**SCRIPT:**

<table>
<thead>
<tr>
<th>Topic RT: min:sec</th>
<th>Audio/Narration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INTRO</strong></td>
<td>All of life must take care of basic functions to stay alive.</td>
</tr>
<tr>
<td></td>
<td>Some take life’s tasks to the limit:</td>
</tr>
<tr>
<td></td>
<td>running faster…</td>
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<tr>
<td></td>
<td>diving deeper…</td>
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<tr>
<td></td>
<td>becoming more enticing…</td>
</tr>
<tr>
<td></td>
<td>or even thriving in the most extreme environments.</td>
</tr>
<tr>
<td><strong>INTRO &amp; Title</strong></td>
<td>[LIFE AT THE LIMITS]</td>
</tr>
<tr>
<td></td>
<td>What explains life at the limits — and all of life — is a simple step-by-step process called natural selection.</td>
</tr>
<tr>
<td><strong>Getting Started &amp; Variation</strong></td>
<td>From day one, life is a struggle for survival.</td>
</tr>
<tr>
<td>Adaptive variations</td>
<td>And yet some individuals are born with slight differences.</td>
</tr>
<tr>
<td></td>
<td>Random, genetic mutations are the main source for all variations in size, coloration,</td>
</tr>
<tr>
<td></td>
<td>the ability to avoid predators and countless other genetic traits.</td>
</tr>
<tr>
<td></td>
<td>Even a slight genetic variation can prove to be an advantage.</td>
</tr>
<tr>
<td><strong>BREATHING</strong></td>
<td>[Intertitle: BREATHING]</td>
</tr>
<tr>
<td></td>
<td>Diving mammals take breathing — inhaling and processing oxygen — to a much deeper level.</td>
</tr>
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<tr>
<td>BREATHING &amp; VISTA</td>
<td>Over 25 million years ago a mammal shifted from land to hunting underwater. It could make the transition because of a random genetic variation that allowed it to store higher concentrations of oxygen in its muscle tissues. The underwater hunter had tapped into a new food source, which helped it survive and pass on the ability to its offspring. Generation after generation the new trait was inherited, so it spread through the population. After millions of years of mutations, the trait became fixed in an ancestor of all pinnipeds, the group that includes seals, sea lions and walruses. Elephant seals can hold their breath the longest, for nearly two hours.</td>
</tr>
<tr>
<td>MOVING &amp; ADAPTATION</td>
<td>[Intertitle or some graphic change of pace: MOVING] It takes a lot of energy to move. But just about every step in life requires it. In the struggle to survive, creatures can’t afford too many false moves. Natural selection drives the most effective adaptations for locomotion.</td>
</tr>
<tr>
<td>EATING &amp; ADAPTATION</td>
<td>[Intertitle or some graphic change of pace: EATING] Unique ways of grabbing a meal can be the difference between just getting by, or thriving. The harpy eagle’s giant curved talons grasp large prey. A gaping jaw and an elastic stomach allows the black swallower to eat fish much larger than itself. The mantis shrimp takes a crack at even the hardest shell.</td>
</tr>
<tr>
<td>SENSING &amp; ADAPTATION</td>
<td>[Intertitle or some graphic change of pace: SENSING] Keen vision, ultra receptive smell, touch and hearing —specialized senses are useful in specific environments.</td>
</tr>
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<tr>
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<tr>
<td>Adaptation to Extreme Environment</td>
<td>[Intertitle or some graphic change of pace: EXTREME ENVIRONMENT]</td>
</tr>
<tr>
<td>Tardigrade</td>
<td>Tardigrades are masters of survival, enduring for years in the absence of air, food and water.</td>
</tr>
<tr>
<td></td>
<td>The tiny animal transforms itself into a near death-like state, and then waits... until the bad times are over to spring back to life.</td>
</tr>
<tr>
<td></td>
<td>But the individual genetic differences of this particular tardigrade will only persist if it reproduces.</td>
</tr>
</tbody>
</table>

| GETTING STARTED                           | [Intertitle or some graphic change of pace: MATING]                             |
|                                           | Creatures that have survived to reproductive age face the **ultimate** test of fitness. |
|                                           | The drive to sexually reproduce ensures that adaptive genetic traits are passed on to the next generation. |

<p>| Reproduction &amp; Random VARIATION           | Sexual reproduction shakes up the gene pool — introducing new, random genetic variations. |
|                                           | As an egg is formed, copying errors can arise and new combinations of genes are produced as it sorts out its genetic material. |
|                                           | Random, genetic variations are not <strong>all</strong> positive. |
|                                           | Most make no difference. |
|                                           | Some are clearly a disadvantage. |
|                                           | But genetic variations are a <strong>good</strong> thing because life on Earth is changing all the time. |</p>
<table>
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<tbody>
<tr>
<td>Flexibility built into the process</td>
<td>Environmental change, shifting populations, competition for resources that ebb and flow.</td>
</tr>
<tr>
<td>NATURAL SELECTION &amp; ENDING</td>
<td>No matter what changes come, all creatures are in a struggle for survival.</td>
</tr>
<tr>
<td></td>
<td>Over time, the pattern that emerges is the process of natural selection.</td>
</tr>
<tr>
<td></td>
<td>The resilience of the process means that each generation faces new tests of survival, brings new adaptations, and new ways to stretch the astounding limits of life.</td>
</tr>
</tbody>
</table>

CREDITS:

[Credit pages for Intro Theater video]
LIFE AT THE LIMITS
[on-screen text at end of program:]

[Page 1]
Produced by the
Exhibition Department of the
American Museum of Natural History

Curators
Mark E. Siddall

Life at the Limits — section 1.2 — INTRO Theater Script
Topic: Audio/Narration

RT: min:sec  [ ] = Audio notes

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Narration
Mark E. Siddall

[page 4:]
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University of Cambridge, Department of Zoology: Malcolm Burrows, Darron Cullen, Marina Dorosenko and Gregory Sutton
Woods Hole Oceanographic Institution

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