We decided to create a traveling exhibit and a curriculum module about vector-borne disease because it is a topic important to everyone in the United States. Our home state of Connecticut plays a major role in the study of two well-known vector-borne diseases: 1) Lyme disease, named for the town of Lyme, Connecticut; and 2) West Nile virus, which first appeared in this country in 1999 and is being closely studied by the Connecticut Agricultural Experiment Station.

The two lessons posted here were drawn from a five-lesson curriculum module developed by Yale Peabody Museum in collaboration with Connecticut middle and high school teachers. We want to thank the National Center for Research Resources of the National Institutes of Health for providing us with a Science Education Partnership Award to fund this project.

The curriculum module has been extensively field tested in California, Massachusetts, Oregon, Texas, Washington and Wisconsin. It is now available for national dissemination through selected sites in museums, science centers and school districts. Please contact Program Director Laura Fawcett (laura.fawcett@yale.edu) to find out about becoming a national dissemination site for the complete module.

During the time we have been testing this curriculum module, we have heard two questions from students:

1. Why would a museum care about vector-borne diseases?
2. Why should I care about this stuff?

Let’s start with the first question...

Yale Peabody Museum, founded in 1866 in New Haven, Connecticut, is a special place. Its mission is to help understand and keep a record of the earth’s history, including all of life and every human culture – a big task! How is such a task even possible? The museum does this by collecting, conserving and doing research on specimens from around the globe.

In 1908, Peabody’s scientists – including biologists, geologists and anthropologists - would make observations, take measurements, and analyze their data. Their work might have included describing a new species or observing how a species evolved over millions of years. In 2008, Peabody’s scientists would also observe, measure and analyze, but with some added twists. Today’s scientists also include evolutionary biologists who might analyze genetic data that reveal how organisms that look very different are actually related. Or they’ll discover the exact opposite - organisms that look related might not be genetically close at all. Museum scientists also work with Geographic Information System (GIS) experts. Together, they might observe rainfall patterns with GIS computer technology to predict how climate change might affect food crops. They can even map the exact spot where museum specimens were collected and figure out the environments in which they lived.
You might be surprised to find that this is the work of a museum. But let’s take a look at our complete name: Yale Peabody Museum of Natural History. If you know the definition of natural history it is not surprising at all.

**Natural history:** the scientific study and description of living things and natural objects, especially their origins, evolution, and relationships to one another.

Is there any part of this definition that helps you to understand why Yale Peabody Museum cares about vector-borne disease? Let’s take a closer look…

“The scientific study and description of living things” sounds like the definition of a word you may already know: biology. The prefix, *bio-*, means “life or living” – think of words like biography (the story of someone’s life), biohazard (a material that is dangerous to living things), and biofuel (fuel made from recently living materials, instead of fossil fuel from long dead material) The suffix -ology means “the scientific study of” – think of words like geology (the scientific study of the earth), entomology (the scientific study of insects), and ornithology (the scientific study of birds).

In an earlier paragraph, we mentioned an evolutionary biologist and the definition above includes the word evolution. What does this have to do with a vector-borne disease?

**Evolution:** In biology, any change over time in the genetic material of a population of organisms. There can be different degrees of evolution, from small changes in minor genes to major genetic changes that differentiate species. Evolution explains the diversity of all life on earth as a result of these genetic changes.

Hmm...we already know that natural history is the scientific study of living things. And now we know that evolution has to do with changes in genes in populations. We also know that evolution can result in the formation of new species. So, it makes sense that a natural history museum studies evolution, right? But, we still haven’t figured out why the museum cares about vector-borne disease...or, have we?

Let’s look at a few more important words.

As a middle or high school student in the 21st century, you have probably heard the word ecology. You may even know its definition.

**Ecology:** the scientific study of how living things interact with their environment, including the physical environment and other living things.

Maybe your teacher had you build a rainforest in the classroom. Your scout troop might have collected money to protect an endangered animal. Or, you did something as simple as play a food web game using a piece of string to show how some plants and animals are connected. All of these activities were to help you learn about an important part of ecology, biodiversity.
**Biodiversity**: the total range and variety of life-forms, including differences between gene pools, species, populations and entire ecosystems.

Did you know that this word didn’t exist before 1986? That year the National Forum on BioDiversity was held in Washington, D.C. Scientists from all over the United States came together to discuss the importance of knowing as much as possible about *every living thing* – from genes to species to ecosystems to interactions with every other living thing. These scientists recognized that many of plant and animal species are facing extinction. They also realized that we don’t even know how many species there are! Current estimates put the number of plants, animals and microorganisms known to science at about 1.7 million. The truth is that most species have not yet been described and named. Many scientists think that the actual number of species on earth is anywhere from 10 to 80 million, but no one is sure. This means we are losing species that haven’t even been described yet. Sadly, we may be losing more than just particular species.

Humans can build and use computers, create space shuttles and travel to the moon and invent ways to copy and change DNA molecules. But our bodies have evolved to follow the same biological rules as every other living thing on the planet. This can cause us problems, as you’ll see when you learn about zoonotic diseases in this module. The same virus or bacterium can live in a bird, mouse, mosquito and human, causing illness and even death. People have always depended on biodiversity for medicines. There are parts of other living things that can treat or even cure diseases. One example is the rosy periwinkle, a plant from Madagascar. It contains chemicals that are used to treat a fatal childhood cancer. Thousands of children have been saved by this plant-based medicine. Another example concerns high blood pressure, a deadly condition of adults. The venom of a poisonous rain forest snake was used to make a powerful medicine that treats this illness. Today, we need new medicines to treat emerging diseases. We also need to be able to treat pathogens that have become resistant to the antibiotics we use now.

So, by now you have read a number of reasons why Yale Peabody Museum thinks biodiversity is important. But what about vector-borne disease? Although you will learn more about this type of disease in the module, let’s take a quick look now.

A vector-borne disease has a complex story. First, there is the pathogen – a virus or bacterium that actually causes the illness. This pathogen must go through several steps before it can infect a person. It must find a non-human vertebrate host to live in – often a bird or a mammal. A host can carry the pathogen in its bloodstream without getting sick. This allows the pathogen to keep reproducing until it is picked up by a vector. The vector is a blood-sucking arthropod – often a mosquito, tick or flea. When the vector takes blood from an infected host, it picks up the pathogen, too.

But here’s the thing (and here’s a hint about why we have been talking about biodiversity): Every specific pathogen has specific vectors and specific hosts. For example, West Nile virus doesn’t use all birds as its hosts. It only uses specific species, such as robins, sparrows, and a few other song birds. When we say that “mosquitoes carry West Nile virus,” we don’t mean all mosquitoes. The virus is carried and transmitted by a few specific types of mosquitoes, mostly *Culex* species. In order to understand, treat and prevent this type of complicated disease, we must know all we can about all the species involved.
So, when we say that biodiversity matters, we mean that each species in this web of life matters. The truth is that we know so little about the role of biodiversity that we do not know how many species we can lose without putting the whole planet in danger.

Edward O. Wilson is a famous biologist who writes a lot about biodiversity. He said it best:

“If enough species are extinguished, will ecosystems collapse and will the extinction of all other species follow soon afterwards? The only answer anyone can give is: Possibly. By the time we find out, however, it might be too late. One planet, one experiment.”

We at the Yale Peabody Museum hope that you might consider becoming a scientist in order to help us protect the future.

And, finally, here’s the answer to the second question, why should you care? Because you are the future.