I want to thank Jill, Kristy and David for organizing this event, the other panelists for participating, David Lazarus for moderating, and to all of you for being here today.

I believe that the contributions of animal research to medical science are undeniable.

A visit to a physician 100 years ago would have resulted in a recommendation to induce vomiting, diarrhea or, more commonly, bleeding. Diphtheria, mumps, measles and polio were common and untreatable; today they have been largely conquered. Life expectancy in the US was less than 50 years; it is now close to 80. Our generation benefits from treatments and medicines our parents and grandparents only dreamt about.

Animal research has contributed to many of these advances. Anti-coagulants that make up blood thinning medicines were first isolated in dogs. Insulin was discovered in dogs and purified in rabbits. Lung surfactants, that save the lives of premature babies every single day, were first extracted and studied in dogs. Rabbits, dogs and cattle were used to develop a vaccine for cervical cancer. And these are just a few examples.

These advances owe much to scientific research, and it is worth spending a few words discussing how such work is normally conducted.

Scientific research is in fact a search. A search for explanations to natural phenomena. A search for theories that can explain everything from the structure of matter to how viruses attack a living organism.

It is important to recognize that in this search for explanations it is natural and expected for many paths to lead to blind alleys and dead-ends. This is a feature of science, not a bug. This is what actually makes science work -- ruling out ideas that are proven wrong by data allows us to gradually narrow down the list of possible explanations and

eventually land on an answer. History has shown, time and again, that such strategy works, producing advances in everything from mathematics and physics, to life sciences and medicine.

Science does not provide recipes. There is no recipe that can ensure a particular type of work will lead to a unified theory of physics. Similarly, there is no recipe that will ensure a particular type of work, weather using humans or animals, will lead to cures for cancer, paralysis or autism. If such recipes were available, we would use them. We must understand and accept that this is not how science works.

So how does it work?

When facing any one question scientists start by asking themselves where and how they will search for an answer. They rely on the available data and accumulated knowledge, along with their own intuition, as to where it would be most promising to search next.

Scientists are not stubborn. They are ready and willing to follow the most promising research directions. This is evidenced when, from time to time, some breakthroughs move a substantial proportion of scientists to work on new topics. It can be string theory if you are a theoretical physicist, or stem cell research if you are a cell biologist.

Clearly, many scientists today believe that to understand disease we must study its molecular and cellular underpinnings, the level at which disease normally attacks. They work in animals because non-invasive methods that would allow experimental manipulation at such small scales in humans do not yet exist.

In animals we can turn individual genes on and off and observe the consequences; we can make cells fluoresce and track their movements during development or tumor growth; we can reconstruct a 3D volume of tissue down to cellular resolution. These

and many other sophisticated tools are not available when working with human subjects.

Scientists try to replicate the conditions of human disease in animals so they can explore molecular and cellular approaches to therapy. There is no doubt animal models of disease are approximations to the human condition and can have limitations. It is part the scientist's job to be aware of the limitations, understand why they occur, and to continuously improve the models to replicate the disease process in humans with ever increasing fidelity.

In contrast, work with humans has the advantage that it can provide data that is most relevant to us, but such work limits in serious ways the scope of techniques that can be used. In particular, we cannot not observe life processes at the cellular and molecular levels in a living human being.

Because of the different limitations of the methods, it is by combining both animal and human studies that we can maximize our chances of finding cures for human ailments.

Another fact about science that is not always appreciated is the unpredictability of breakthroughs, as evidenced in the fact that they are often achieved by connecting unrelated branches of science in ways that nobody could have anticipated.

It was curiosity about the physics of vacuum tubes that lead to the discovery of X-rays, which is the most used medical diagnostic device today. The abstract mathematics of reconstructing 3D objects from their shadows or projections, along with the quantum physics of atomic resonance, is what allowed the development of magnetic resonance imaging. Ultrasound was discovered in bats, and first developed for the detection of large floating objects in the sea. Today, it allows you to monitor the health of your baby during pregnancy and diagnose a multitude of other ailments.

None of the researchers involved in the initial discoveries had in mind a medical application for their research. They were just curious about the world. They produced accurate explanations of the phenomena they were interested in, and their results found applicability in medicine and beyond.

To anyone claiming to know with certainty where the next breakthrough will be, or to anyone declaring an entire field of research doomed to failure because it involves the use of animals, I can only offer my skepticism in return.

While I believe the scientific contributions of animal research to medical science are clear, it is equally evident that not every line of research carry the same ethical baggage, and this is something that must be considered as well.

The question before us is: 'Is it right to use animals to advance scientific knowledge and medical science?'

I believe this is really the central issue that divides our positions on animal research; it is not the science, it is the ethics.

This is a legitimate and difficult question that deserves to be discussed with the public. A discussion that should involve not only the scientists that carry out the work and those that oppose it, but also the federal agencies that direct biomedical research, our public health officials, as well patients and their families. After all, it must be recognized that scientists are carrying out the research our society as a whole, through our representatives, has decided it is in our common interest.

The ethics of animal experimentation should also be discussed within the larger scope of our relationship with and animals. In many parts of the world horses, mules and

elephants are used for transportation. Animals also play an integral part in working the land in agricultural communities. Animals are used for clothing, entertainment and education. Above all, animals are used for food. The number of animals used in these activities vastly outnumbers those used for medical research (~1000 times more). Yet, it is only scientific research that generates long-lasting knowledge that will benefit all future generations.

Nobody can dispute that animals can suffer, that they can experience the world, that they can have rich social lives, and that animal life has inherent value. This recognition imposes important obligations on our treatment of animals.

When it comes to research, it is our duty to treat animals humanely and with respect, to minimize their pain, to provide them with an appropriate social environment, to use alternative methods when these are available, and to develop new ones when they are not. Let me be clear on this point -- I fully support the development of alternatives, and so does every single scientist I know.

At the same time, nobody can deny the cognitive gulf that separates animals and humans. It is humans that have understood the basic laws of physics. It is humans that have built instruments that can peek as far as the edge of the universe, and all the way down to single atoms. It is humans that have sequenced their own genome. It is humans that have created the arts. It is humans, that have the unique ability to store our shared knowledge outside our bodies in ways that will survive our physical deaths and benefit generations to come. To deny these differences is to deny our humanity.

We should not be afraid to acknowledge these differences, as such an act does not imply in any way that we have the right to do with animals as we please. In fact, it implies exactly the opposite. Accepting that evolution has put us in a place to be the

stewards of our planet, its environment and all living creatures within it, carries a tremendous responsibility that we must accept and face.

I want to conclude by sharing with you a story from the Talmud that reflects my feelings about basic research.

The main character in the story is Honi , and it goes like this:

One day Honi was walking on the road and saw a man planting a carob tree.

Honi asked the man, "How long will it take for this tree to bear fruit?"

The man replied, "Seventy years."

Honi then asked the man, "And do you think you will live another seventy years and eat the fruit of this tree?"

The man answered, "Perhaps not. However, when I was born into this world, I found many carob trees planted by my father and grandfather. Just as they planted trees for me, I am planting trees for my children and grandchildren so they will be able to eat the fruit of these trees."

To me basic research is the tree in this story. The fruits are the therapies and cures of, perhaps, a distant tomorrow. Even though we might not be able to benefit directly from the basic research of today, we owe it to our children and our grandchildren to develop the knowledge that they will need to build a better future for their generation and those to come.

This goal, and this goal alone, is what motivates my work and that of my colleagues.