learning in a Swiss Zoo." *Science Education* 90 (2): 296-315.
- Littledyke, Michael. 2008. "Science Education for Environmental Awareness: Approaches to Integrating Cognitive and Affective Domains." *Environmental Education Research* 14 (1): 1-17.
- Miles, Roger S. 1982. *The Design of Educational Exhibits*. London: George Allen & Unwin.
- Myers Jr., Olin Eugene, Carol D. Saunders, and Erik Garrett. 2004. "What do Children Think Animals Need? Developmental Trends." *Environmental Education Research* 10 (4): 545.
- Ogden, Jackie and Joe E. Heimlich. 2009. "Why Focus on Zoo and Aquarium Education?" *Zoo Biology* 28 (5): 357-360.
- Oregon Coast Aquarium. 2010. Trends in Zoo and Aquarium Exhibit Interpretation: International Association of Zoo Educators.
- Patrick, Patrick G., Catherine E. Matthews, David F. Ayers, and Sue D. Tunnicliffe. 2007. "Conservation and Education: Prominent Themes in Zoo Mission Statements." *The Journal of Environmental Education* 38 (3): 53.
- Polakowski, Kenneth J. 1987. *Zoo Design: The Reality of Wild Illusions*. The University of Michigan School of Natural Resources.
- Price, Emily A., Joanne Vining, and Carol D. Saunders. 2009. "Intrinsic and Extrinsic Rewards in a Nonformal Environmental Education Program." *Zoo Biology* 28 (5): 361-376.
- Reading, Richard P. and Brian J. Miller. 2007. "Attitudes and Attitude Change among Zoo Visitors." In *Zoos in the 21st Century: Catalysts for Conservation?*, edited by Alexandra Zimmermann, Matthew Hatchwell, Lesley A. Dickie and Chris West, 63: Cambridge University Press.
- Robinson, Michael H. 1996. "The BioPark Concept and the Exhibition of Mammals." In *Wild Mammals in Captivity: Principles and Techniques*, edited by Devra G. Kleiman, Mary E. Allen, Katerina V. Thompson and Susan Lumpkin. 1st ed., 161. Chicago: The University of Chicago Press.
- Routman, Emily, Jackie Ogden, and Keith Winsten. 2010. "Visitors, Conservation Learning, and

- the Design of Zoo and Aquarium Experiences." In *Wild Mammals in Captivity: Principles and Techniques for Zoo Management*, edited by Devra G. Kleiman, Katherine Thompson and Charlotte K. Baer. 2nd ed., 137-150. Chicago: The University of Chicago Press.
- Seidensticker, J. and J. G. Doherty. 1996. "Integrating Animal Behavior and Exhibit Design." In *Wild Mammals in Captivity: Principles and Techniques*, edited by D. G. Kleiman, Mary E. Allen, Katerina V. Thompson and Susan Lumpkin. 1st ed., 180-190. Chicago: The university of Chicago Press.
- Smith, Liam, Sue Broad, and Betty Weiler. 2008. "A Closer Examination of the Impact of Zoo Visits on Visitor Behaviour." *Journal of Sustainable Tourism* 16 (5): 544-562.
- Soulé, Michael, Michael Gilpin, William Conway, and Tom Foose. 1986. "The Millenium Ark: How Long a Voyage, how Many Staterooms, how Many Passengers?" *Zoo Biology* 5 (2): 101.
- Steinbrener, Christoph and Dempf, Rainer. "Trouble in Paradise." Steinbrener/Dempf, accessed 04/13, 2011, http://www.steinbrener-dempf.com/index.php?article_id=1.
- Stoinski, T. S., M. T. Allen, M. A. Bloomsmith, and Terry L. Maple. 2002. "Educating Zoo Visitors about Complex Environmental Issues: Should we do it and how?" *Curator* 45 (2): 129-143.
- Stuart Perry, H. Elizabeth and Carol D. Saunders. 1997. "Summative Evaluation of the Swamp : A Conservation Exhibit with a Big Idea." *Visitor Behavior* XII (12) (1 2): 4-10.
- Tirri, Kirsi and Petri Nokelainen. 2008. "Identification of Multiple Intelligences with the Multiple Intelligence Profiling Questionnaire III." *Psychology Science Quarterly* 50 (2): 206.
- Wagoner, Brady and Eric Jensen. 2010. "Science Learning at the Zoo: Evaluating Children's Developing Understanding of Animals and their Habitats." *Psychology* 3 (1): 65.
- Walker, Jason B. and Michael W. Seymour. 2008. "Utilizing the Design Charrette for Teaching Sustainability." *International Journal of Sustainability in Higher Education* 9 (2): 157.
- WAZA. 2005. *Building a Future for Wildlife: The World Zoo and Aquarium Conservation Strategy*, edited by Peter J. Olney. Bern, Switzerland: The World Zoo and Aquarium Association.
- Weiler, Betty and Liam Smith. 2009. "Does More Interpretation Lead to Greater Outcomes? an Assessment of the Impacts of Multiple Layers of Interpretation in a Zoo Context." *Journal of Sustainable Tourism* 17 (1): 91-105.
- Wineman, Jean, Craig Piper, and Terry L. Maple. 1996. "Zoos in Transition: Enriching Conservation Education for a New Generation." *Curator* 39: 94-107.

ACKNOWLEDGEMENTS

My greatest thanks go to Eric Bernard for all of his continued dedication to this project even though he had limited experience in zoo exhibit design. His continued encouragement and belief in this project maintained my confidence even at the darkest of times by pushing my abilities to create clarity of my ideas, from which I am eternally grateful. Also, his guidance and teaching goes beyond this thesis but as a landscape architect and a human being. I would also like to thank my other committee members Jessica Canfield and Ted Cable for their helpful suggestions and critical feedback throughout the process.

This project would not have been possible without PGAV and Jones & Jones for believing in my project and allowing their employees to take time to participate in the workshop. I would especially like to thank Stacy Tarpley and John Kemper for assisting in coordinating the workshop at the St. Louis Zoo, and Louise Bradshaw and David McGuire from the St. Louis Zoo in providing the facilities for the workshop and their input during the workshop. I would also like to thank Duane Dietz for coordinating the Seattle workshop and Jones & Jones for their facilities.

Many thanks go to Kirby Barrett, and Bonnie for allowing him to return to Seaton 200, for a few late nights in preparation for the St. Louis workshop and keeping me sane throughout the trip. He also deserves thanks for listening to my frustrations and providing advice. Similar thanks go to all the Seaton 200 crew entertaining my ramblings about zoos.

I would also like to thank the other people in my life who have helped me through the sleepless nights and times of confusion. Most importantly, I thank my mom and dad for their continued love and support. Thank you.

LIST OF FIGURES

Identity

- Figure 1.0 - What do visitors do in zoos? *(Ploutz 2012)*
- Figure 1.1 - How are their actions satisfying their Identity? *(Ploutz 2012)*
- Figure 1.2 - How do you think about the Cheetahs? *(Bernard 2012)*
- Figure 1.3 - The five Identities. *(Ploutz 2012)*
- Figure 1.4 - Girl exploring exhibit. *(Bernard 2012)*
- Figure 1.5 - Unique swaying bridge. *(Ploutz 2012)*
- Figure 1.6 - Interacting with fish in pond. *(Ploutz 2012)*
- Figure 1.7 - Parent interacting with children. *(Ploutz 2012)*
- Figure 1.8 - What would they be discussing? *(Ploutz 2012)*
- Figure 1.9 - Me at the zoo. *(Ploutz 2012)*
- Figure 1.10 - Zoo research laboratory. *(Ploutz 2012)*
- Figure 1.11 - Zoo keeper activities demonstration. *(Ploutz 2012)*
- Figure 1.12 - Photographing family with sculpture. *(Ploutz 2012)*
- Figure 1.13 - Unusual encounter with performers. *(Ploutz 2012)*
- Figure 1.14 - Memorable close encounter with animal. *(Ploutz 2012)*
- Figure 1.15 - Watching animals. *(Ploutz 2012)*
- Figure 1.16 - Space separate from primary circulation. *(Ploutz 2012)*

Attention

- Figure 2.0 - Where do you direct your attention? *(Ploutz 2012)*
- Figure 2.1 - What are they looking at? *(Ploutz 2012)*
- Figure 2.2 - Train whistle requires our attention. *(Ploutz 2012)*
- Figure 2.3 - Powerful stimulus redirect attention. *(Ploutz 2012)*
- Figure 2.4 - Where do you direct you attention? *(Ploutz 2012)*
- Figure 2.5 - Sign separate from other objects. *(Ploutz 2012)*
- Figure 2.6 - Bright colored flamingos. *(Ploutz 2012)*
- Figure 2.7 - Large waterfall. *(Ploutz 2012)*
- Figure 2.8 - Framed view of tree. *(Ploutz 2012)*
- Figure 2.9 - Spot lighted beaver dam. *(Ploutz 2012)*
- Figure 2.10 - Directional arrow locating animal. *(Ploutz 2012)*

Figure 2.11 - Engaging Linguistic Intelligence. *(Ploutz 2012)*
Figure 2.12 - Interaction with fish. *(Ploutz 2012)*
Figure 2.13 - Crocodile with sign and tractor tire. *(Steinbrener and Dempf)*
Figure 2.14 - Zebra carcass eaten by lions. *(Ploutz 2012)*
Figure 2.15 - Familiar zoo animal. *(Bernard 2012)*
Figure 2.16 - Sheep match the ranch. *(Ploutz 2012)*
Figure 2.17 - What makes the snake interesting? *(Bernard 2012)*
Figure 2.18 - Which pathway would you choose? *(Ploutz 2012)*

Inform

Figure 3.0 - Where do you direct your attention? *(Ploutz 2012)*
Figure 3.1 - How are they engaged for learning? *(Ploutz 2012)*
Figure 3.2 - Question instructs engagement activity. *(Ploutz 2012)*
Figure 3.3 - Sign directs attention. *(Ploutz 2012)*
Figure 3.4 - Sign explains relationship. *(Ploutz 2012)*
Figure 3.5 - Example identifying cheetahs. *(Ploutz 2012)*
Figure 3.6 - Handout with images of animals in exhibit. *(Dallas World Aquarium 2012)*

Recall

Figure 4.0 - What do you associate with the buffalo and buildings? *(Ploutz 2012)*
Figure 4.1 - What prior experiences do you recall? *(Ploutz 2012)*
Figure 4.2 - My sister who loves horses. *(Ploutz 2012)*
Figure 4.3 - What do you recall about a windmill? *(Ploutz 2012)*
Figure 4.4 - How does the boat influence your thoughts about the pelican? *(Ploutz 2012)*
Figure 4.5 - Question stimulating recall. *(Ploutz 2012)*
Figure 4.6 - How do the railroad tracks influence your thoughts about buffalo? *(Steinbrener and Dempf)*
Figure 4.7 - What is this exhibit situation? *(Ploutz 2012)*
Figure 4.8 - Bats in a jungle. *(Ploutz 2012)*
Figure 4.9 - Bats in the interior of a house. *(Ploutz 2012)*
Figure 4.10 - What do you recall about rhinos and cars? *(Steinbrener and Dempf)*
Figure 4.11 - How do you think about penguins and oil wells? *(Steinbrener and Dempf)*

Figure 4.12 - Concept Hierarchy Diagram. (Ploutz 2012)

Figure 4.13 - Gas can used to kill rattlesnake. (Ploutz 2012)

Grasp

Figure 5.0 - What is the zoo message? (Ploutz 2012)

Figure 5.1 - Concrete experience of wetland. (Ploutz 2012)

Figure 5.2 - Abstract concept describing wetland. (Ploutz 2012)

Figure 5.3 - Physical example illustrating an abstract example. (Ploutz 2012)

Figure 5.4 - Physical example illustrating an abstract example. (Ploutz 2012)

Figure 5.5 - Using your prior knowledge of your height to compare animals. (Ploutz 2012)

Figure 5.6 - Abstraction of animal population. (Ploutz 2012)

Figure 5.7 - Changes overtime. (Buffington 2012)

Figure 5.8 - Close animal encounter. (Ploutz 2012)

Guide

Figure 6.0 - How do you interpret the situation. (Ploutz 2012)

Figure 6.1 - What is occurring in the photo? (Ploutz 2012)

Figure 6.2 - Information about local landscape. (Ploutz 2012)

Figure 6.3 - Sign illustrating plant. (Ploutz 2012)

Figure 6.4 - Butterflies emerging from cocoon. (Ploutz 2012)

Figure 6.5 - How do you respond? (Ploutz 2012)

Figure 6.6 - Girl watching lemur. (Ploutz 2012)

Apply

Figure 7.0 - What do you conclude from this situation? (Ploutz 2012)

Figure 7.1 - Simple application of learning using a flip sign. (Ploutz 2012)

Figure 7.2 - Entrance to the exhibit illustrating human settlement. (Ploutz 2012)

Figure 7.3 - Why is the jaguar displaced from its habitat? (Ploutz 2012)

Figure 7.4 - Visitors determining a course of action. (Ploutz 2012)

Figure 7.5 - Visitors identifying an animal. *(Ploutz 2012)*

Figure 7.6 - Visitors comparing the landscape. *(Ploutz 2012)*

Transfer

Figure 8.0 - Natural habitat in a zoo. *(Ploutz 2012)*

Figure 8.1 - Does this wild raccoon connect to your zoo experiences? *(Ploutz 2012)*

Figure 8.2 - How does beach trash relate to your daily lives? *(Ploutz 2012)*

Figure 8.3 - How does the gift shop relate to the exhibit learning? *(Ploutz 2012)*

Individual

Figure 9.0 - How do you think they learn differently? *(Ploutz 2012)*

Figure 9.1 - How do you prefer to learn? *(Ploutz 2012)*

Figure 9.2 - How do you want to engage the exhibit? *(Ploutz 2012)*

Figure 9.3 - What different information would they want? *(Ploutz 2012)*

Figure 9.4 - How do you want to learn? *(Ploutz 2012)*

Figure 9.5 - Listening to a recording. *(Ploutz 2012)*

Figure 9.6 - Rhythm used to explain information. *(Ploutz 2012)*

Figure 9.7 - Proportions over time. *(Ploutz 2012)*

Figure 9.8 - Which way do you go? *(Ploutz 2012)*

Figure 9.9 - Visual graphic. *(Ploutz 2012)*

Figure 9.10 - Mimicking a monkey. *(Ploutz 2012)*

Figure 9.11 - Climbing a rock. *(Ploutz 2012)*

Figure 9.12 - Identifying plants. *(Ploutz 2012)*

Figure 9.13 - Visitor reflecting. *(Ploutz 2012)*

Figure 9.14 - Interaction between parent and children. *(Ploutz 2012)*

Help the Otters

Figure 10.0 - Help the Otters exhibit. *(Ploutz 2012)*

Figure 10.1 - Visceral encounter with otters. *(Ploutz 2012)*

Figure 10.2 - Otters swimming with metal barrel. *(Ploutz 2012)*

Figure 10.3 - Tire swing and plastic bottles. *(Ploutz 2012)*

Figure 10.4 - Cleaning up bottles. *(Ploutz 2012)*

Figure 10.5 - Positive conclusion. *(Ploutz 2012)*

What Animal is That?

Figure 11.0 - What Animal is That? exhibit. *(Ploutz 2012)*

Figure 11.1 - Introduction informing visitor. *(Ploutz 2012)*

Figure 11.2 - Example explains how to use the phone app. *(Ploutz 2012)*

Figure 11.3 - Using a smart phone app. *(Ploutz 2012)*

Figure 11.4 - Changing ecosystems. *(Ploutz 2012)*

Figure 11.5 - Identifying an animal. *(Ploutz 2012)*

Figure 11.6 - Network of pathways. *(Ploutz 2012)*

Figure 11.7 - Place for Rechargers. *(Ploutz 2012)*

Mimic the Animal

Figure 12.0 - Mimic the Animal exhibit. *(Ploutz 2012)*

Figure 12.1 - Familiar animal. *(Ploutz 2012)*

Figure 12.2 - Wearing a gorilla suit. *(Ploutz 2012)*

Figure 12.3 - Visceral with gorilla. *(Ploutz 2012)*

Figure 12.4 - Abstract timeline. *(Ploutz 2012)*

Figure 12.5 - Link sign to animal. *(Ploutz 2012)*

Figure 12.6 - Climbing activity. *(Ploutz 2012)*

Figure 12.7 - Overall exhibit. *(Ploutz 2012)*

Where is the Animal?

Figure 13.0 - Where is the Animal? exhibit. *(Ploutz 2012)*

Figure 13.1 - Leaving the briefing area. *(Ploutz 2012)*

Figure 13.2 - Using a clue. *(Ploutz 2012)*

Figure 13.3 - Tree house. *(Ploutz 2012)*

Figure 13.4 - Find the animal. *(Ploutz 2012)*

Figure 13.5 - Locating the animal. *(Ploutz 2012)*

Four Lives

Figure 14.0 - Four Lives exhibit. *(Ploutz 2012)*

Figure 14.1 - Selecting role playing. *(Ploutz 2012)*

Figure 14.2 - Native cattle. *(Ploutz 2012)*

Figure 14.3 - Helping in the village. *(Ploutz 2012)*

Figure 14.4 - Encountering elephants. *(Ploutz 2012)*

Figure 14.5 - Damaged corn field. *(Ploutz 2012)*

Figure 14.5 - Poached elephant. *(Ploutz 2012)*

Figure 14.7 - Making a decision. *(Ploutz 2012)*

Figure 14.8 - Choosing a pathway. *(Ploutz 2012)*

Two Waterways

Figure 15.0 - Two Waterways exhibit. *(Ploutz 2012)*

Figure 15.1 - Using microscopes to see algae. *(Ploutz 2012)*

Figure 15.2 - Suburban landscape. *(Ploutz 2012)*

Figure 15.3 - Degraded landscape. *(Ploutz 2012)*

Figure 15.4 - Healthy landscape. *(Ploutz 2012)*

Figure 15.5 - Comparing landscapes. *(Ploutz 2012)*

Figure 15.6 - Typical landscape. *(Ploutz 2012)*

Who is Right?

Figure 16.0 - Who is Right? exhibit. *(Ploutz 2012)*

Figure 16.1 - Overlooking the exhibit. *(Ploutz 2012)*

Figure 16.2 - Rancher and cattle. *(Ploutz 2012)*

Figure 16.3 - Personal encounter with wolves. *(Ploutz 2012)*

Figure 16.4 - Wolf eating deer. *(Ploutz 2012)*

Figure 16.5 - Elk *(Ploutz 2012)*

Figure 16.6 - Elevated position with overview of exhibit. *(Ploutz 2012)*

how do
YOU WANT TO LEARN
about zoo design ?