

Exploring the KU Natural History Museum

Investigating VIST Evolutionary Principles

(Variation, Inheritance, Selection & Time)

Target Audience: Middle school and above

Differentiated Instruction Summary

Strategy	Levels	Content/ Process/ Product	Grouping(s)*
Cubing	Readiness Level 1 – VIST principles in <i>Explore Evolution</i> exhibit (organized around VIST) Level 2 – VIST principles in other exhibits	Content Process Product	Small groups Peer partners Homogeneous Heterogeneous

* Varied grouping options can be used for this activity, depending on student needs and chaperone ability.

Objective: Investigate the evolutionary principles of variation, inheritance, selection and time.

Pre-assessment/Prior Knowledge: Prior to their visit, students should be familiar with the four evolutionary principles of variation, inheritance, selection and time (VIST).

Activity Description: Students explore the four principles of evolution: variation, inheritance selection and time through museum exhibits. In Level 1, students explore these four principles in the *Explore Evolution* exhibit. This exhibit presents evolutionary research across seven different organisms, from the smallest to the very large, and is organized around (and explicitly addresses) the VIST principles work in each organism. In Level 2, students apply the VIST principles to exhibits on various floors, most of which do not explicitly use this framework.

Materials Needed:

- Student
 - Cubes (three levels, see attached)
 - Notebooks/paper and pencils

Note: Format to record/present findings determined by individual teacher. Provide clear instructions about expectations for documenting participation.

- Teacher
 - Content Outline
 - Cube labels
 - Cube template

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Content: VIST* Overview

There are four principles at work in evolution—variation, inheritance, selection and time. These are considered the components of the evolutionary mechanism of natural selection.

** Many resources add 'adaptation' to their discussion of the evolutionary principles or mechanisms of natural selection and so use the VISTA framework.*



Variation

In all species, individuals differ in their genetic makeup, producing many variations in their physical features; individuals in a population vary from each other.



Inheritance

Individuals pass some of their genetic material to their offspring; parents pass on their traits to their offspring.



Selection

Some individuals have inherited character (genes) that allows them to better survive or produce more offspring. These offspring, in turn, are more likely to survive and create offspring of their own. As a result, their genes become more common in the entire population; some variants reproduce more than others.



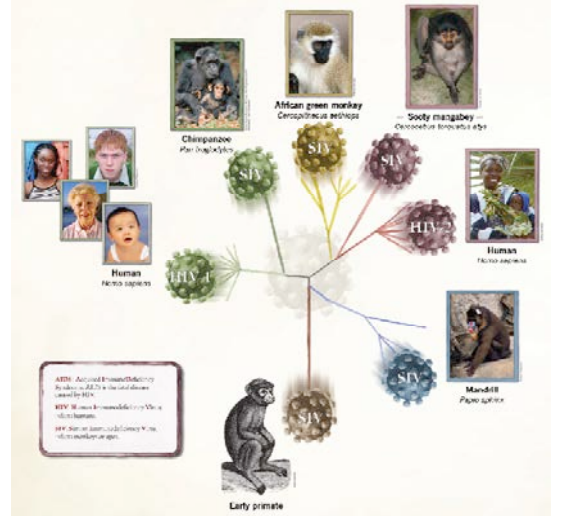
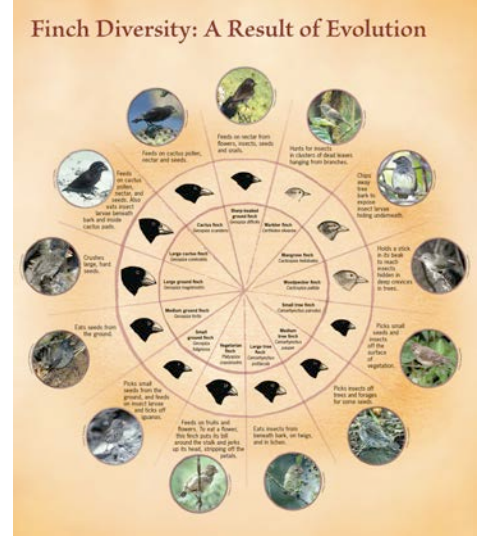
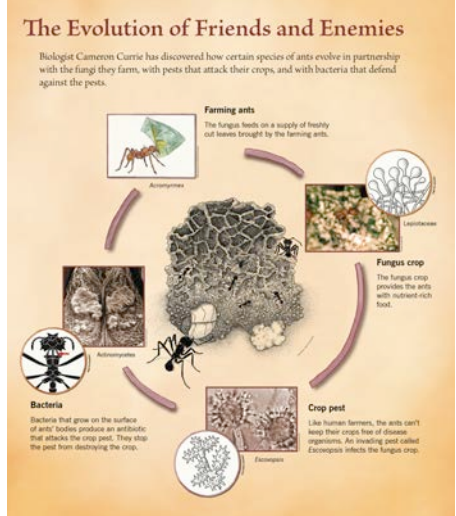
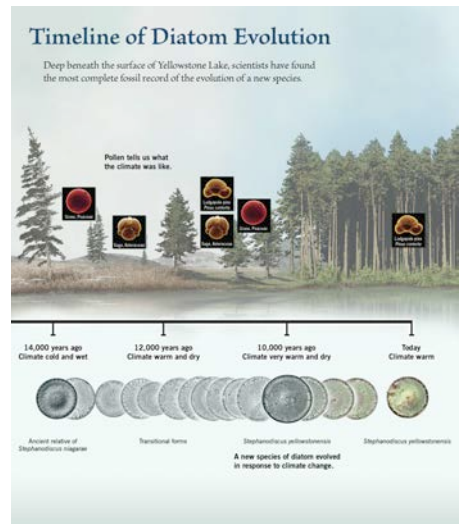
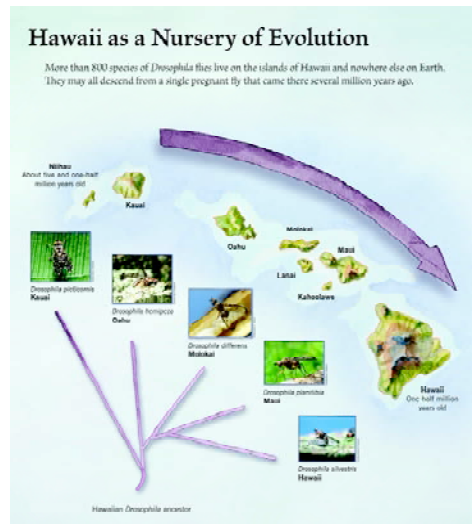
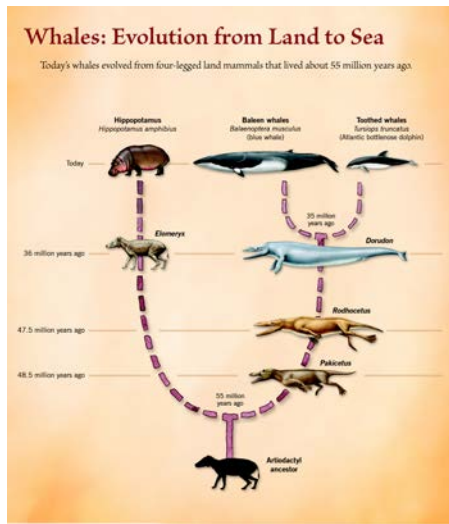
Time

Over time, selection results in changes in species. These changes may take days, or decades, or millions of years to occur; successful variations accumulate over time.

VIST Content in *Explore Evolution: Level 1* (exhibit layout and example graphics below)

Organism	Explanation
HIV Virus	Time – whale evolution occurred over many millions of years, HIV evolution occurs very rapidly
Hawaiian Fruit Flies	Variation – answers will vary, but could include body size, head shape, wing pattern
Medium Ground Finches	Selection – wet years result in more small soft seeds, smaller beaked ground finches more likely to survive; dry years large tough seeds, large beaked medium ground finches more likely to survive
Finches	Variation – answer will vary, but should include specific shapes and their connection to diet
Whales	Time – loss of hindlimbs, forelimbs become flipper-like, development of tailfin/fluke, migration of nostril towards back of skull, isolation of middle ear bones

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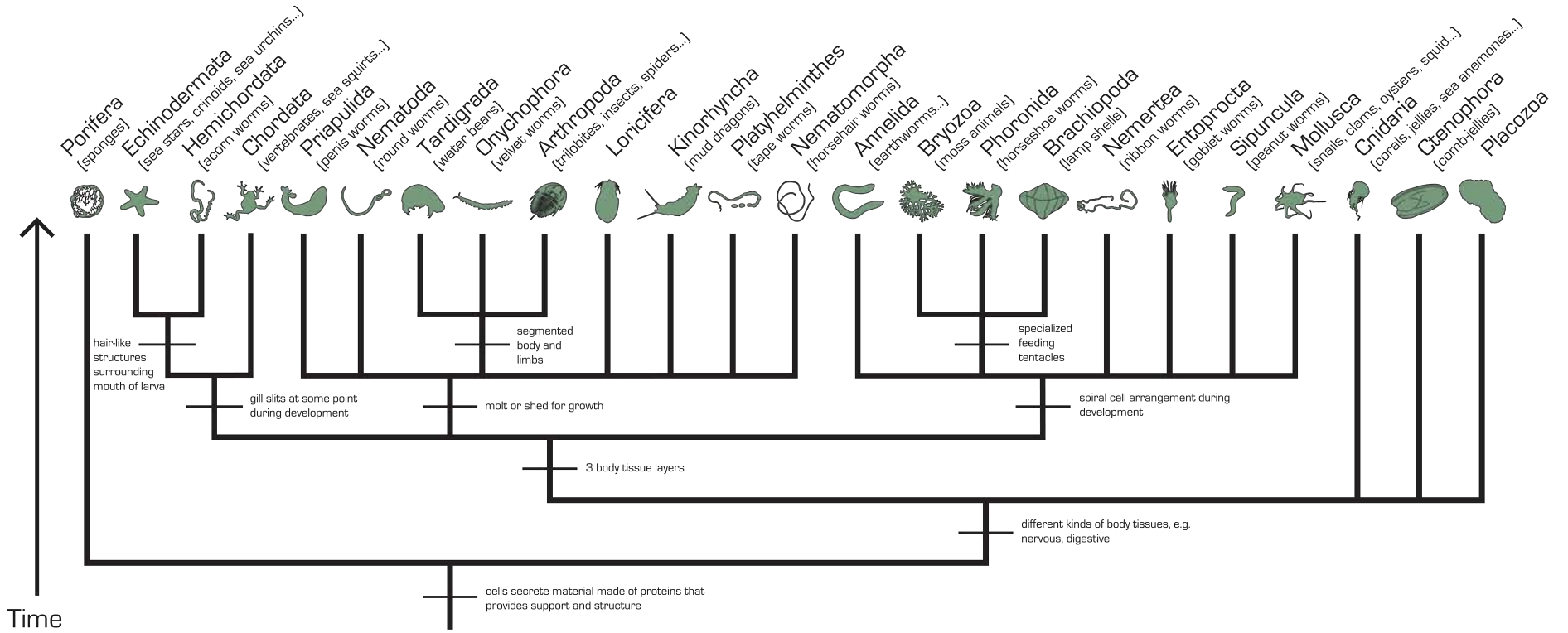
Graphic panels associated with VIST principles in *Explore Evolution* exhibit (top: whale, fruit flies, human/chimp, diatom; bottom: ant, finches, HIV).

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VIST Content: Level 2

Organism	Explanation
<i>Bugtown</i>	Variation – answers will vary (emphasis on observation skills)
<i>Camarasaurus</i> , <i>Dimetrodon</i> , turtles	Time – <i>Dimetrodon</i> appears and disappears before others (Permian); <i>Camarasaurus</i> (Jurassic) appears after <i>Dimetrodon</i> and turtles; and turtles appear after <i>Dimetrodon</i> , and appear and persist after <i>Camarasaurus</i>
Fruit flies	Selection/Inheritance – fancy features would decrease in subsequent generations; if males without fancy features are preferred by females and successfully reproduce more often, they pass these traits onto their offspring, that will be more likely to reproduce
Panorama	Selection – answers will vary
Snakes	Variation – answers will vary, but could include loss of limbs, feeding strategies, color, patterns
Invertebrate tree (see image on next page)	Inheritance/Time – shared characters on the tree reflect common ancestry; answers will vary by lineage

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Invertebrate tree graphic, third floor, Dyche Hall, KU Natural History Museum

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Materials: Cube Labels

VIST Cubing labels – Level 1 (Explore Evolution exhibit)

<p>IDENTIFY <u>two</u> differences you can see among male Hawaiian fruit flies (V)</p>	<p>COMPARE the timeframe over which changes occurred in whale and HIV virus evolution (T)</p>	<p>PREDICT the future Hawaiian Fruit Fly population if only males with a poor songs reproduced (I)</p>
<p>CONTRAST the success of medium ground finches in wet and dry years (S)</p>	<p>TELL an evolutionary story about beak variation and finch diversity (V)</p>	<p>EXPLAIN <u>three</u> changes in whale anatomy over time during their evolution (T)</p>

VIST Cubing Labels – Level 2 (museum galleries)

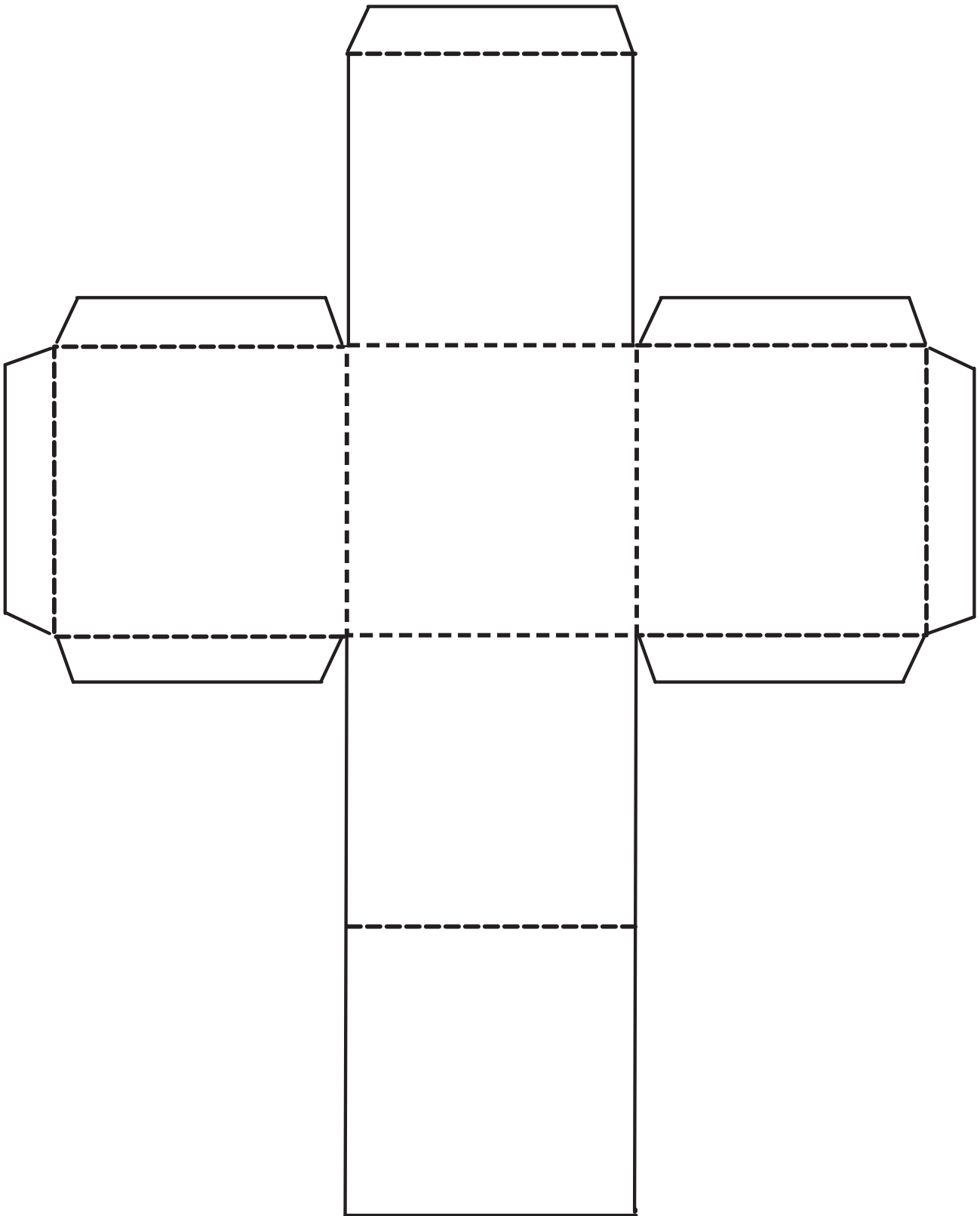
<p>DESCRIBE <u>three</u> differences between individuals of the same species in Bugtown (3rd floor)</p>	<p>COMPARE the time ranges of <i>Camarasaurus</i>, <i>Dimetrodon</i>, and all turtles (3rd floor)</p>	<p>PREDICT the future Hawaiian Fruit Fly populations if females chose males with less fancy features (5th floor)</p>
<p>CONTRAST the factors that might impact reproductive success in <u>two</u> regions depicted in the Panorama (4th floor)</p>	<p>APPLY the idea of variation to the evolutionary history of snakes (6th floor)</p>	<p>ASSEMBLE the relative timeline for appearance of shared traits in one lineage shown in the invertebrate tree (3rd floor)</p>

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Materials: Cube Template

Cube Pattern

Cut on solid lines - Fold on dashed lines



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Rubric: VIST Principles

VIST	Needs further support	Meets Expectations	Exceeds Expectations
Variation Level 1	Flies: Additional descriptive information needed	Flies: Correctly and adequately describes observed differences	Flies: Links descriptions with additional information (e.g. function)
	Finches: Provides descriptive information about beaks and diversity	Finches: Provides descriptive information about beaks and diversity with functional context	Finches: Descriptive information about beaks and diversity, functional <u>and</u> historical context
Inheritance Level 1	Recognize that there would be a change in population over time	Recognize that there would be a change in population due to inheritance of males with poor songs	Extend ideas beyond males with poor songs (e.g. other males, role of female choice, etc.)
Selection Level 1	Describes differences in seeds and beaks for wet and dry years (e.g. more small beaks in wet, more large beaks in dry) but without predictive element	Describes differences in seeds and beaks for wet and dry years with predictive element	Extends ideas beyond factors outlined in exhibit panels
Time Level 1	HIV/Whales: Evolution of groups at different rates but without time context	HIV/Whales: Different rates and time context	HIV/Whales: Extends beyond exhibit
	Whale: List anatomical changes	Whales: Descriptions of anatomical features, and functional context	Whales: Descriptive information as well as functional <u>and</u> historical context
Variation Level 2	Bugtown & Snakes: Provides descriptive information, but without functional or historical context	Bugtown & Snakes: Strong descriptions of features, and functional context	Bugtown & Snakes: Descriptive information as well as functional <u>and</u> historical context
Selection/ Inheritance Level 2	Recognize that there would be a change in the population over time (male features), but does not explicitly mention inheritance or selection	Recognize that there would be change in population over time, features are inherited, and that it is due to selective pressure (females)	Extend ideas beyond those outlined (e.g. change in female choice)
Selection Level 2	Provides descriptive information, but without mechanism	Provides descriptive information and includes potential mechanism	Provides descriptive information, potential mechanism and outcome
Inheritance/ Time Level 2	List of shared traits in selected lineages, but without clear timeline	Clear outline of lineage and relative appearance of shared characters	Clear outline of lineage and shared characters with reference to other groups
Time Level 2	Geological time ranges outlined, but without comparison	Geological time ranges outlined, and compared (e.g. overlapping or not)	Extend beyond those ideas outlined