

ECOSYSTEM LAB

Life Sciences Program
Teacher's Guide

Royal Saskatchewan Museum



Ministry of
Tourism, Parks,
Culture and Sport



RSM since 1906
www.royalsaskmuseum.ca

Thank you for booking an Ecosystem Lab at the Royal Saskatchewan Museum.

This program is designed to introduce your students to the human impact on Saskatchewan environments and the need to balance resource use with environmental conservation.

We have enclosed a number of supplementary activities for use in the classroom before and after your program. Activities are optional – please feel free to do any or all of them, or add your own materials as you see fit!

For further information on this and other programs
please contact:

Public Programs
Royal Saskatchewan Museum
2445 Albert Street
Regina, Saskatchewan
S4P 4W7
Phone: (306)787-0814
Fax: (306)787-2820
Website: www.royalsaskmuseum.ca

© Royal Saskatchewan Museum 2008

The contents of this resource package may be reproduced for classroom use only. No portion may be duplicated for publication or sale.

Teacher Activity Kit

Ecosystem Lab

Grades 4 to 8

GOAL

To introduce students to the human impacts on Saskatchewan environments and the need to balance resource use with environmental preservation

OBJECTIVES

By the end of the program, students will be able to:

1. identify major environmental needs of organisms (biotic, abiotic and other factors) and how these needs are met in Saskatchewan environments
2. describe ways in which human activities impact Saskatchewan environments
3. describe ways in which these activities can be balanced with environmental preservation

VOCABULARY

Ecology – interactions organisms have with other organisms and with their environment.

Environment – all of the biotic and abiotic factors that act on an organism, population, or ecological community and influence its survival and development. Organisms respond to changes in their environment by evolutionary adaptations in form and behavior.

Ecosystem – a self-sustaining natural system with interacting abiotic and biotic components

Biotic factors – living components of an environment e.g. plants and animals

Abiotic factors – non-living components of an environment e.g. sunlight, soil, air, water, pollution

Habitat – the living place of an organism. There are five components of a habitat that animals need to survive: food, water, air, shelter and space. For plants there is a sixth: sunlight.

Habitat loss – a process of land use change in which one habitat type is removed and replaced with another, resulting in the displacement or destruction of plants and animals that previously used the site. Urban sprawl, logging, mining, trawling, and agriculture are all causes of habitat loss. It is currently ranked as the most important cause of species extinction worldwide.

Habitat restoration – The return of a habitat to its original community structure, natural complement of species and natural functions.

Environmental impact – any change to an ecosystem, natural or man-made, harmful or beneficial.

Biodiversity – variety of life on earth

Pre-visit Activities

1. Explore the vocabulary list with your class then have students review words and their definitions by completing either the attached Crossword Puzzle (more advanced) or the Vocabulary Matching exercise.
2. Review the term “environment” with your students. Organisms can survive only in environments that meet their needs. The earth has many different environments and each has unique conditions. These conditions include abiotic factors (soil, air, water and sunlight), biotic factors (other organisms that may be predators or prey to the organism) and other factors (temperature, rainfall, soil quality, salinity, pH). Organisms have evolved features that make them well-adapted to tackle the challenges of the environment they live in. Changes in an organism’s environment may result in death, migration, or survival of a few well-adapted individuals in the population. Students can explore the meaning of the term environment through *the language arts activity worksheet “Environment is...”*.
3. To further explore the topic of environment, have students compare the factors that comprise their environment with those of a favourite animal (“*What’s YOUR environment?*” *Worksheet, attached*). How are the two environments similar? How are they different? As human beings, we are able to control some environmental factors way more than any other living organism (e.g. we’ve invented heating systems that keep our homes warm even in the depths of winter). What advantages has this ability brought with it? Any disadvantages?

4. If the weather is nice, take your students out in the schoolyard or other local greenspace to do the Schoolyard Wonders Activity (*worksheet attached*). This is an experiential way for your students to learn about abiotic and biotic factors comprising the environments of organisms. Have students share their results. Which items were abiotic? Which were biotic? How would they describe the environment visited – healthy or unhealthy?
5. Have students keep track of what they ate on a particular day then trace each food back to its origin. They will soon find that everything can be traced back to plants! What is required for plants to grow? *Soil, water, air and sunlight*. Discuss the ways in which we compromise soil, water and air quality and possibly impact the ability of plants to grow. What can we do differently? (*“What’s for Dinner?” Worksheet, attached*)
6. The Ecosystem Ingredients journal prompt (*attached*) is another way for students to conceptualize abiotic conditions required for plant growth. In this activity they get to take things one step further, and think about how they could change those conditions for the better! This is also a good opportunity to discuss how people in the past changed those conditions for the worse: the Dust Bowl of the 1930s was partially the result of unsound agricultural practices such as overgrazing and tillage that encouraged soil erosion.

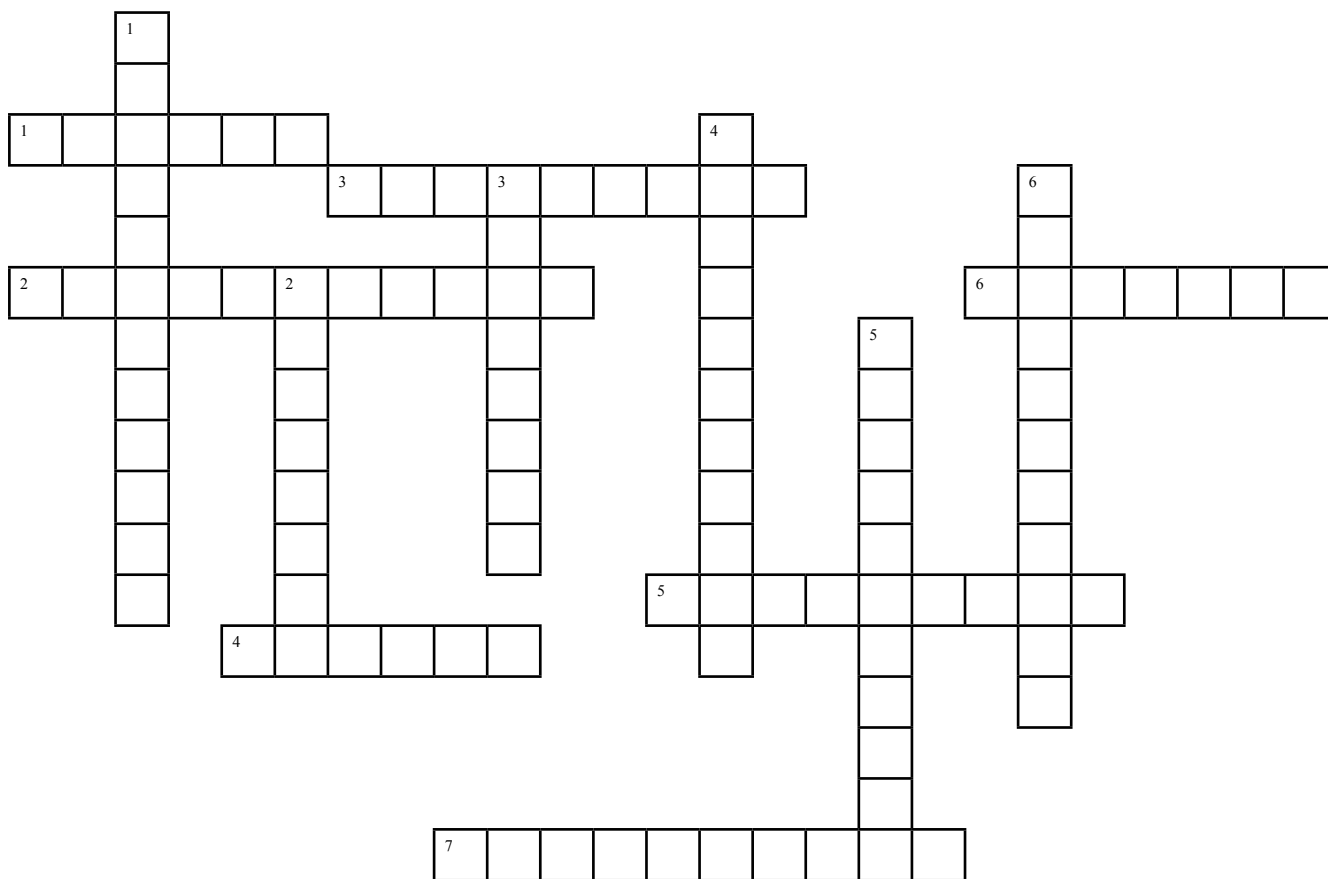
Post-visit Activities

1. Have your students brainstorm the different ways in which humans impact the environment. Which activities impact individual plants or animals? Which activities impact entire habitats? In what situations, if any, does it seem appropriate to harm a single plant or animal? An entire habitat? In what situations, if any, does it seem inappropriate to harm a single plant or animal? An entire habitat? The *worksheet “Our Impact”* gives students the opportunity to think about these issues and their solutions individually. You may wish to follow up by having students select and research a specific impact, such as farming or jet-skiing, and develop a poster to educate fellow students about the issue. The poster could focus on the impact itself, or on ways it could be alleviated.
2. Discuss the difference between ethics and law. In some instances these two things are the same: for example, it is both unethical and unlawful to steal the property of another person. In other instances the distinction is not so clear: although hunting is a legal past time, for a variety of reasons many individuals feel that it is unethical.
 - a) Research legislation relevant to the protection of wildlife, habitats and/or resources in your area. Some wildlife species such as migratory birds, are under federal protection, while mammals and resident birds are afforded protection by provincial law. Why are some things under federal jurisdiction while others provincial?
 - b) Play Environment Scruples! Make several copies of the Dilemma Cards (*attached*). Divide your class into groups of four and give each a stack of dilemma cards. Cards are placed face down in the centre of the group. The first student draws a card from the top of the stack, and is given a moment to study the situation, decide what he or she should do, and formulate his or her reasons. When ready, the student reads the situation and options aloud to the rest of the group, then gives the decision he or she has chosen and the reasoning involved. Each of the members of the group is invited to comment on the dilemma and what he or she would do in the situation. Once the discussion on that card is finished it can be placed at the bottom of the pile, and the next student proceeds to take a card from the top of the pile and begin the process again.
3. Discuss environmental careers with your students. How many of them have thought about a career with animals or wildlife? What would their ideal career look like? The Environmental Education for Kids (EEK) website (www.dnr.state.wi.us/org/caer/ce/eek/job/index.htm) has a careers link with information on environmental jobs. Have your class brainstorm a list of possible environmental careers (e.g. wildlife biologist, fisheries biologist, forester, conservation officer, landscape architect, farmer, environmental educator, etc.). Then have each student select and research the career that most appeals to them. Some things they could learn about that career include: What are the average earnings for that job? What level of

education is required? What would be the best part of the job? What would be the worst part? You may wish to have students present their findings to the rest of the class. As an extension to this activity, arrange to have a speaker come to your class to talk about their career and what steps they took to get where they are today.

4. In the article “King Rat and the Brilliant Squibbon” by Miguel Llanos (*attached*) experts speculate on the future fauna of planet earth. Have students read the article and then discuss it as a class. Some questions for discussion are: Is there any value in “speculative biology” or theorizing about the future in the way the article describes? What do you think about a world dominated by rats and snakes? Should we be concerned and responsible today for a world that might exist millions of years in the future? What should our role be in influencing the evolution of species?

RSM ECOSYSTEM LAB
Environment Crossword



Across

- 1 living
- 2 the combination of biotic and abiotic factors acting on an organism
- 3 a self-sustaining natural system
- 4 any change to an ecosystem, natural or man-made, harmful or beneficial
- 5 a man-made abiotic factor
- 6 non-living
- 7 in danger of extinction in the foreseeable future

Down

- 1 the variety of life
- 2 a living thing
- 3 an abiotic factor especially important for plants to make food
- 4 noun; to return something to its original state
- 5 an industry; the leading cause of habitat loss on the prairies
- 6 when one habitat type is removed and replaced with another; the leading cause of species extinction

RSM ECOSYSTEM LAB
Vocabulary Matching Game

Cut out the terms and definitions below then paste onto a separate page, matching the correct term with its definition.

| | |
|-----------------------------|--|
| Ecology | variety of life on earth |
| Habitat restoration | interactions organisms have with other organisms and with their environment |
| Abiotic factors | all of the biotic and abiotic factors that act on an organism and influence its survival and development |
| Environmental impact | when one habitat type is removed and replaced with another |
| Biodiversity | the return of a habitat to its original community condition or state |
| Biotic factors | any change to an ecosystem, natural or man-made, harmful or beneficial |
| Habitat loss | the living place of an organism; food, water, air, shelter and space |
| Habitat | non-living components of an environment e.g. sunlight, soil, air, water, pollution |
| Ecosystem | living components of an environment e.g. plants and animals |
| Environment | a self-sustaining natural system with interacting abiotic and biotic components |

RSM ECOSYSTEM LAB
ENVIRONMENT is...

Organisms can survive only in environments that meet their needs. The earth has many different environments and each has unique conditions. These conditions include abiotic factors (soil, air, water and sunlight), biotic factors (other organisms that may be predators or prey to the organism) and other factors (temperature, rainfall, soil quality, salinity, pH). Organisms have evolved features that make them well-adapted to tackle the challenges of the environment they live in. Changes in an organism's environment may result in death, migration, or survival of a few well-adapted individuals in the population.

Use the letters below to help you develop a list of words related to the definition of "environment". The letter can appear anywhere in the word (e.g. the first word could be tEmperature).

E

N

V

I

R

O

N

M

E

N

T

RSM ECOSYSTEM LAB
WHAT'S YOUR ENVIRONMENT?

Organisms can survive only in environments that meet their needs. The earth has many different environments and each has unique conditions. These conditions include abiotic factors (soil, air, water and sunlight), biotic factors (other organisms that may be predators or prey to the organism) and other factors (temperature, rainfall, soil quality, salinity, pH).

Think about the things that make up your environment and write them down below. Then do the same for your favourite animal.

MY ENVIRONMENT

MY ANIMAL'S ENVIRONMENT

Abiotic factors

Abiotic factors

Biotic factors

Biotic factors

Other factors

Other factors

How is your environment like that of your favourite animal?

How is it different?

Sometimes the best way to get familiar with the ecology of an area is to put your senses to work and explore. Search for the following items within your schoolyard or a nearby park. Observe carefully and be prepared to share your findings with other groups.

- Find something living in a place that is always shady.
- Look for an area with the wettest soil.
- Find a tree (or tree part) that is used as an animal home.
- Find a place where plants grow poorly.
- Look for an animal home attached to a building or structure.
- Find a critter living under something.
- Find something living in a crack in the sidewalk or parking lot.
- Find a place where ants have set up housekeeping.
- Find something that is living in an area that is always sunny.
- Locate the rockiest area you can find. Any critters living there?

Sometimes the best way to get familiar with the ecology of an area is to put your senses to work and explore. Search for the following items within your schoolyard or a nearby park. Observe carefully and be prepared to share your findings with other groups.

- Find something living in a place that is always shady.
- Look for an area with the wettest soil.
- Find a tree (or tree part) that is used as an animal home.
- Find a place where plants grow poorly.
- Look for an animal home attached to a building or structure.
- Find a critter living under something.
- Find something living in a crack in the sidewalk or parking lot.
- Find a place where ants have set up housekeeping.
- Find something that is living in an area that is always sunny.
- Locate the rockiest area you can find. Any critters living there?

RSM ECOSYSTEM LAB

What's for dinner?

Keep track of everything you eat during the day and record it below. Then trace the origins of each food item back as far as you can (e.g. Pepperoni Pizza: crust – wheat; tomato sauce – tomato plant; cheese – milk – cow – grass; pepperoni – beef or pork – grass).

Breakfast

Origin

Lunch

Origin

Supper

Origin

What is the origin of all the food we eat? _____

Using the organisms listed below, construct at least three food chains:

People, rabbits, grass, lettuce, cougars, robins, earthworms, hawks, mice, insects, wheat, cows, corn, pigs, deer, acorns, fish, lobster, shrimp, plankton, whale.

Food chain 1

Food chain 2

Food chain 3

RSM ECOSYSTEM LAB
OUR IMPACT on the environment

Make a list of five things people do that harm wildlife habitat.

Make a list of five things people do that harm wildlife.

For each thing listed, describe what you can do about it.

Make a list of ten things people do that help wildlife.

DILEMMA CARD

You own a popular golf course in a semi-arid area. The area has had below-average precipitation for some time and area officials are recommending that businesses and individuals conserve water. Without regular watering your golf course will turn brown and you may start to lose business. Would you?

- ignore the conservation recommendation and continue watering your golf course daily
- sacrifice the beauty of your golf course by watering less often
- sell your golf course
- other (specify)

DILEMMA CARD

You are having a picnic with your family at the beach and you see another family leaving to go home, without having picked up their own trash. It is clear that the other family is going to leave litter all around. Would you?

- move quickly and ask them to pick up the trash before they leave
- wait for them to leave and pick up the trash for them
- do nothing
- other (specify)

DILEMMA CARD

You are president of a large corporation. You are very interested in pollution control and have assigned a task force to study the pollution your plant is creating. The task force reports that you are barely within the legal requirements. The plant is polluting the community's air and water. To add the necessary equipment to reduce pollution would cost so much that you would have to lay off 50 employees. Would you?

- add the equipment and fire the employees
- wait a few years to see if the costs of the equipment will drop
- hire an engineering firm to provide further recommendations
- other (specify)

DILEMMA CARD

You are finally able to build the home your family has dreamed about. After reviewing the plans for your home, you realize that you cannot include all of the features you had planned for, due to rising construction costs. If you can only choose to include one of the following features, which would you choose?

- solar heating
- recreation room with fireplace
- hot tub and sauna
- greenhouse
- other (specify)

DILEMMA CARD

You are an influential member of the community. On your way home from work, you are stopped by a police officer and cited for having excessive automobile emissions. Would you?

- use your influence to have the ticket invalidated
- sell the car to some unsuspecting person
- work to change the law
- get your car fixed and pay the ticket
- other (specify)

DILEMMA CARD

Your friend has just given you a lovely ivory necklace that she purchased on a trip to Africa. You are aware that African elephants are being slaughtered for their ivory tusks and are now endangered species. Would you?

- accept the necklace and wear it often
- accept the necklace but keep it in a drawer
- explain to the friend why you do not wish to accept her gift
- other (specify)

DILEMMA CARD

Your favorite lunch spot continues to use polystyrene food containers. You are aware that the production of polystyrene releases chlorofluorocarbons (CFCs) into the atmosphere. CFCs are responsible for destroying the atmosphere's protective ozone layer and contributing to global warming. Would you?

- stop buying food at that café
- talk with the manager about switching to more ecologically sound containers
- bring your own plate or cup and ask them not to give you a container
- do nothing
- other (specify)

DILEMMA CARD

You live in a densely wooded area where you enjoy seeing squirrels, rabbits, deer, chipmunks, rabbits and several varieties of birds on a regular basis. The house next door has just been sold to a family that wants to cultivate a large, green lawn on their entire property. This would require them to cut down over an acre of trees surrounding their home. Would you?

- tell them lawns waste water and energy
- plead with them to preserve their wildlife habitat
- do nothing
- move
- other (specify)

DILEMMA CARD

Your school doesn't have a recycling program. Plastic, cans, bottles and papers all go into the trash. Would you?

- write a letter to the school board encouraging them to recycle
- organize a group of students to start a recycling program
- save up your own recyclables until you find a place to recycle them
- recycle only when there are containers set up
- other (specify)

DILEMMA CARD

You are taking care of your best friend's family house for the weekend. You discover that they keep a lot of toxic cleaning supplies under the sink: drain cleaner, ammonia, disinfectant, and pesticides. Would you?

- Dispose of all their toxic chemicals and replace them with safer alternatives
- Discreetly leave them a note or book explaining the dangers of these toxins
- Clean up the house using safe alternatives, and bring up the subject when they complement you on your cleaning job
- Do nothing, but continue to use safe alternatives in your own home
- other (specify)

DILEMMA CARD

You have your very own apartment for the first time, which you have furnished with old, mis-matched furniture. Your rich uncle offers to buy you an all-new living room set. Would you?

- Ask your Uncle to help fix up the old furniture with new upholstery and finish
- Give your old furniture to a second hand store for someone else to use
- Put your old furniture out on the curb for the trash, hoping someone else will like it enough to take it
- Politely decline to take your Uncle's offer
- Go shopping with your Uncle for a nicely matched set of used furniture
- other(specify)

DILEMMA CARD

A new power company moves into your neighborhood. For an extra ten dollars a month, you could support their use of alternatives to fossil fuels. Though it wouldn't replace the more popular power company, it would be a step towards encouraging alternative power. Would you?

- Continue to use the cheaper power company, but try to conserve electricity
- Use the new power company, and cut down on costs by conserving electricity
- Support alternative power by spreading the word about its benefits rather than paying extra money
- Stick with the big power company
- other (specify)

King rat and the brilliant squibbon by Miguel Llanos

Experts imagine a future with, and without, humans.....

It's not that Peter Ward has a special fondness for rats. It's just that he sees them as survivors and, in the future world he posits, they might be the ultimate survivor — and evolver.

Sure, humans will still have their pets, but they probably will not thrive on their own and many will be genetically engineered. As for large mammals such as lions and tigers and bears, in Ward's world they will be driven to extinction by the loss of their habitats and global warming.

No, the real rulers will be rodents — and snakes. “The fossil record shows that they have the genetic capability of whipping out new species,” says Ward, a biology professor at the University of Washington.

Oh yeah, cockroaches are also within the category he calls “champion speciators.”

Ward is among the academics who focus on the future of evolution. Many agree that animal evolution will be shaped by urbanization, genetic engineering and climate change. But some disagree on whether humans themselves will continue as a species.

British geologist Dougal Dixon, in the book “The Future is Wild,” creates a scenario millions of years from now in which humans become extinct and are replaced by an animal kingdom dominated by a giant land-based squid.

Why dabble in what Dixon himself calls “speculative biology?” For Dixon, it's a “novel approach to the instruction of science.

“To give fictitious examples of factual process and situations, especially in evolution, ecology and the other life sciences, gives people another way to look at those subjects — a way that has not been explored before,” he says.

The future is now

In Ward's world, described in his book “Future Evolution,” humans don't die off, but Earth as we know it sure has changed. “You've got to assume

that humans are going to continue and at high population numbers,” he tells MSNBC.com.

If that's the case, he says, then animals will have to evolve to thrive in two dominant environments — cities, where the masses live, and tracts of cropland cultivated to feed those masses.

Gone will be the vast grasslands that gave rise to large mammals. “I bet we'll never see a large animal species ever again,” Ward says. “Give it a million years,” he says, and lions, tigers and bears might all be gone.

Temperature swings over time in this world will favor species that can adapt relatively quickly, and animals will have to be able to survive in polluted air and water. A perfect world for rodents, snakes, cockroaches and foraging birds like crows.

Ward believes rats and snakes belong in the category known as “supertaxa,” groups of organisms that create many new species while having a relatively low extinction rate.

Steve Stanley, a geobiologist at Johns Hopkins University who coined the term, agrees. Rats and snakes “are diversifying rapidly today,” he says, “and if rodents continue to diversify, they will further stimulate the diversification of snakes, because many snakes eat rodents.”

The human touch

A parallel track in this future world involves animals domesticated or engineered by humans.

Stanford biologist Stephen Palumbi, in his book “The Evolution Explosion,” argues that humans have accelerated evolution with well-intentioned tinkering — and usually without thinking of the consequences.

He calls this tinkering “brute force evolution,” writing that “we humans have a talent for upping the evolutionary ante and accelerating the evolutionary game, especially among the species that live with us most intimately — our diseases, food and pests.”

“Anything that works we like to do more and more and more of,” he said in an interview, noting that in the case of vaccines, insecticides and herbicides, that means short-term gains against

disease and pests only to see them develop a resistance and come back even stronger.

Palumbi does see a “movement towards greater awareness” of such dangers and suggests that society take them into account much as it does significant environmental changes that come with development. “There’s no reason we couldn’t do an ‘evolutionary impact statement,’” he says.

Do we really need a cat-dog?

Ward agrees with Palumbi’s concerns, saying it’s one thing to mix dog genes to come up with a new breed, but another to mix genes from different animals.

“If you really want to see how fast evolution can be,” he says, “just focus on dogs.” In just the last 200 years of human domestication, dogs “are now the most widely genetic type of creature on the planet.”

But, he asks, “What happens if the same ease in producing things gets caught up in creatures we don’t like?”

“We’re attacking things with an ax and we don’t yet have the sophistication to know the impacts”, Ward says. “There will be an escape of genomes from good stuff to bad stuff ... (and) it’s going to effect evolution.”

Earth without humans

In “The Future is Wild,” Dixon, the British geologist, and co-author John Adams create an animal kingdom in which humans no longer reign.

Dixon and Adams give whimsical names to the creatures they dream up, aiming not so much to predict the future but to show some possibilities.

In their vision, humans become extinct in an Ice Age 5 million years from now. “Shagrats,” or giant rodents, and “gannet whales,” large aquatic birds, have evolved during this stretch of time.

The Ice Age melts away 100 million years later, marking the beginning of the end of large mammals and giving rise to creatures like the “ocean phantom,” a jellyfish the size of a truck; the “swampus,” a relative of the octopus that emerges from swamps to feed; and the “toraton,” a reptile bigger than dinosaurs.

In 200 million years, evolution brings bizarre animals like “flish,” birds that evolved from fish; “bumblebeetles,” beetles that fly; and “megasquid,” multi-ton, land-based squid creatures.

“Squibbons,” a hybrid squid-gibbon ape, live in trees, eat plants as well as flish and “represent the pinnacle of intelligent life on Earth,” according to Dixon and Adams’ vision.

But it won’t be the last species on top. “Undoubtedly,” the authors conclude, “the far future will be even wilder.”

Rival worlds

Dixon says speculating about such a future helps educate people. “The public appetite for monsters and aliens and strange things of that sort can be a valuable tool and can deliver an audience that would be willing to be informed and educated,” he says.

Ward isn’t convinced and says his interest in the field of future evolution is driven by presenting scenarios that contrast with visions such as Dixon’s.

”I get tired of futurists so missing the mark, or so it seems to me,” he says. “First, there is the sense that humans will soon be gone, or second, that we will produce some ‘Blade Runner’ world that is all pollution and Michael Jackson mouth masks.”

Palumbi, the Stanford biologist, says that as long as humans do inhabit the planet it will pay to listen to Mother Nature. “Changes to the environment are irreversible,” he said, “and thinking them through is important.”

© 2007 MSNBC Interactive