Student Sheet 1

PROBLEM SOLVING ACTIVITY: WARMING TO EVOLUTION

Background Information: Scientists have known for a long time that many species on Earth come and go with varying environmental conditions, natural competition, and changes in habitats and climates. The decline in ***biodiversity*** (the number of different species of organisms on Earth) that has occurred in the last few decades, however, is a rapid decline. From what has been learned from studying rock records, it is a much more rapid decline than any other in Earth's history. Biodiversity loss also threatens human security and well-being. Food chains on which we depend will be disrupted, water sources may disappear, and medicines and other resources obtained from lost organisms—or the organisms that depend on them—could be lost to us.

Many things are known to determine the growth and distribution of plants and animals within ecosystems:

- temperature,
- precipitation,
- carbon dioxide concentration,
- light,
- available food,
- chemical components and
- disturbances such as disease, severe storms, wildfires, and human land use or
- any combination of these factors.

For example, trees have "moved" thousands of miles over the course of Earth's history in response to global temperature changes of about 5 degrees Celsius occurring over thousands of years. If the rate of change is a degree or so over a thousand years, species seem able to move and "keep up" with the changing climate. However, extensive studies of fossil pollen from lakes around North America tell scientists that intact forest and animal ecosystems do not just move north as temperatures change. Animal and plant

species change in abundance, which then changes the entire "look" of the ecosystem. It is this kind of change over time and location that has ecologists most concerned.

Climate change is considered a major driver of the loss of biodiversity, and it is predicted to have an even greater impact in the decades to come. Melting Arctic sea ice, ocean acidification, warming temperatures, extreme weather events, and rising sea levels will have a devastating effect on some species, and in the long term, on humans as well.

Student Sheet 3

DATA TABLE: CLIMATE CHANGE FACTORS and ECOSYSTEM RESPONSE

ROUND	YEARS	AVERAGE ANNUAL PRECIPITATION	AVERAGE ANNUAL TEMPERATURE	CHANGES IN ORGANISMS
1	200			
2	400			
3	600			
4	800			
5	1000			
6	1200			
7	1400			
8	1600			
9	1800			
10	2000			
11	2200			
12	2400			
13	2600			
14	2800			
15	3000			
16	3200			
17	3400			
18	3600			
19	3800			
20	4000			
21	4200			

22	4400			
23	4600			
24	4800			
25	5000			
26	5200			
27	5400			
28	5600			
29	5800			
30	6000			
31	6200			
32	6400			
33	6600			
34	6800			
35	7000			
36	7200			
37	7400			
38	7600			
39	7800			
40	8000			
41	8200			
42	8400			
43	8600			
44	8800			
45	9000			
46	9200			
47	9400			

48	**9600**			
49	**9800**			
50	**10000**			

Student Sheet 3

ECOSYSTEM EVOLUTION INFORMATION SHEET

PART I

An oak tree grows next to a shallow stream in a grassy area. There are no shrubs here. Grasshoppers and Black-tail jack - rabbits feed on little bluestem grass. Duckweed grows in the water, providing food for wood ducks. These birds also feed on grasshoppers, acorns and grass. The ducks are a major food source for the Red wolves.

PART II

To the west of the grassy area there is a desert. There, Glossy snakes eat Merriam pocket mice. These mice can burrow under shrubs and cacti to hide from the snakes. The mice cannot live in a grassy area. In the desert they burrow under mesquite shrubs and eat seeds. Grasshoppers and jack rabbits eat the mesquite leaves.

The climate is changing in the grassy area. For the next 10,000 years the average precipitation will decrease by 1.25 cm every 200 years. The average temperature will increase by 0.3 ° C every 200 years.

An average annual temperature of more than 22 °C or an annual average precipitation of less than 51 cm will cause the stream to start drying up and the oak trees to die.

If the average annual temperature reaches 31 °C or the average annual precipitation is less than 34 cm, the water table will be too low for grass to grow.

Student Sheet 4

FOOD WEB ILLUSTRATIONS #1

Grasshopper

Red wolf

Glossy snake

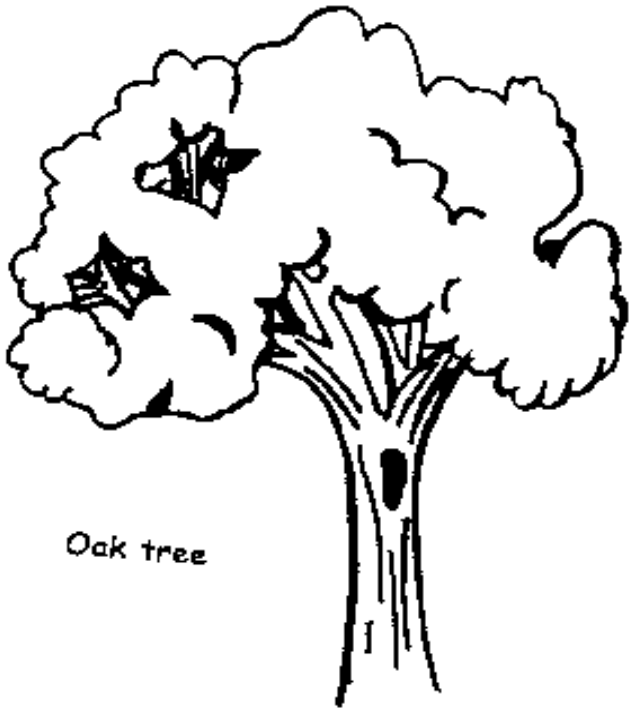
Black-tailed Jackrabbit

Merriam pocket mouse

Wood Duck

Student Sheet 5

FOOD WEB ILLUSTRATIONS #2

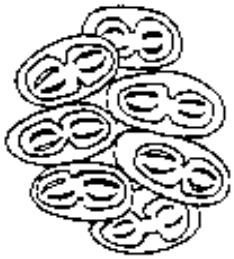


Oak tree

Bluestem grass

Mesquite bush

Cactus



Duckweed

Student Sheet 6

ANALYSIS AND CONCLUSION:

1. When did the first changes in the ecosystem occur?

2. What were the changes that took place?

3. What subsequent changes occurred and in which years?

4. What similarities and differences are there between the initial and the final food webs?

5. What is a barrier to dispersal for the Merriam pocket mouse?

6. What limited the Red wolves population size?

7. What climatic factors are responsible for the other changes?

8. Why could the use of annual average values for temperature and precipitation make this model artificial?