Life Sciences/HHMI Outreach Program

- Summer 2006 Workshop
- in Biology and Multimedia
- for High School Teachers
MASS EXTINCTION & DIVERSIFICATION
Chronology of Mass Extinctions

- Five major mass extinctions in the history of the planet
  - Ordovician-Silurian
  - Late Devonian
  - Permian-Triassic
  - End Triassic
  - Cretaceous-Tertiary
Timeline for Mass Extinctions
Millions of Years Ago

- Ordovician-Silurian - 435 mya
- Late Devonian - 370 mya
- Permian-Triassic - 240 mya
- End Triassic - 205 mya
- Cretaceous-Tertiary - 65 mya
### Organisms Affected by Massive Extinctions

<table>
<thead>
<tr>
<th></th>
<th>Ordovician - Silurian</th>
<th>Late Devonian</th>
<th>Permian - Triassic</th>
<th>End Triassic</th>
<th>Cretaceous - Tertiary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Families</td>
<td>25%</td>
<td>22%</td>
<td>53%</td>
<td>22%</td>
<td>16%</td>
</tr>
<tr>
<td>Genera</td>
<td>50%</td>
<td>57%</td>
<td>84%</td>
<td>52%</td>
<td>47%</td>
</tr>
<tr>
<td>Species</td>
<td>85%</td>
<td>82%</td>
<td>96%</td>
<td>76%</td>
<td>76% Species including the dinosaurs</td>
</tr>
</tbody>
</table>
Percentage of Species Wiped Out

- Ordovician-Silurian - 85%
- Late Devonian - 82%
- Permian-Triassic - 96%
- End Triassic - 76%
- Cretaceous-Tertiary - 76%
Major Indirect Causes for Mass Extinctions

1. Continental Flood Basalt Lava (3 of 5)

2. Abrupt Falls in Sea Levels (1 of 5)

3. Asteroid Impact (4 of 5)
Diversification and Speciation after Mass Extinctions

Surviving Species take over vacant habitats and resources
Speciation takes every 100 to 100,000 year
10 to 10,000 new species per year
<table>
<thead>
<tr>
<th>Period</th>
<th>Onset</th>
<th>Major Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cambrian</td>
<td>540 Ma</td>
<td>most animal phyla present, diverse algae</td>
</tr>
<tr>
<td>Ordovician</td>
<td>490 Ma</td>
<td>first jawless fishes, animal diversification</td>
</tr>
<tr>
<td>Silurian</td>
<td>445 Ma</td>
<td>first bony fishes, colonization of land</td>
</tr>
<tr>
<td>Devonian</td>
<td>420 Ma</td>
<td>first insects and amphibians, fish diversify</td>
</tr>
<tr>
<td>Carboniferous</td>
<td>355 Ma</td>
<td>extensive forests, first reptiles, insects radiate</td>
</tr>
<tr>
<td>Permian</td>
<td>290 Ma</td>
<td>reptiles radiate, insects are diverse</td>
</tr>
<tr>
<td>Triassic</td>
<td>250 Ma</td>
<td>early dinosaurs, first mammals, marine inverts. diversify</td>
</tr>
<tr>
<td>Jurassic</td>
<td>200 Ma</td>
<td>first birds, diverse dinosaurs</td>
</tr>
<tr>
<td>Cretaceous</td>
<td>145 Ma</td>
<td>flowering plants and mammals diversity, dinosaurs continue diversification</td>
</tr>
<tr>
<td>Tertiary</td>
<td>65 Ma</td>
<td>radiation of mammals, birds, flowering plants, pollinating insects</td>
</tr>
<tr>
<td>Quaternary</td>
<td>2 Ma</td>
<td>humans evolve, extinctions of large mammals</td>
</tr>
</tbody>
</table>

Is there a potential Sixth Major Extinction?

Species are becoming extinct at a rate of about
4000/year
100/day
1 species every 15 minutes
2050

• 50% of all species on the planet will be either endangered or extinct
  – Habitat destruction
  – Global Warming
• 25% mammalian species
• 15% bird species