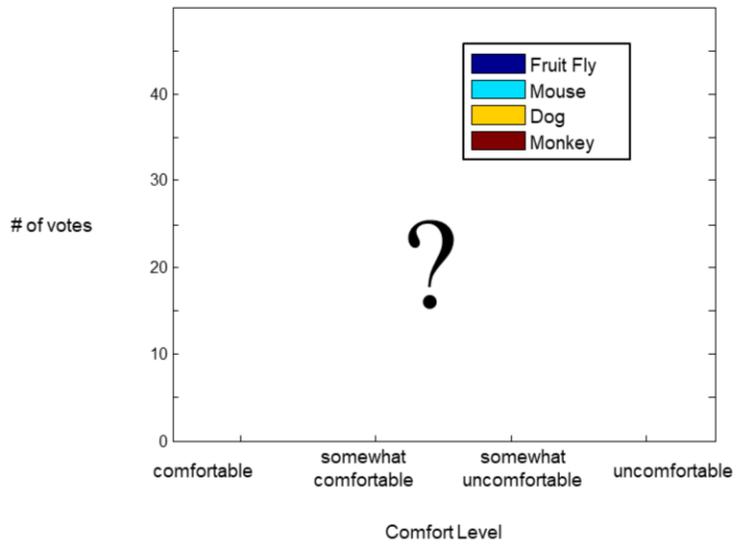


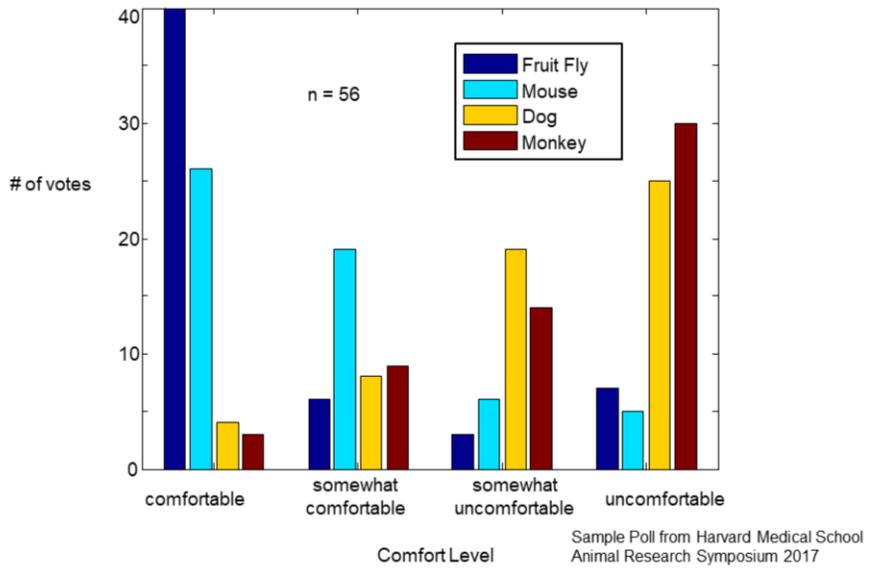
# **The Role of Animals in Basic, Medical, and Veterinary Health Research**



Please Rate Your Comfort Level With the **Prescribing of Drugs** Developed and Tested Using the Following Species

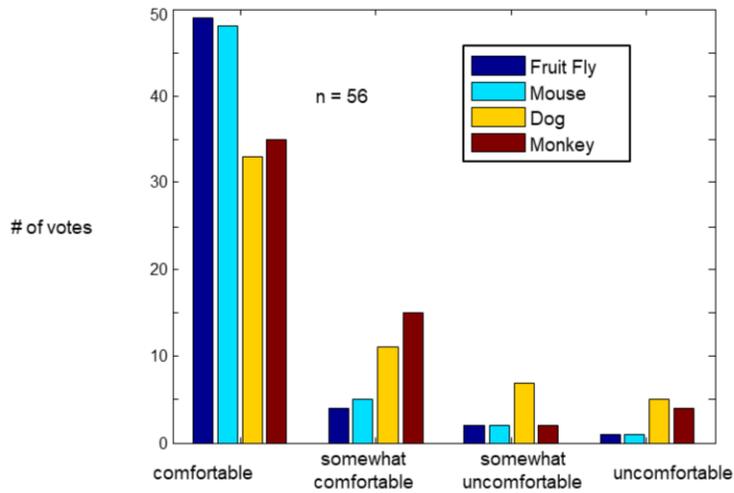


Please Rate Your Comfort Level With the Use of the Following Species in Your Own Research.



Survey given to Harvard Medical School, Division of Medical Sciences graduate students enrolled in the Conduct of Science Course in October of 2013. Total of 56 respondents.

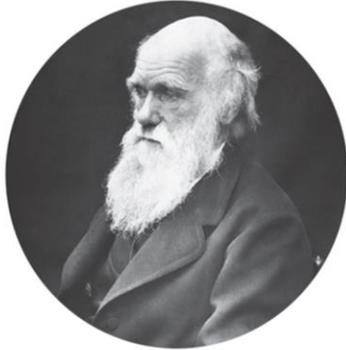
Please Rate Your Comfort Level With the Use of Data From Experiments on the Following Species.



Sample Poll from Harvard Medical School  
Animal Research Symposium 2017

Survey given to Harvard Medical School, Division of Medical Sciences graduate students enrolled in the Conduct of Science Course in October of 2013. Total of 56 respondents.

Animal research contributed to  
**70% of Nobel prizes** in physiology or medicine



 SOCIETY for  
NEUROSCIENCE

"I know that physiology cannot possibly progress except by means of experimenting on live animals, and I feel the deepest conviction that he who retards the progress of physiology commits a crime against mankind."

Charles Darwin  
The London Times, 1881

### Introduce importance of animal research for medical progress

Nobel prize percentage source:

<https://speakingofresearch.files.wordpress.com/2008/03/medical-advances-and-animal-research1.pdf>

Quote source: **Darwin CR.** Mr. Darwin on vivisection. The Times of London 1881;10. as quoted in: Ringach DL. The use of nonhuman animals in biomedical research. Am J Med Sci. 2011 Oct;342(4):305-13. doi: 10.1097/MAJ.0b013e31822a6c35. PubMed PMID: 21817874.

For example, utilizing genetic likeness of animals for scientific progress.

Transgenic animals are useful models to:

- Study disease development
- Evaluate medicines and gene therapies
- Produce and test the purity of human therapeutic proteins

## The **Beneficiaries** of Animal Research



*Our Families*



*Our Environment*



(Image: SVP&Z)

*Our Pets*



Without animal research, who would lose? Introduce listed beneficiaries: medical advances through animal research help humans, the health of our pets, and provide an understanding of our environment and the interconnectedness / biodiversity of life. Pets suffer from many of the same diseases as humans and, thus, benefit from many of the same treatments developed via animal research (e.g., similarities between feline immunodeficiency virus and HIV). Pets' food, medicines, and vaccinations were developed using animal research. For example, many puppies died within months of contracting canine parvovirus until the vaccine was developed via animal research in the early 1980s.

# Human Health Advances

Examples of medical advances based on animal research:

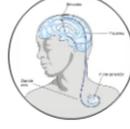
kidney transplants



insulin injections



Parkinson's disease implants



**INSULIN**  
dogs, rabbits, and mice

**MMR VACCINE**  
nonhuman primates

**BLOOD TRANSFUSIONS**  
dogs, guinea pigs, and rabbits

**POLIO**  
mice and nonhuman primates

**KIDNEY TRANSPLANTS**  
dogs and pigs

**PARKINSON'S DISEASE IMPLANTS**  
nonhuman primates

**GENE THERAPY RETINITIS PIGMENTOSA**  
dogs

**PENICILLIN AND STREPTOMYCIN**  
mice and guinea pigs

"There could have been no oral polio vaccine without the use of innumerable animals."  
Albert Sabin, Polio researcher

Virtually all medical advances utilized animal research models at some point in the R & D process

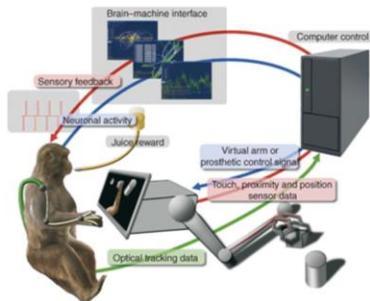
Model system used for discovery is listed alongside medical advance

Source: <https://speakingofresearch.files.wordpress.com/2008/03/medical-advances-and-animal-research1.pdf>

<https://speakingofresearch.com/facts/medical-benefits/>

## Limb Function Through Advances in Brain Machine Interfaces (BMI)

### BMI technology informed by nonhuman primate neuronal recordings



### BMI's potential to restore limb mobility



Source: Lebedev & Nicolelis. Trends in Neuroscience. July 2006.

BMI involves a direct connection between the brain areas associated with movement and a wired device like a prosthetic. Neuronal activity is recorded and processed through a computer to power the robotic arm. Feedback from sensors on the arm is converted to micro stimulation of sensory brain areas. BMI aims to generate a prosthetic that feels and acts like a human limb. BMIs may be used as therapy for restoring motor control in disabled individuals. More information can be found at <http://www.brainfacts.org/in-the-lab/animals-in-research/2016/animal-research-success-stories-brain-machine-interface-090616>

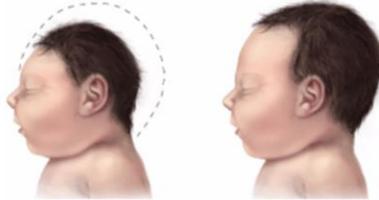
Images from:

<http://www.afanporsaber.es/files/homepage/group/loveLAB/love/classes/design/readings/bmi2.pdf>

## Why Researchers Select A Specific Animal Model

### Biological similarity between animal model and human

For example, the common disease progression of the Zika virus:

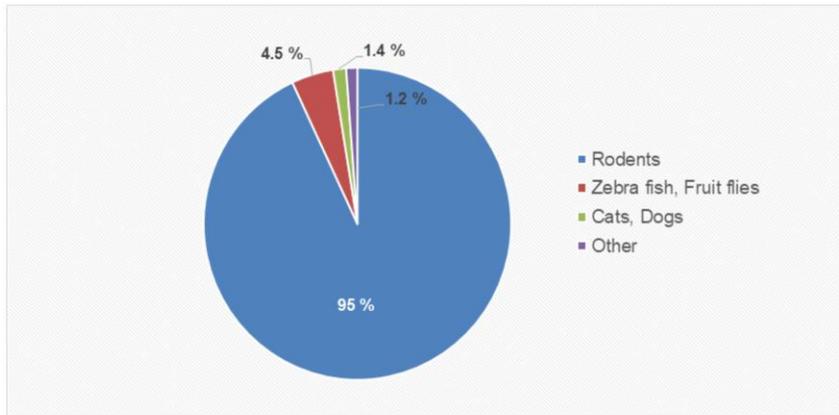


Researchers are working with macaque monkeys to understand the impact of Zika, the latest virus to emerge as a global threat. Zika infection in pregnant women can cause microcephaly, a condition where the child is born with a small head due to abnormal brain development. It also appears to cause stillbirth, miscarriages and fetal growth restriction. These problems all appear to be rooted in how the Zika virus affects the developing fetus and the placenta, which nourishes the baby in its mother's womb. The Zika virus infects monkeys just as it does humans, and both experience the disease in the same way. Researchers can study pregnant monkeys much as an obstetrician follows a woman's pregnancy – they can take blood, monitor fetal development through ultrasounds and collect amniotic fluid. They can then test vaccines and drugs with the hope of protecting the fetus. No other animal model allows for this entire spectrum of study and application of the findings to pregnant women.

Photo source: FBR (<https://fbresearch.org/new-threats-zika-infection-complications-pregnancy/>)

## Laboratory Animals: 'Partners' in biomedical innovation

Laboratory Animals in U.S.



Source: *Love Animals? Support Animals in Research*. Foundation for Biomedical Research. September 2017.

The majority of animals in biomedical research are rodents with a small percentage of researchers working with cats, dogs, and NHPs.

Source: *Love Animals? Support Animals in Research*. Foundation for Biomedical Research. September 2017.

## Researchers Manage the Health and Well Being of Laboratory Animals



### HEALTH CARE

cared for daily by animal welfare staff and regularly monitored by veterinarians

### NUTRITION

veterinarian approved diet

### ENVIRONMENT

clean with minimal stressors

### PSYCHOLOGICAL

species specific enrichment



Laboratory animals are kept in clean, enriched environments with oversight from veterinarians and behavioral experts.

Photo source: <https://nprcresearch.org/primate/NHP-White-Paper-Print-08-22-16.pdf>

## Veterinary Advances

FOWL POX VACCINATION  
mice



RUMENSIN ANTIMICROBIAL  
mice



ELEPHANT ENDOTHELIOTROPIC HERPES VIRUS  
mice and rabbits



WHITE NOSE SYNDROME  
brown bats



Through animal research, scientists better understand and have developed treatments for conditions affecting the animal kingdom including diseases affecting pets.

Sources: <https://www.wsj.com/articles/love-your-dog-support-animal-research-1505672563>; <https://fbresearch.org/animal-research-helps-endangered-species/>

Model system used for discovery is listed alongside veterinary advance

Fowl pox: virus produces lesions on bird's skin, throat, and trachea; interferes with bird's ability to eat, drink, and breathe normally

Rumensin: antimicrobial used to prevent and control coccidiosis parasite was originally developed through mouse research

EEHV: Asian elephants are highly susceptible to EEHV, a lethal strain of herpes; studying antibody responses to EEHV proteins in mice and rabbits aims to improve diagnostics and treatments for wild and captive elephants

White nose syndrome: bats' wings are coated in white 'fuzz' during hibernation; fungus affects endangered Indiana and gray bat species; exposed common brown

bats to white fungus to understand disease mechanisms

<https://speakingofresearch.com/facts/veterinary-benefits/>

## How Animal Research is Regulated

In the US today, the **Animal Welfare Act (AWA)** and the **Public Health Service (PHS) Policy** assure the humane treatment of animals in research, testing, and teaching practices.



Implements PHS Policy

Animal procedures in NIH and NSF grants are evaluated by NIH Office of Laboratory Animal Welfare



Drug metabolism and device biocompatibility require regulated animal research



USDA oversees AWA compliance

Scientists work with laboratory animals in a regulated way as set forth by AWA and PHS.

FDA:

Requires animal research for device and drug approval.

Devices – animal testing is only necessary if new material is used; biocompatibility testing is required

Drugs and Biologics – animal testing is used to determine drug absorption (into blood), drug metabolism, product and metabolite toxicity, speed of metabolite excretion

<https://www.fda.gov/AboutFDA/Transparency/Basics/ucm194932.htm>

OLAW:

<https://grants.nih.gov/grants/olaw/olaw.htm>

USDA:

<https://www.nal.usda.gov/awic/animal-welfare-act>

## Regulations Governing Animal Research

**Animal Welfare Act (AWA)** and the **Public Health Service (PHS) Policy** require each research institution to appoint an **Institutional Animal Care and Use Committee (IACUC)** including a veterinarian and a non-affiliated public representative to review all experimental protocols, inspect facilities, and suspend any research practice not in compliance



In IACUC proposals, scientists must...

1. Cite literature to explain:

- Why their model is the **appropriate experimental subject** to address the research question
- Why **alternative research subjects** (e.g., cell culture and computer simulation) would not yield similar information
- Why their potential results would not **unnecessarily duplicate** previous research

2. Perform sample size calculations to determine **number of animals necessary**

Many institutions are implementing animal research conduct by following the 3 R's:

- Replace with an alternative
- Refine methods to minimize pain and invasiveness
- Reduce the number of animals

Each research institution oversees individual laboratories' practices through an IACUC. The IACUC requires researchers to justify their work with animals and their use of the 3 Rs.

Above source: <https://www.darwinproject.ac.uk/commentary/life-sciences/darwin-and-vivisection>

Below source: <http://www.nabr.org/animal-welfare-2/animal-welfare-in-practice/functions-of-the-iacuc/>

<https://speakingofresearch.com/facts/research-regulation/>

## Animal Research Resources

### Foundation for Biomedical Research



Animals behind the 25 most prescribed drugs

Species-specific examples of animal research:

1. Rodents

2. Dogs

3. Cats

4. Nonhuman primates



### Federation of European Neuroscience Societies



### Americans for Medical Progress



Come See Our World video

Love Care Progress nonhuman primate video

### Speaking of Research



### Association for Assessment and Accreditation of Laboratory Animal Care International



Please utilize these resources for additional information.