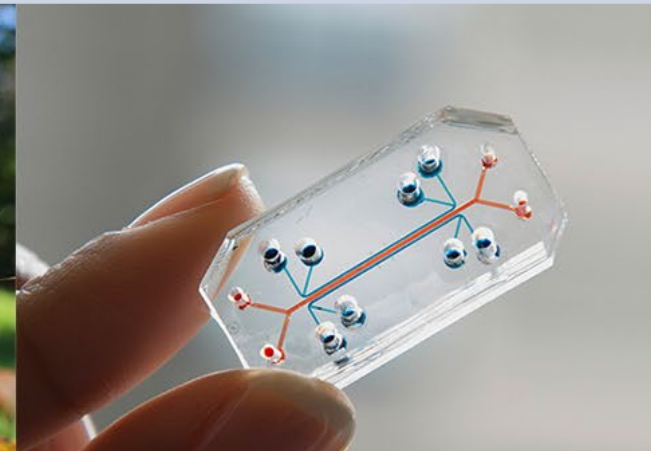
USDA National Agricultural Library
U.S. DEPARTMENT OF AGRICULTURE

Animal Welfare Information Center Workshop

Meeting the Requirements of the Animal Welfare Act



What comes to mind when you think of animal welfare in research?

https://www.menti.com/alurscksw n3a

The AWIC Team

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Tell Us About You!

What area of research do you work in? (Choose all that apply)

1. Toxicology
2. Nutrition
3. Immunology
4. Genetics
5. Behavior and welfare
6. Biomedical/health
7. Other
8. None

What animals do you work with in your research? (Choose all that apply)

1. Mice
2. Rats
3. Hamsters
4. Guinea pigs
5. Rabbits
6. Ferrets
7. Dogs
8. Cats
9. Horses
10. Farm animals
11. Zebrafish
12. Other
13. None

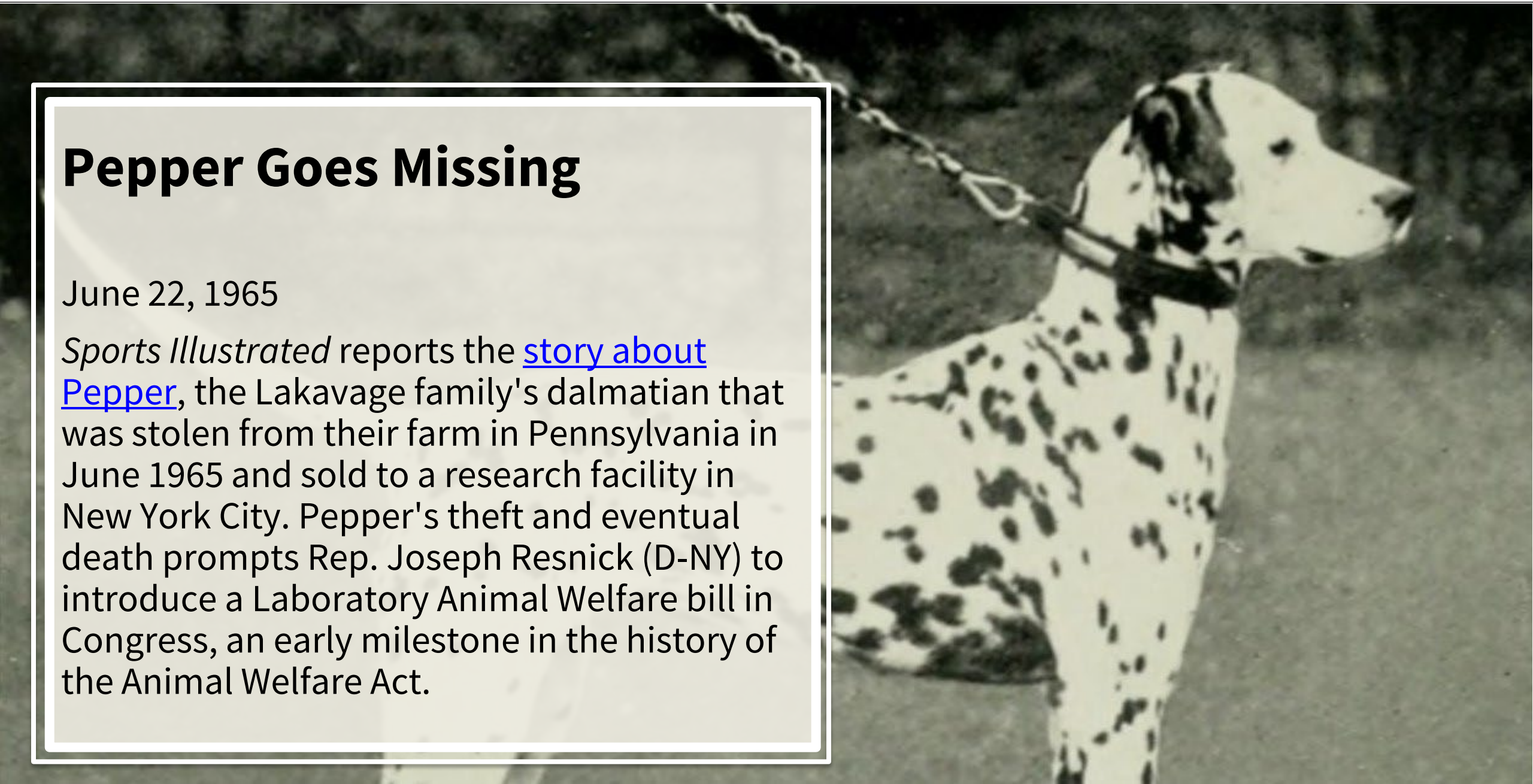
OBJECTIVES

- Overview of the Animal Welfare Act and AWIC
- Define the 3Rs Alternatives
- Databases and Non-Database Resources
- Search Strategies and Live Demonstration
- A Word from APHIS & OLAW

Pepper Goes Missing

June 22, 1965

Sports Illustrated reports the story about Pepper, the Lakavage family's dalmatian that was stolen from their farm in Pennsylvania in June 1965 and sold to a research facility in New York City. Pepper's theft and eventual death prompts Rep. Joseph Resnick (D-NY) to introduce a Laboratory Animal Welfare bill in Congress, an early milestone in the history of the Animal Welfare Act.



Animal Welfare Act (Public Law 89-544) August 24, 1966

Rep. Resnick's efforts lead to the passage of the (Laboratory) Animal Welfare Act, of which the stated intention is "to protect the owners of dogs and cats from theft of such pets and to prevent the sale or use of stolen dogs and cats for purposes of research and experimentation."

Laboratory Animal Welfare Act of 1966
Public Law 89-544

- Established licensing of dog and cat dealers.
- Authorized Secretary of Agriculture to regulate transport, sale, and handling of animals prior to research or "for other purposes."
- Defined animal as dogs, cats, nonhuman primates, guinea pigs, hamsters, and rabbits.






Animal Welfare Act of 1970
Public Law 91-579

- Secretary to develop regulations regarding record keeping and humane care and treatment of animals involved in commerce, exhibition, experimentation, and transport.
- Clarified the definition of animals as all warm-blooded vertebrates *except*:
  - Horses not used in research
  - Farm animals used for breeding, food, fiber, etc.

What About Animals Not Covered by The AWA?

Farm Animals

- Governed through state and local laws
- Science-based animal care guidelines
- Voluntary third-party audits
- Auditing companies/Certification programs
  - Global Animal Partnership
  - American Humane
  - National Dairy FARM Program
  - United Egg Producers Certified

Case of the Silver Spring Monkeys

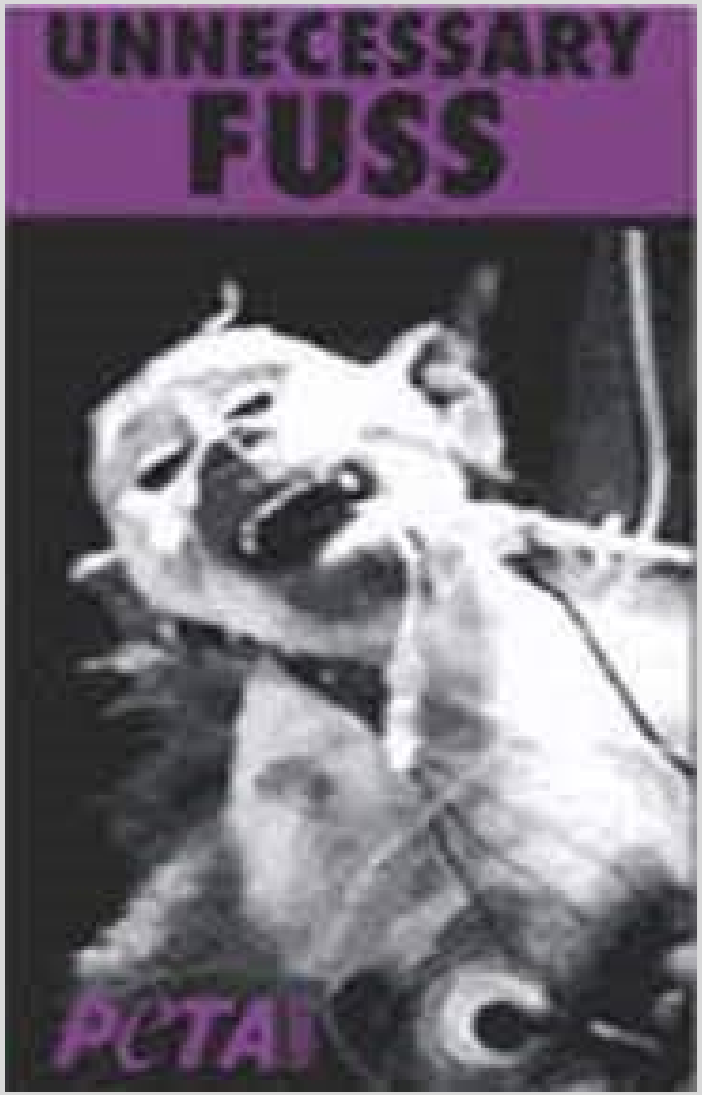
September 11, 1981

"…records showed that the animals had not received routine veterinary care for a period of years. Dr. Taub's grant was suspended until… his laboratory could…demonstrate that he could meet all the standards set forth in the Guide.

Taub's laboratory was never restored, and the animals remained, by court order, in the custody of NIH…"

- Charles R. McCarthy, Former OPRR Director

Image sourced from: Loveandradio.org



Charles R. McCarthy
Former Director, OPRR
https://www.youtube.com/watch?v=EdnYpJ9b_NY

University of Pennsylvania Head Trauma Clinic

May 28, 1984

Although the *Unnecessary Fuss* publication by PETA grossly overstated the deficiencies in the Head Injury Clinic, OPRR did find several serious issues in violation of the Guide for Care and Use of Laboratory Animals…

The Results of OPRR's Findings:

- U Penn. was put on probation & the clinic was closed
- The chief veterinarian was fired
- New training programs for investigators and staff
- Quarterly progress reports to OPRR were required.

- Charles R. McCarthy, Former OPRR Director

Sen. Robert Dole of Kansas

Food Security Act of 1985

Subtitle F, Animal Welfare, Public Law 99-198
Improved Standards for Laboratory Animals Act

"…the farm bill contains legislation dealing with the humane treatment of animals. The main thrust of the bill is to **minimize pain and distress suffered by animals used for experiments and tests. In so doing, biomedical research will gain in accuracy and humanity.** We owe much to laboratory animals and that debt can best be repaid by good treatment and keeping painful experiments to a minimum."

Congressional Findings for the 1985 Amendment

Pub. L. 99–198, title XVII, subtitle F (§§1751–1759), §1751, Dec. 23, 1985

The Congress finds that—

- Animal use is instrumental for advancing research and education.
- Non-animal testing methods which are faster, less expensive, and more accurate are continuing to be developed.
- Preventing unnecessary duplication of animal experiments can result in better use of Federal funds.
- Addressing public concern for laboratory animal welfare is important in assuring that research will continue to progress.

Improved Standards for Laboratory Animals Act

Animal Care and Housing Guidelines

Institutional Animal Care and Use Committees (IACUCs)

Animal Welfare Information Center

Improved Standards for Laboratory Animals Act
Humane Care and Reducing Pain and Distress

- Clarifies humane care to include specific criteria such as sanitation, ventilation, and housing.

- Directs the Secretary of Agriculture to establish regulations for
  - Exercise for dogs and
  - A physical environment adequate to promote the physiological well-being of primate.

- Specifies that animal pain and distress must be minimized (veterinary care, anesthesia, analgesia, tranquilizers, and euthanasia).

Defining a Painful Procedure

Title 9, Chapter I, Subchapter A,
Animal Welfare

"…as applied to any animal means any procedure that would reasonably be expected to cause **more than slight or momentary pain or distress** in a human being to which that procedure was applied, that is pain in excess of that caused by injections or other minor procedures."

-- **Painful Procedure**, Sec. 1.1

Improved Standards for Laboratory Animals Act

Animal Care and Housing Guidelines

Institutional Animal Care and Use Committees (IACUCs)

Animal Welfare Information Center

Responsibilities of the IACUC

[The] IACUC shall determine that…

(i) Procedures involving animals will **avoid or minimize discomfort, distress, and pain** to the animals;

(ii) **The principal investigator has considered alternatives** to procedures that may cause more than momentary or slight pain or distress to the animals, and has **provided a written narrative description of the methods and sources, e.g., the Animal Welfare Information Center**, used to determine that alternatives were not available;

(9 CFR, Section 2.31(d)(1)(i) & (ii))

Responsibilities of the IACUC (cont.)

[The] IACUC shall determine that…

iii. The principal investigator has provided written assurance that the activities **do not unnecessarily duplicate previous experiments.**

iv. Procedures that may cause **more than momentary or slight pain or distress** to the animals will:

(A) **Be performed with appropriate sedatives, analgesics or anesthetics**, unless withholding such agents is justified for scientific reason, in writing, by the principal investigator and will continue for only the necessary period;

(9 CFR, Section 2.31(d)(1)(iii) & (iv))

What are the Information Requirements?

Title 9, Chapter 1, Subchapter A, Animal Welfare Sec 2.31 (e)

- Rationale for using animals.
- Appropriateness of the animal species.
- Appropriateness of the numbers of animals.
- Complete description of research procedures.
- Description of euthanasia method.

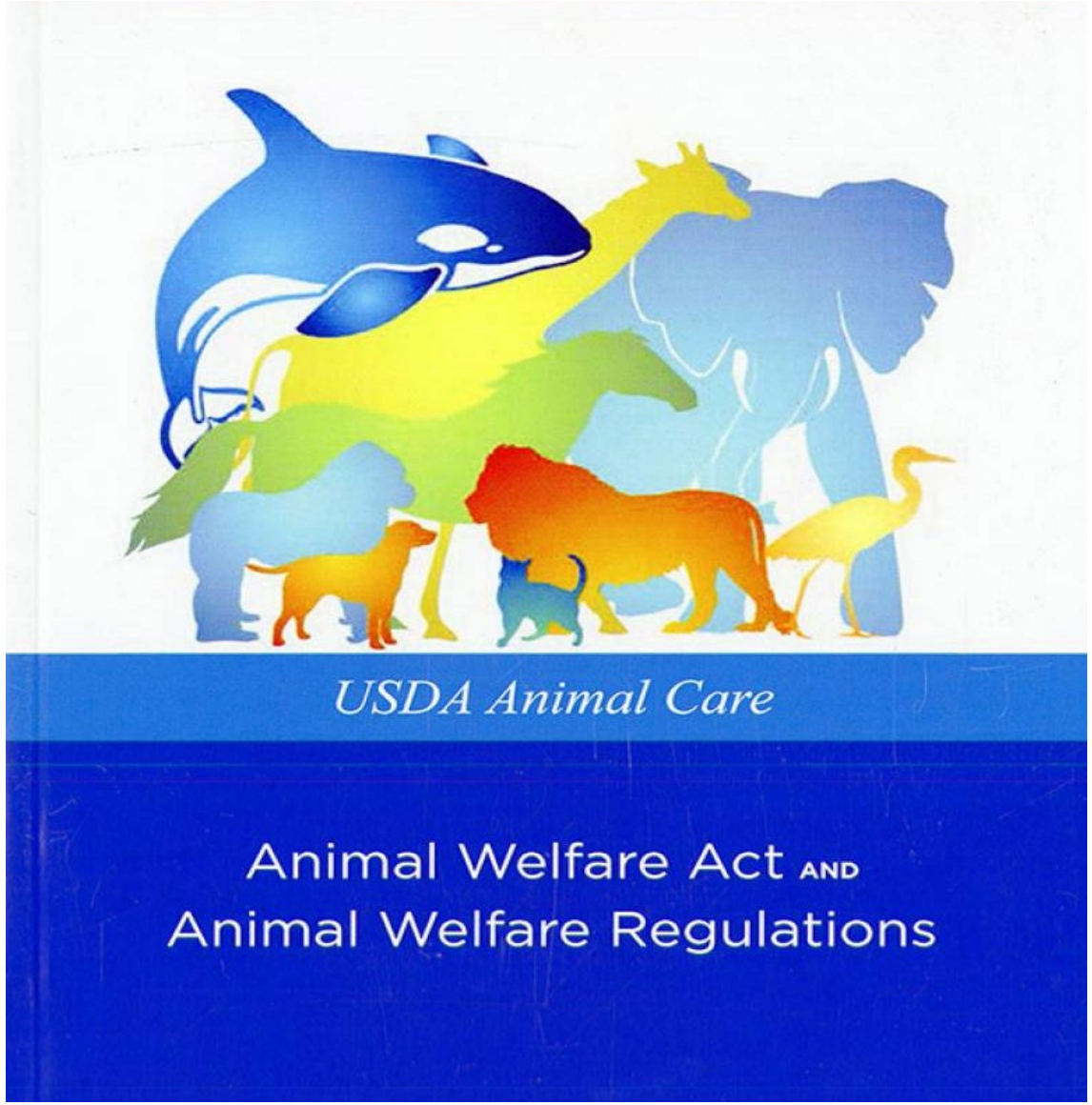


Image Courtesy of APHIS

Federal Register
Final Rules and Regulations, Vol. 54 (168)
August 31, 1989

"The principal investigator must provide a **written narrative of the sources, such as biological abstracts, Index Medicus, the Current Research Information Service (CRIS), and the Animal Welfare Information Center** that is operated by the National Agricultural Library.

"We believe that in fulfilling this requirement Committee members will discuss these efforts with the principal investigator… We also believe that considerations of alternatives will be discussed during Committee meetings where proposed activities are presented for approval, and made part of the meeting minutes…"

Required Contents for an Institutional Training Program

9 CFR Sec. 2.32 (c)

Employees must receive training in these 5 areas:

1. Humane animal handling and care methods.
2. Research or testing methods that limit the use of animals or minimize animal distress.
3. Proper use of anesthetics, analgesics, and tranquilizers.
4. Methods whereby deficiencies in animal care and treatment are reported.
5. Utilization of Services (e.g., **National Agricultural Library**, National Library of Medicine) to provide information regarding:

   - Appropriate methods of animal care and use.
   - Animal use alternatives in research.
   - Prevention of unnecessary duplication of animal research.
   - The intent and regulation of the Act.

Improved Standards for Laboratory Animals Act

Animal Care and Housing Guidelines

Institutional Animal Care and Use Committees (IACUCs)

Animal Welfare Information Center

AWA Defines Service at NAL

(7 U.S.C. 2142, Sec. 13, Subsection e)

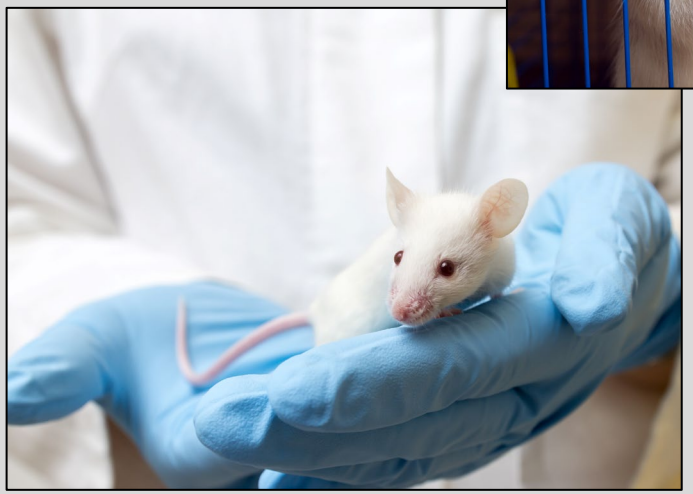
The Secretary shall establish an information service at the National Agricultural Library. Such service shall, in cooperation with the National Library of Medicine, provide information—

1. pertinent to employee training;
2. which could **prevent unintended duplication** of animal experimentation as determined by the needs of the research facility; and
3. on improved methods of animal experimentation which could—
   (a) **reduce or replace animal use**; and
   (b) **minimize pain and distress to animals**, such as anesthetic and analgesic procedures.

Animal Welfare Act of 2002

Public Law 107-171

- Changed definition of "animal" to exclude:
  - Birds bred for research
  - Rats of the genus Rattus bred for research
  - Mice of the genus Mus bred for research



Animal Welfare Act...What is Covered?

Animals being raised for food and/or fiber	
Swim-with-the dolphins programs	
Animals in biomedical research	
Horse shows and rodeos	
Dogs and cats bred for pets or other purposes and sold by dealers or "sight-unseen" sales (e.g., email or internet)	
Animals in zoos and marine mammal parks	
Animals being transported commercially	
State and county fairs	

Animal Welfare Act...What is Covered?

Animals being raised for food and/or fiber	NO
Swim-with-the dolphins programs	YES
Animals in biomedical research	YES/NO
Horse shows and rodeos	NO
Dogs and cats bred for pets or other purposes and sold by dealers or "sight-unseen" sales (e.g., email or internet)	YES
Animals in zoos and marine mammal parks	YES
Animals being transported commercially	YES/NO
State and county fairs	NO

Animal Welfare Act History Digital Collection

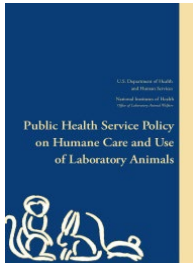
The AWAHDC Page
https://naldc.nal.usda.gov/animal_welfare

Not sure where to start?
Begin by going to the
Interactive Timeline

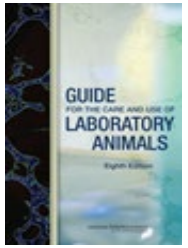
Read the Animal Welfare Act and Regulations

- AWIC's Animal Welfare Act Webpage
- Animal Welfare Act
- Animal Welfare Act Regulations

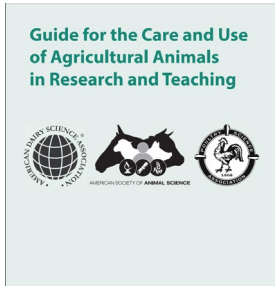
Other Policies and Guidelines



- Public Health Service Policy on Humane Care and Use of Laboratory Animals, Office of Laboratory Animal Welfare, National Institutes of Health.



- Guide for the Care and Use of Laboratory Animals, 8th edition, National Academies for Sciences, Engineering, and Medicine.



- Guide for the Care and Use of Agricultural Animals in Research and Teaching, 4th edition, American Dairy Science Association.

AVMA®
American Veterinary Medical Association

- American Veterinary Medical Association Guidelines on Euthanasia (2020 Edition).

3Rs Alternatives

Video provided for informational purposes by Roche Research and Development

Have you heard of the 3Rs in animal research before?

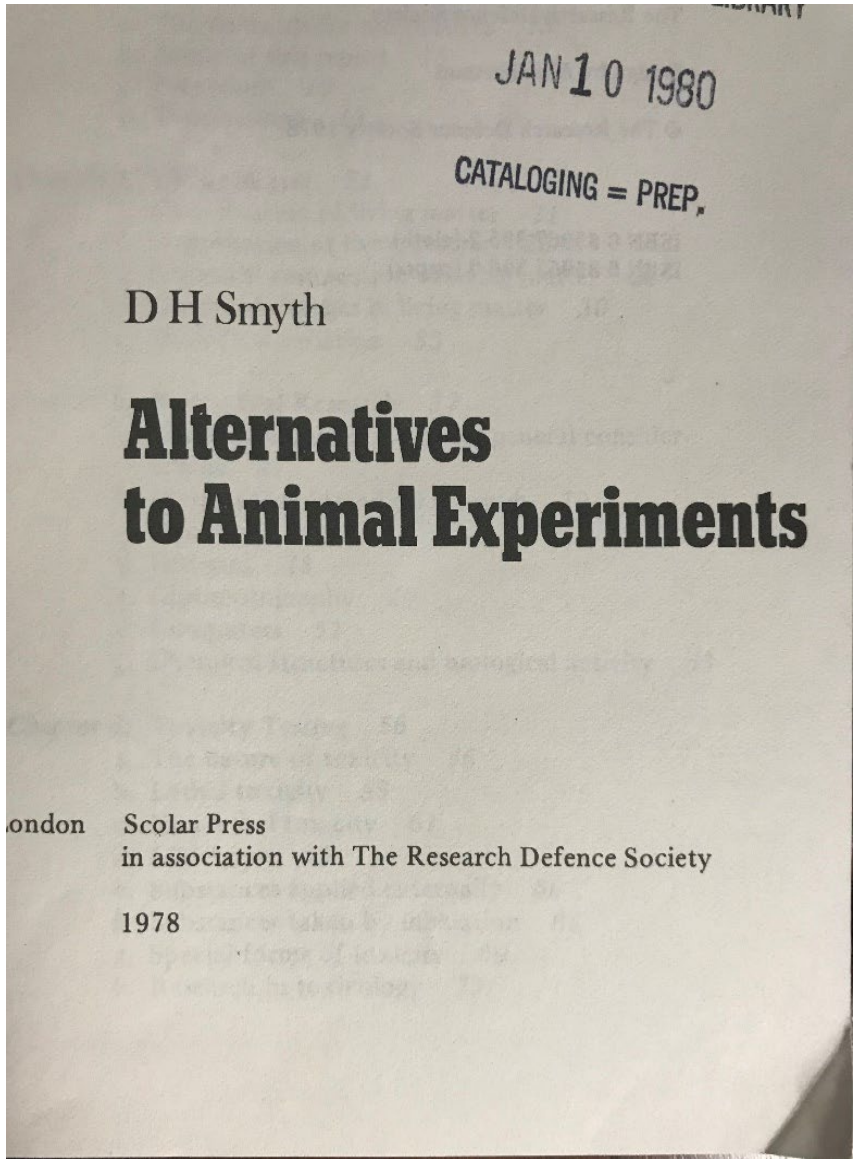
Yes- I have heard of the 3Rs and can define each of the 3Rs.

No- I have NOT heard of the 3Rs and cannot define the 3Rs.

A little- I have heard of the 3Rs. However, you cannot define the 3Rs.

History of the 3Rs

- Introduced by Dr. William Russel and Dr. Rex Burch
- 1959 book, *The Principles of Humane Experimental Technique*
- Implement the 3Rs while still achieving research goals



"Alternatives" Term Coined & Scientific Acceptance of the 3Rs

Smyth's term "alternatives" became synonymous with Russell and Burch's 3Rs and is the accepted definition of alternatives in animal research.

Synonymous 3Rs Terms

- Animal Use Alternatives
- Alternatives
- 3Rs Alternatives
- Alternatives to Animal Use
- Alternatives to Animal Testing
- New Approach Methodologies (NAMs)

What 3Rs examples can you think of?

https://www.menti.com/alurscksw n3a

Replacement

Methods that avoid using animals. The term includes absolute replacement as well as relative replacement.

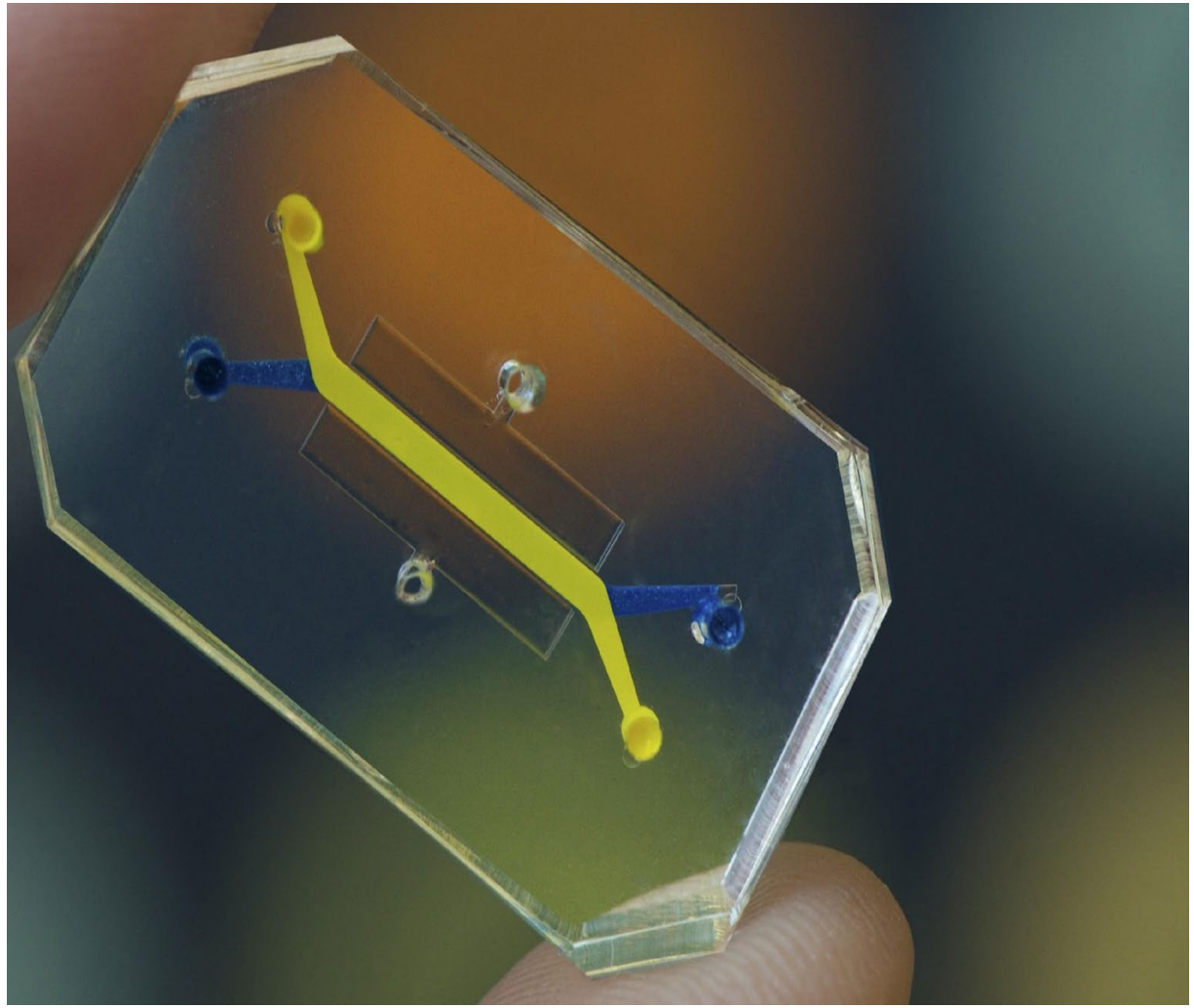


Image: Wyss Institute

National Research Council. 2011. Guide for the Care and Use of Laboratory Animals: Eighth Edition. Washington, DC: The National Academies Press.

Replacement

Partial/Relative

Animal tissue/cells are still required. However, animals are not exposed to distress in the actual experiment.

Full/Absolute

Animals are not required in any stage of the scientific method.

Relative Replacement: Zebrafish Embryos

- Produce high amounts of offspring quickly.
- Undeveloped sensory receptors until 3 days post-fertilization (~120 hours).
- Transparent embryo that develops quickly for internal study.
- Used in toxicology research.

Traditional Method: Sentinel Animals

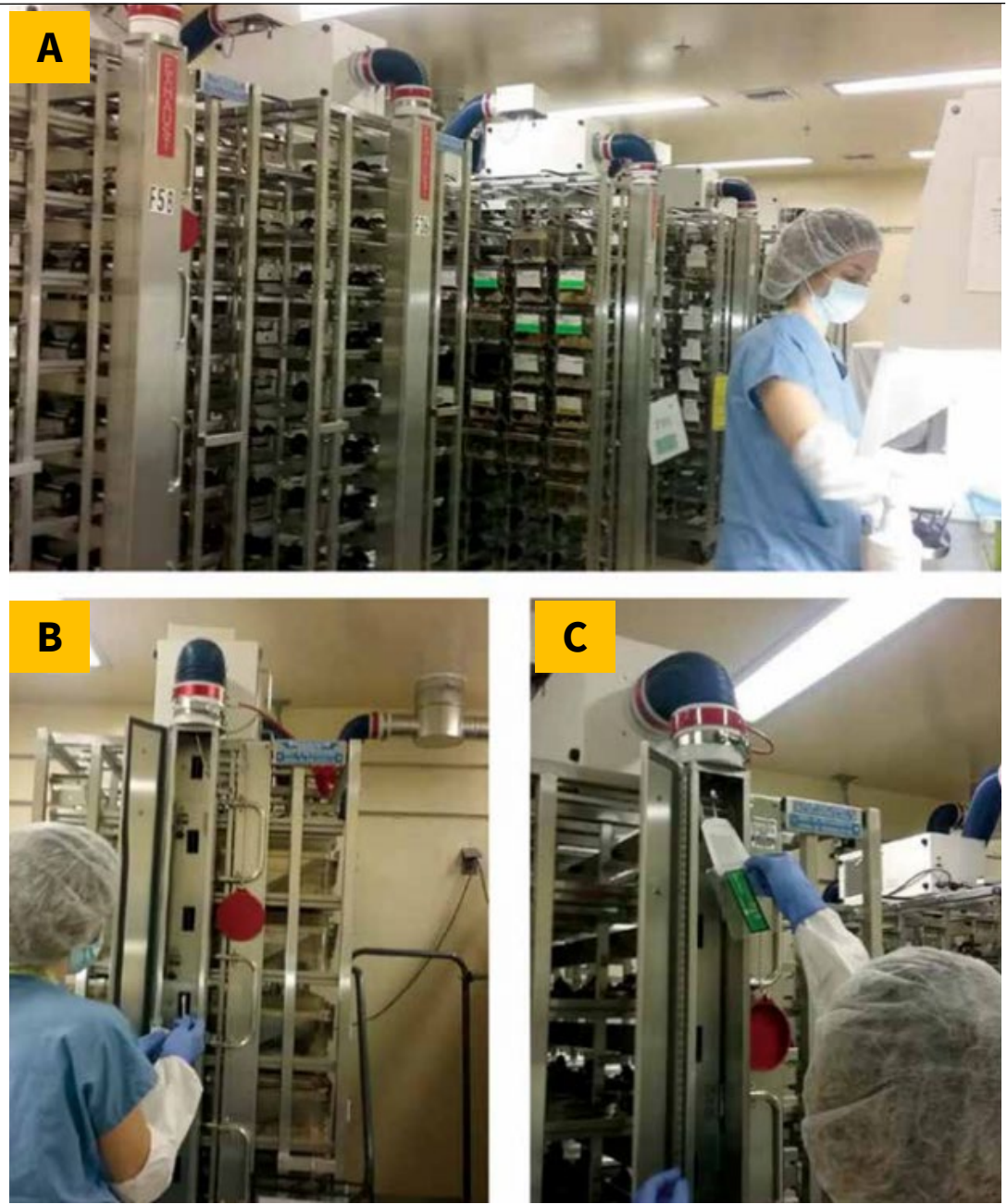
"The colony's soiled bedding is collected and placed in the *sentinel animal's cage to see if the animal becomes infected with a bacteria, virus, or parasite."

-LARC

*Animals used as a monitoring tool to observe animal groups for infectious agents that may impact the health of the animals as well as the experimental study.

Replacement Method: Environmental Health Monitoring

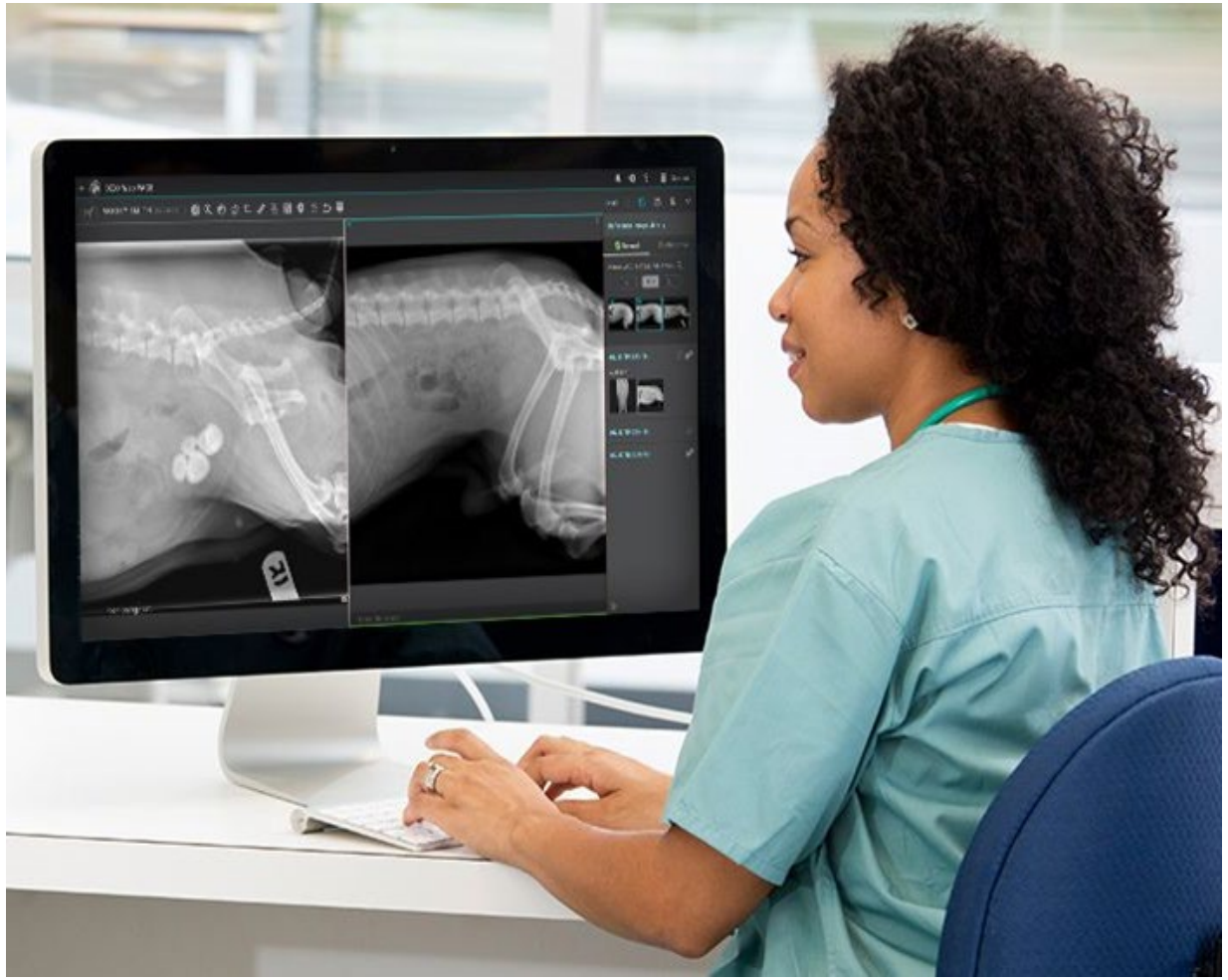
New methods, like Exhaust Air Dust Testing (EADT), can replace sentinel animals to detect specific pathogens in animal colonies



Pettan-Brewer, C., Trost, R. J., Maggio-Price, L., Seamons, A., & Dowling, S. C. (2020). Adoption of Exhaust Air Dust Testing in SPF Rodent Facilities. *Journal of the American Association for Laboratory Animal Science*, *59*(2), 156–162. https://doi.org/10.30802/AALAS-JAALAS-19-000079

III Reduction

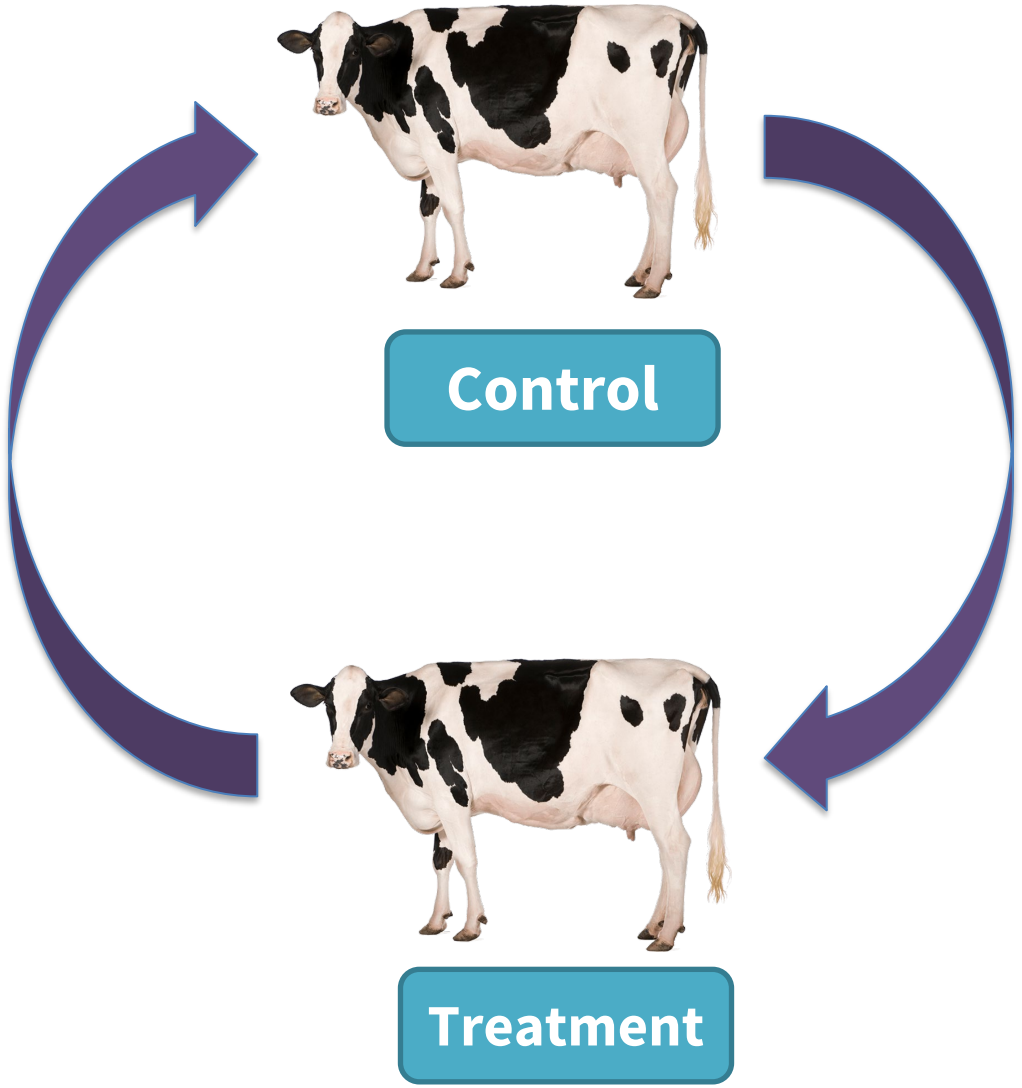
Strategies that help obtain comparable levels of information from the use of fewer animals



National Research Council. 2011. Guide for the Care and Use of Laboratory Animals: Eighth Edition. Washington, DC: The National Academies Press.

Animals Serving as Their Own Control

- Same animal experiencing control and treatment groups = **fewer animals**
- **Reduces variability in results!**
- Example:
  - Tracked cow A's steps for 24 hours (control)
  - Tracked cow A's steps during 24-hour laying- deprivation period (treatment)



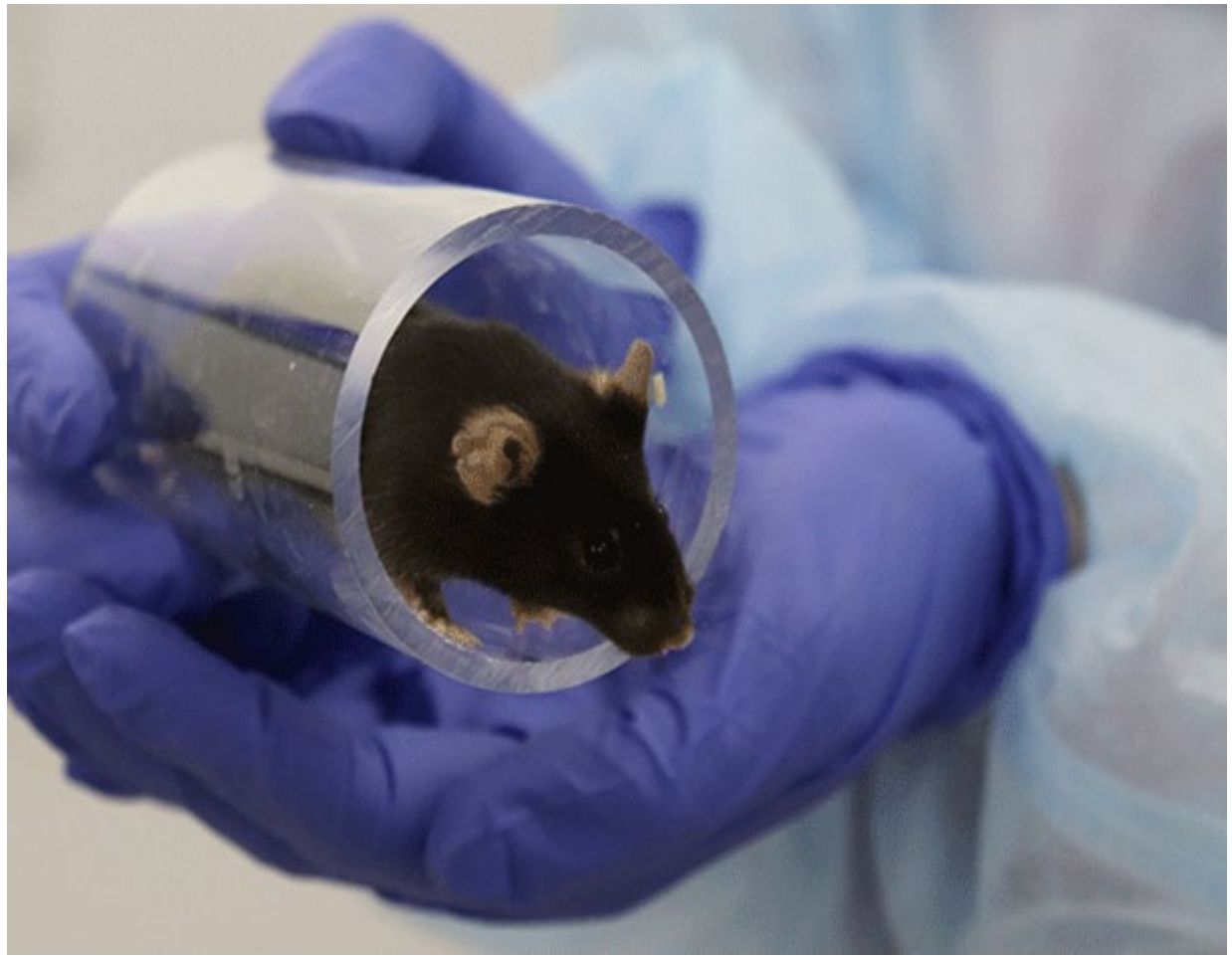
Computational Toxicology and Cheminformatics

Computational toxicology is a subfield of toxicology that uses cheminformatics and existing test data to predict adverse effects of chemicals.

- Computational toxicology modeling could replace some animal testing.
- Reduce animal testing by:
  - Using in silico data to guide in vitro experiments before conducting in vivo studies
  - Use in silico data to provide in vivo endpoints to avoid dosing additional animals

III Refinement

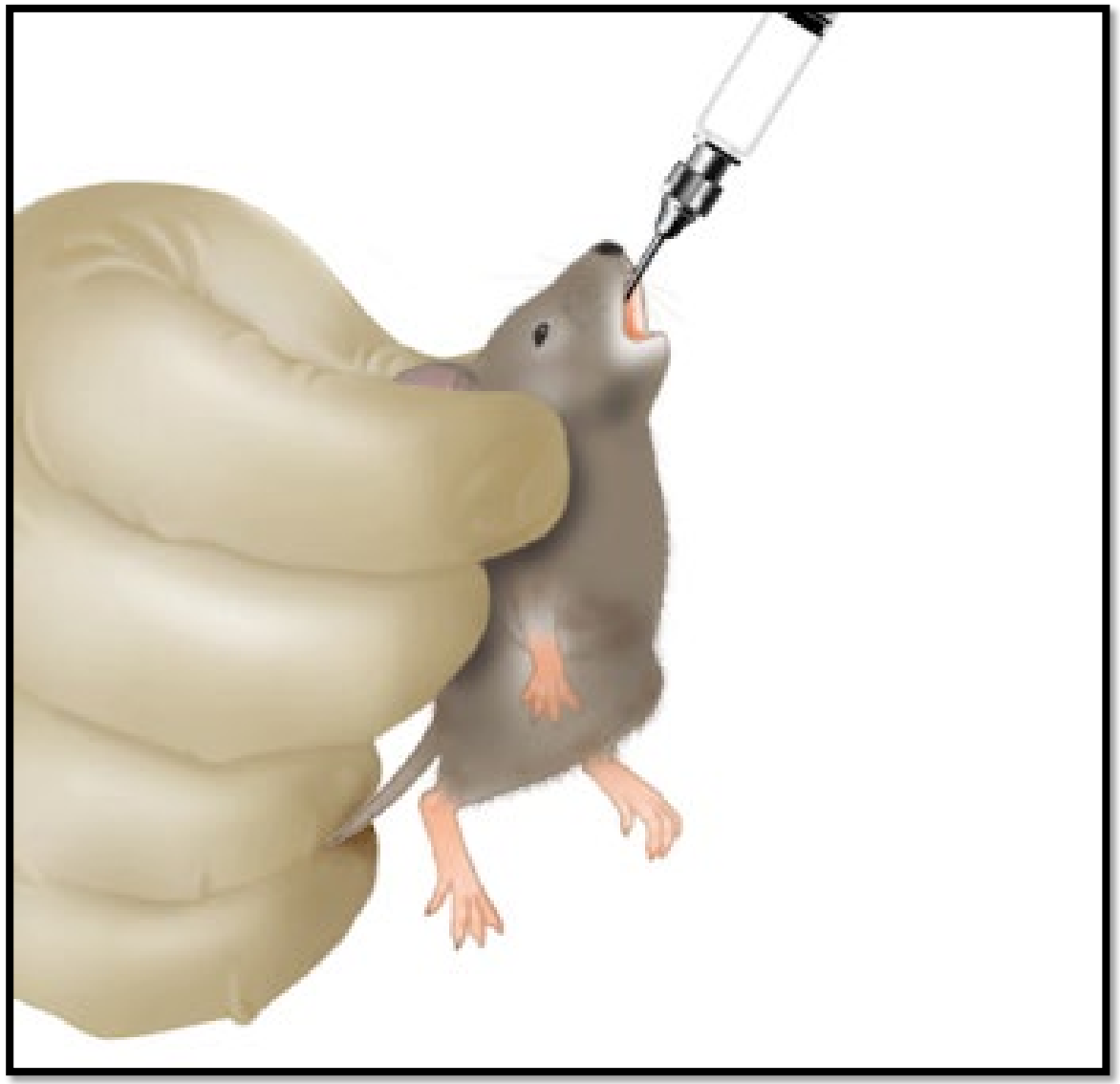
Modification of husbandry or experimental procedures to enhance animal well-being and minimize or eliminate pain and distress



National Research Council. 2011. Guide for the Care and Use of Laboratory Animals: Eighth Edition. Washington, DC: The National Academies Press.

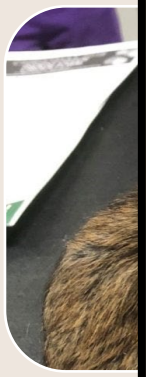
Oral Gavage

- Common dosing method that involves passage of a gavage needle into the esophagus to ensure precise administration of an agent or substance.
- Causes stress & discomfort the animal
- Complications:
  - tracheal administration
  - esophageal trauma
  - aspiration



Featured Image by: JoVE

Less-Aversive Oral Dosing Methods



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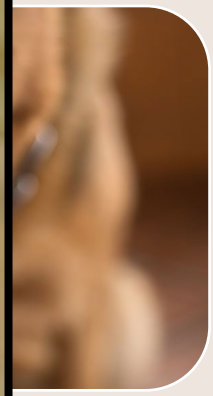
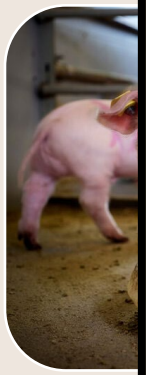


t/pellets



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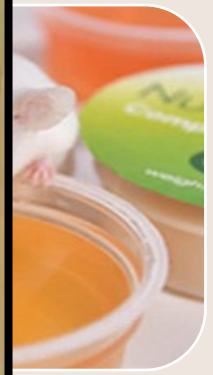
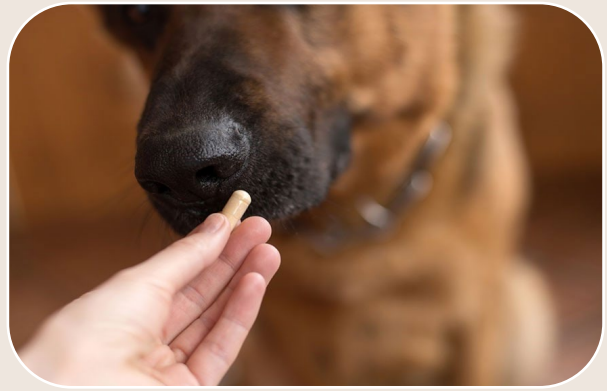


bstances

Less-Aversive Oral Dosing Methods

Syringe feeding

Solid food substances



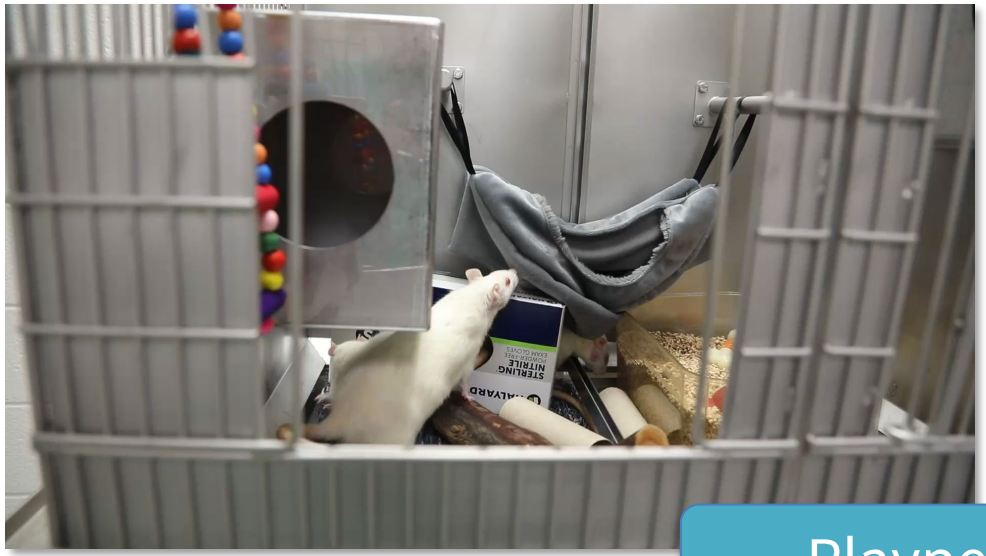
Capsules/tablet/pellets

Incorporated into the diet

Liquid substances

Gelatin-like substances

Housing and Handling



Playpens

Courtesy of NC3Rs The Macaque Website

Enrichments

Cup Handling

10 Minute Break

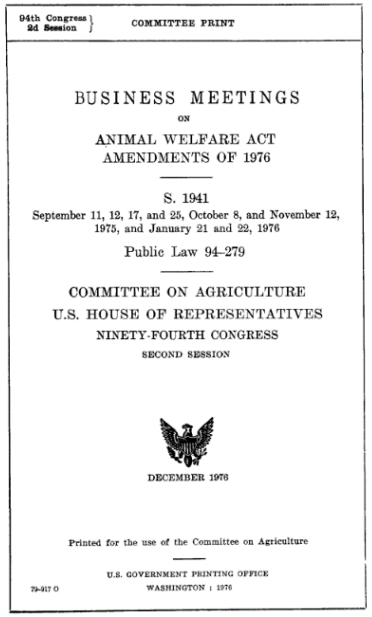
(Stretch and grab your coffee!)

Reasons to Consider Alternatives

- ✓Regulatory
- ✓Social
- ✓Humane
- ✓Economic
- ✓Scientific

Regulatory

- Comply with the Animal Welfare Act.
- Comply with the PHS Policy.
- Maintain AAALAC International accreditation.


94th Congress
2d Session
COMMITTEE PRINT

BUSINESS MEETINGS
ON
ANIMAL WELFARE ACT
AMENDMENTS OF 1976

S. 1941
September 11, 12, 17, and 25, October 8, and November 12, 1975, and January 21 and 22, 1976

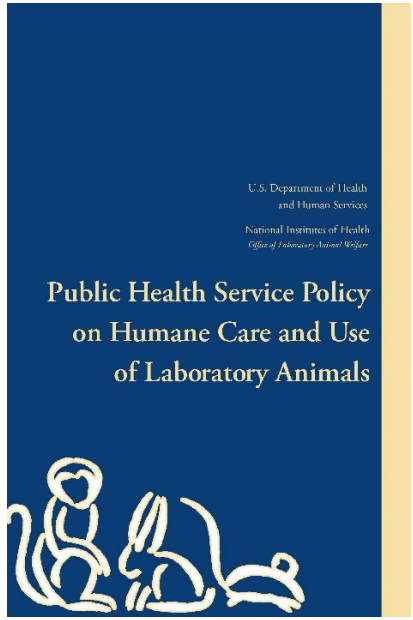
Public Law 94-279

COMMITTEE ON AGRICULTURE
U.S. HOUSE OF REPRESENTATIVES
NINETY-FOURTH CONGRESS
SECOND SESSION

DECEMBER 1976

Printed for the use of the Committee on Agriculture

U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON : 1976



aalac INTERNATIONAL

Social and Humane Aspects

Social

- Response to social pressures.
  - ✓ Change to non-animals as soon as possible.
  - ✓ Make research pain free.

Humane

- Ask ethical questions such as:
  - ✓ Should animals be used in research?
  - ✓ When should animals be used?
  - ✓ How should they be used?

Economic

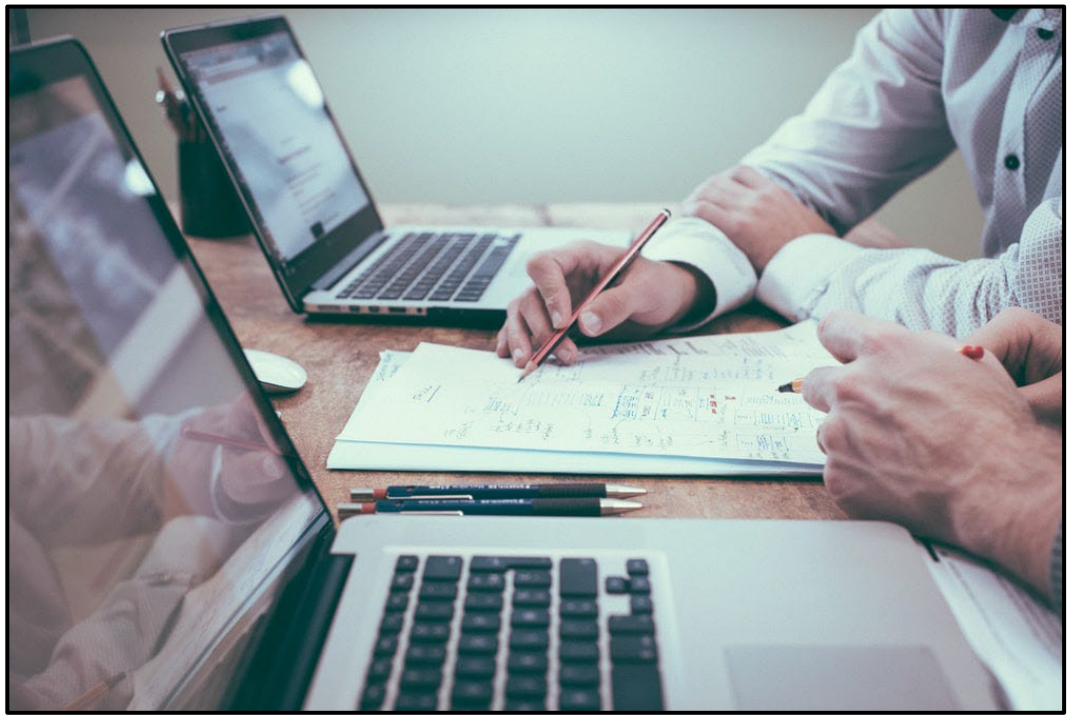
- Reduce the expense of animal use in:
  - Purchase animals.
  - Animal care costs.
  - Personnel costs.
  - Occupational health and safety costs.
  - Specialized facility infrastructure costs (caging, building design, equipment, etc.).

Scientific

✓ Early stages of grant writing process ✗ NOT final step on protocol form

Why? Because it's Good Science!

- Choose the appropriate model.
- Determine appropriate numbers.
- Increase research efficiency.
- Learn new approaches.
- Find opportunities for less painful and invasive procedures.
- Reduce animal stress.
- Identify possible collaborators.



Scientific

Poor Animal Welfare = Unreliable Experimental Results

"…better for the animal to be happy, but whether its **state of mind may also have the potential to influence the scientific results** derived from it. To **ensure good science, the animal should have a normal physiology and behaviour,** apart from specific adverse effects under investigation. There is a growing body of evidence from a wide variety of sources to show that **animals whose well-being is compromised are often physiologically and immunologically abnormal and that experiments using them may reach unreliable conclusions**…"

Poole, T. (1997). Happy animals make good science. *Laboratory Animals*, *31*(2), 116–124. https://doi.org/10.1258/002367797780600198

"…**the provision of suitable enrichment enhances the well-being of the animal, thereby refining the animal model and improving the research data.** Thus, the argument is made that both the **validity and reproducibility of the research are enhanced when proper consideration is given to the research animal's living environment and the animal's opportunities to express species-typical behaviours."**

Bayne, K., & Würbel, H. (2014). The impact of environmental enrichment on the outcome variability and scientific validity of laboratory animal studies. *Revue Scientifique et Technique (International Office of Epizootics)*, *33*(1), 273–280. https://doi.org/10.20506/rst.33.1.2282

"…The first argument against enrichment is that it may bias results, as enriched animals will produce different results from those living in unenriched environments. But if we turn this concept on its head, **primates living in barren, understimulating environments that lead to stress and abnormal conditions will adversely affect studies that are designed to be conducted on normal animals.** The normal, evolved state is one of enrichment, and as Wurbel (2000) and Garner (2005) argue, **animals raised and living in enriched environments should be better (not worse) models,** and the results from such animals should have **improved external validity**…"

Buchanan-Smith, H. M. (2010). Environmental enrichment for primates in laboratories. *Advances in Science and Research*, *5*(1), 41–56. https://doi.org/10.5194/asr-5-41-2010

USDA National Agricultural Library
United States Department of Agriculture

Barriers to Implementing the 3Rs

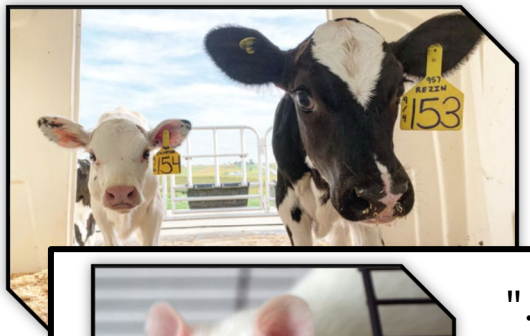
Not enough time to incorporate 3Rs methods	Begin the literature searching process early
3Rs methods are expensive	3Rs methods range in pricing— Start with 3Rs methods that fit your budget
Unproductive search results when searching for 3Rs methods	Literature searching is a team effort— Contact AWIC or your institution's librarians for help
Empathy disconnect	Creating a culture with an enhanced empathy for the research animals
We've always done it this way	Science is the art of progression— The 3Rs help progress science while improving animal welfare
Lack of knowledge of 3Rs research and training	Continue to explore 3Rs resources like AWIC and other 3Rs resources we will discuss

Finding 3Rs Resources & Information

Decreased Discoverability of 3Rs Citations

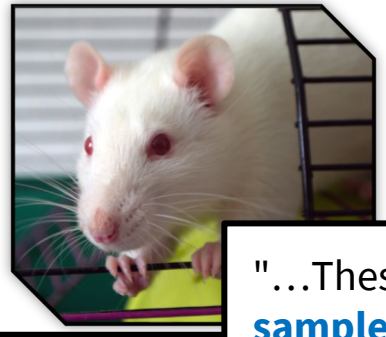
- Authors rarely discuss the 3Rs explicitly in paper title/abstracts
- 3Rs papers rarely tagged with 3Rs thesaurus terms
- Scientists and researchers often have little or no information literacy or library search training
- Searches with "alternatives, replacement, reduction, refinement" yield poor results

Examples of Decreased Discoverability



"…This is the first study to demonstrate that **pair housing improves the affective aspect of calf welfare** when compared to individual housing."

Bučková, K., Špinka, M. & Hintze, S. Pair housing makes calves more optimistic. *Sci*



"…These results suggest **that nesting material enrichment provided throughout an animal's life may reduce overgrooming-related self-injury."**

Khoo SY, Correia V, Uhrig A. Nesting material enrichment reduces severity of overgrooming-related self-

"…These findings suggest that **testing media in pooled soiled bedding samples is more effective than traditional sentinel methods for colony health surveillance** and is a viable option when sampling at the rack level is ineffective."

Hans
Meth
Scien

"This article discusses recent developments **in soft-tissue surgery teaching…A silicon-based, life-like canine ovariohysterectomy model** was developed with the assistance of a model-making and special effects company."

Gopinath D, McGreevy PD, Zuber RM, Klupiec C, Baguley J, Barrs VR. Developments in undergraduate teaching of small-animal soft-tissue surgical skills at the University of Sydney. J Vet Med Educ. 2012 Spring;39(1):21-9. doi: 10.3138/jvme.0411.044R. PMID: 22430078.

Need Help Searching Literature?

Contact AWIC!

Best Databases for Animal Welfare and Alternatives Info

AGRICOLA

PubMed

Web of Science

EMBASE

Scopus

BIOSIS

PsycInfo

CAB Direct

Zoological Record

Aquatic Sciences and Fisheries Abstracts

AGRICOLA

https://agricola.nal.usda.gov/

It's the largest online database of agricultural literature in the world. It also has a strong focus in the 3Rs.

What databases do you use at your institution?
(choose all that apply)

- Agricola
- Web of Science
- Scopus
- PubMed
- Embase
- Biosis
- Google Scholar
- Other

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Subject Coverage of Selected Databases

AGRICOLA	CAB	BIOSIS	EMBASE	MEDLINE
General agriculture	Agriculture	Agriculture	Clinical med.	Clinical med.
Animal science	Animal sci. & production	Aerospace biology	Experimental medicine	Experimental medicine
Chemistry & biochemistry	Crop science	Biochemistry & anatomy	Pharmacology, drugs, potential drugs	Pharmacology
Microbiology	Forestry	Bacteriology (microbiology)	Biochemistry	Microbiology
Cytology	Pest control	Cell biology	Developmental biology	Administration
Human & animal nutrition	Human nutrition	Botany	Forensic med.	Nutrition
Biotechnology	Biotechnology	Anatomy	Health econ.	Nutrition
Physiology	Pesticides	Physiology	Occup. health	Anat. & physiol.
Vet. Medicine	Vet. Medicine	Clinical med.	Toxicology	Vet. Medicine
Wildlife	Machinery and buildings	Pathology		Occupational medicine
Zoology	Economics	Biophysics		Toxicology
Entomology		Toxicology		Other med. topics
Other topics		Other topics		

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Sources of Information for Selected Databases

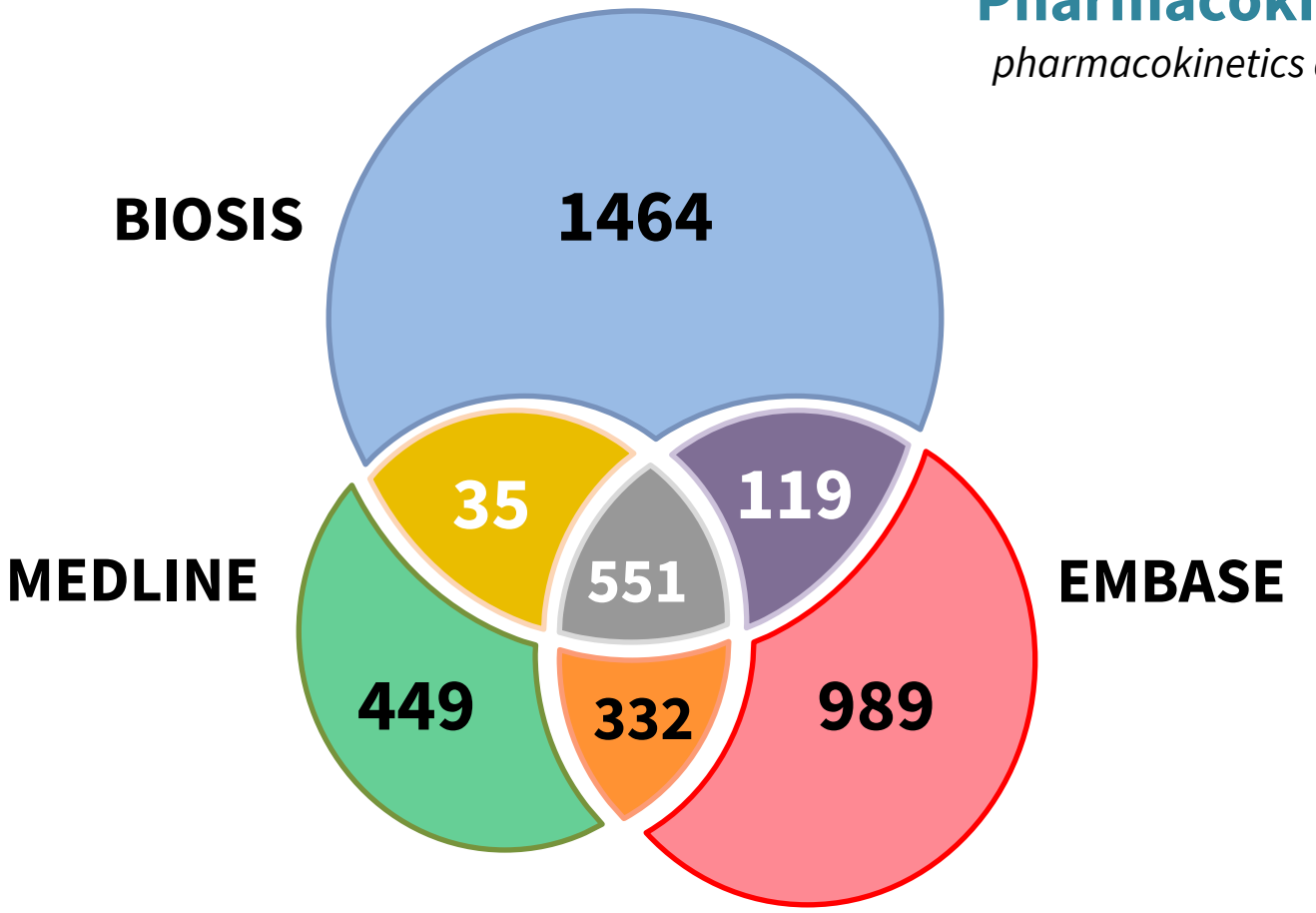
AGRICOLA 1970-present	CAB 1972-present	BIOSIS 1926-present	EMBASE 1974-present	MEDLINE 1946-present
~ 1,000 journals	> 9,500 journals	~ 5,000 journals	~ 7,500 journals	~5,500 journals
Books, Monographs	Books, Monographs	Books, Monographs	Conference proceedings	
Proceedings	Symposia	Proceedings/abs	Symposia, Meetings	
Research reports	Technical reports	Technical reports		
Theses	Theses, Dissertations	Nomenclat. Rules		
Translations	Review journals	Annual reviews		
Bibliographies	Bibliographies	Bibliographies		
Elect. docs.	Patents	Patents 86-89		
Audio visuals	Annual reports	Letters/notes		
USDA pubs.	Guides	Guides		
Gov. docs	Conferences	Research comm.		
Selected newsletters	Meetings	Conferences		
Manuals/sops		Symposia		
Tox. protocols		Meetings		

How many databases do you typically use when conducting a literature search?

Searching Multiple Databases

Pharmacokinetics

pharmacokinetics and pain



- BIOSIS Unique
- MEDLINE Unique
- EMBASE Unique
- BIOSIS, MEDLINE, EMBASE Overlap
- BIOSIS and MEDLINE Overlap
- BIOSIS and EMBASE Overlap
- MEDLINE and EMBASE Overlap

Total: 3,939

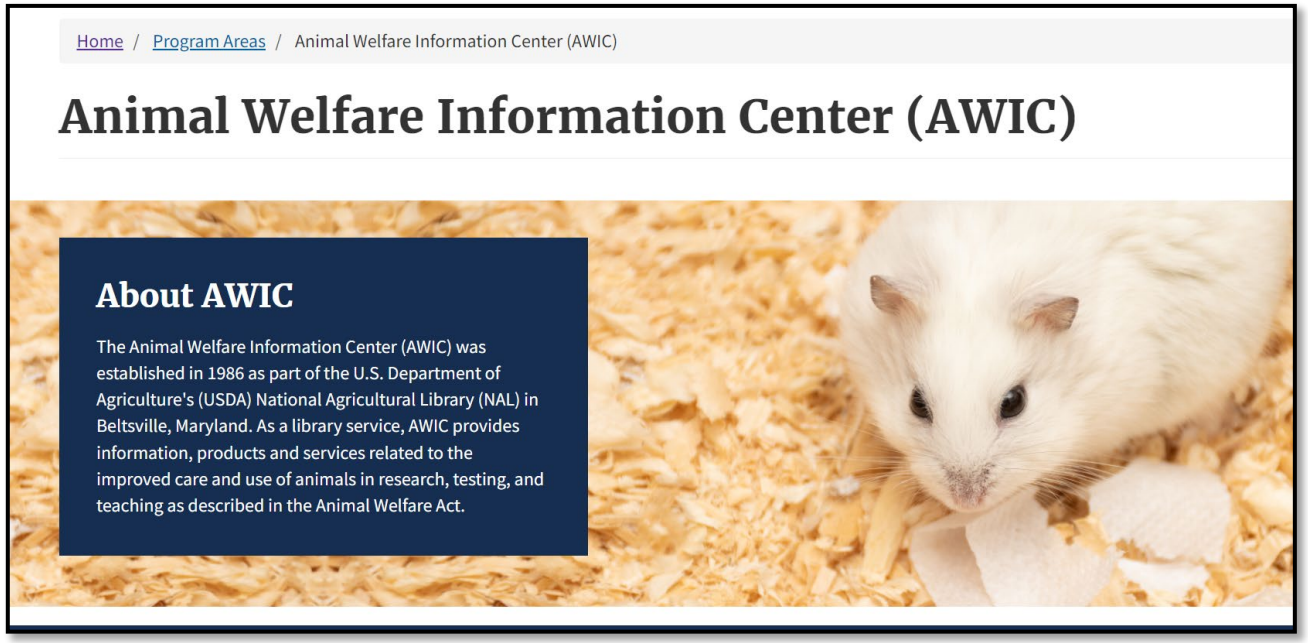
Without ***BIOSIS Previews***, you would be missing 1,464 unique citations.
In addition to hundreds of journal article records, BIOSIS Unique records contain 415 Meeting records.

Additional Resources Available on the Web

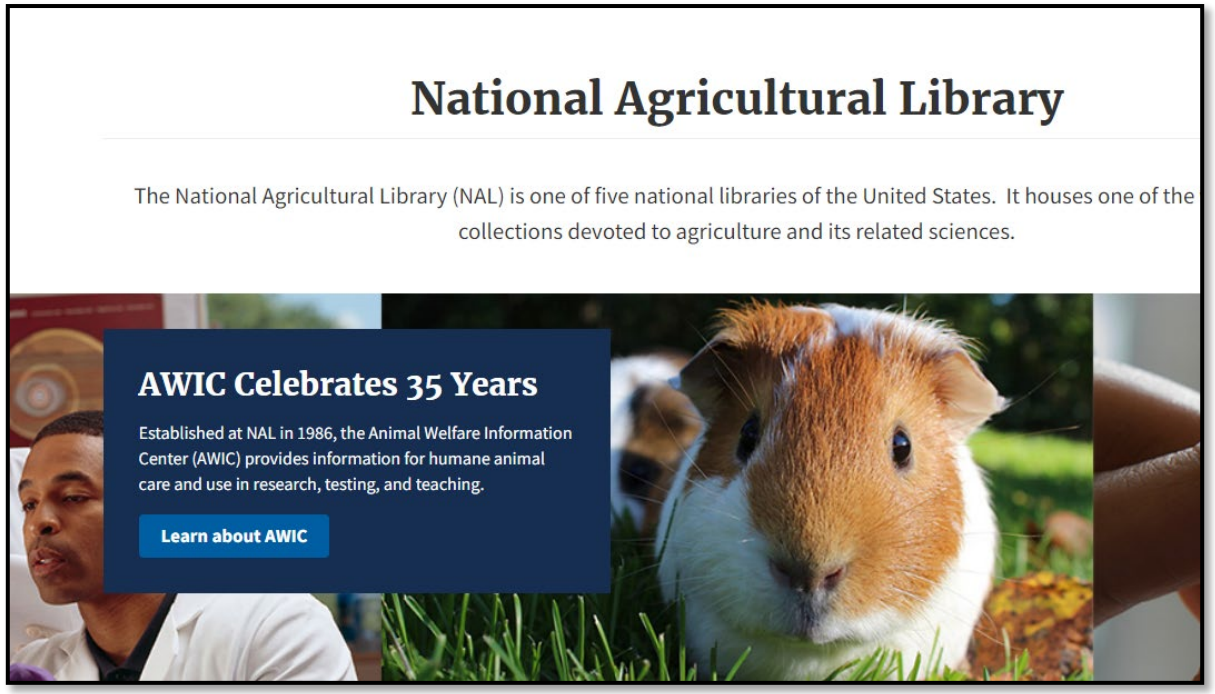
Google Scholar

	Pros	Cons
Access	• Free to use • Can set up library access links in settings	• No full-text access to most articles
Content	• Indexes wide range of literature • Grey literature	• Not organized by experts • No easy way to identify 'peer-reviewed' source
Searching	• Easy to use if you're familiar with Google • Google algorithm ranks relevance to you	• Can't search by material type or subject area • Very limited filters • Google algorithm ranks relevance to you

National Agricultural Library Resources



[Animal Welfare Information Center (AWIC)]



[National Agricultural Library (NAL)]

Additional 3Rs Web Resources

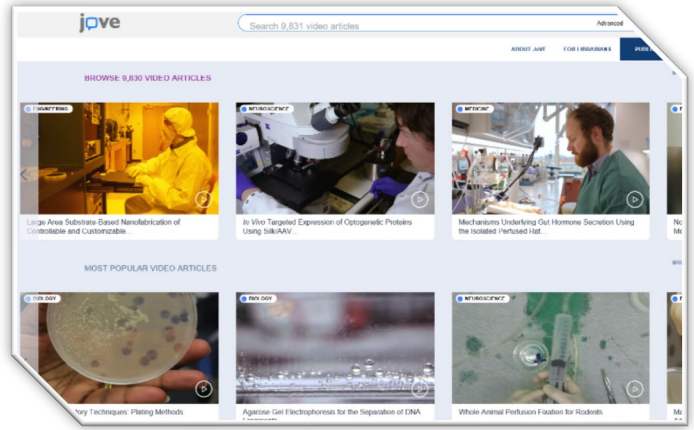
[Research Animal Training]

Animal Welfare Institute's [Refinement Database]

[Norecopa]

[NC3Rs] and [NA3RsC]

[NTP Interagency Center for the Evaluation of Alternative Toxicological Methods (NICEATM)] and [Interagency Coordinating Committee on the Validation of Alternative Methods (ICCVAM)]



[Journal of Visualized Experiments]

Lunch Time!!
30 minutes

Using Search Syntax

Which of these syntax tools have you used before?

- Truncation
- Boolean Logic
- Parenthesis
- Proximity Operators
- Quotation Marks
- None of the Above

Boolean Operators

https://www.youtube.com/watch?v=wsiejD-WSSA

Quotation Marks

Search for exact phrases using double quotation marks.

ex: "animal welfare"

If double quotations are not used, words are searched individually using the Boolean operator AND.

ex: animal welfare = animal AND welfare

Use to search exact phrases in internet search engines to get more relevant results.

Parentheses

(dog OR dogs OR canine) AND (pain OR distress)

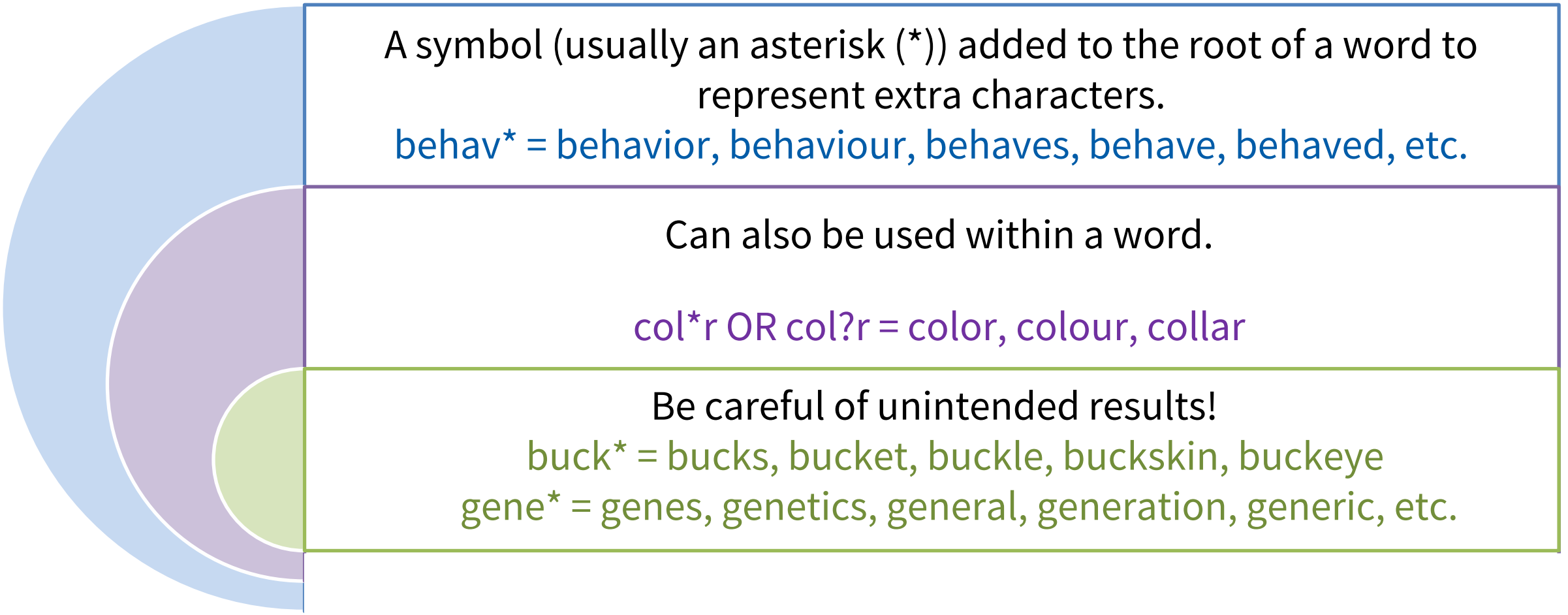
- Used to combine terms in groups.
- The AND operator has higher precedence than the OR operator and is read first.
- Returns all results that contain at least one of the words in the first set of parentheses AND at least one of the words in the second set.

If you searched this string in the **TITLE** field, you would get the following titles:

- "Metastatic aortic body tumor causing neck pain in a dog".
- "Respiratory distress after endotracheal insufflation of baby powder in dogs".
- "Validation of orthopedic postoperative pain assessment methods for dogs: A prospective, blinded, randomized, placebo-controlled study".

Truncation

Truncation means "shortening"



A symbol (usually an asterisk (*)) added to the root of a word to represent extra characters.

behav* = behavior, behaviour, behaves, behave, behaved, etc.

Can also be used within a word.

col*r OR col?r = color, colour, collar

Be careful of unintended results!

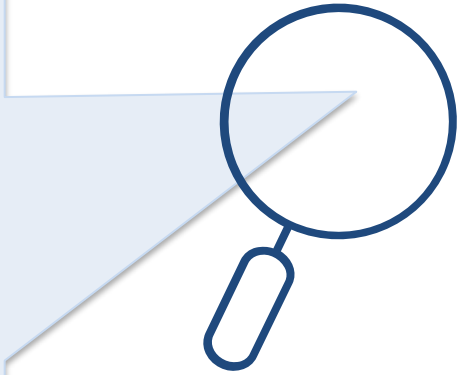
buck* = bucks, bucket, buckle, buckskin, buckeye

gene* = genes, genetics, general, generation, generic, etc.

Proximity Operators

Search for one word within a certain distance of another word.

blood N3 collect* = blood collection, collection of arterial blood, collecting blood



Proximity operators and syntax can vary by database:

- EBSCO databases: N# (near) OR W# (within) [# stands for the maximum number of words between terms]
- Web of Science: NEAR/#
- Scopus: W/# OR PRE/#
- PubMed: does not support proximity operators

AWIC Database Search Operator Reference Guide/Cheat Sheet

https://www.nal.usda.gov/sites/default/files/page-files/AWIC-database-cheat-sheet.pdf

Database Operator Cheat Sheet

Produced by the Animal Welfare Information Center, National Agricultural Library, (https://www.nal.usda.gov/awic/)

	Proximity Operators:	Character/letter combinations that find one search term within a certain number of words from another.
PubMed	PubMed does not support proximity operators	
Web of Science	NEAR/# (words will appear in any order) # indicates maximum number of words between first and second terms Ex: **"non*invasive" NEAR/8 "urine collection"** results in "A **noninvasive urine collection** device for female cattle" SAME: Finds two words in one search field. Functions like the Boolean operator, AND. Ex: **"Agricultural Research Service" SAME Beltsville** results in "Dr Douglass R. Miller, ex-**Agricultural Research Service**, U.S. Department of Agriculture, **Beltsville**, Maryland."	
Scopus	PRE/# ('PRE' means 'precedes' which means the first word will appear before the second) Ex: **"Social housing" PRE/5 rats** results in "Go long(-itudinal)! **Social housing** protects working memory in **rats**" W/# (Within) (words appear in any order) Ex: **"Social housing" W/5 rats** results in "50-kHz chirping (laughter?) in response to conditioned and unconditioned tickle-induced reward in **rats**: Effects of **social housing** and genetic variables"	
EBSCO	N# (Near) (words will appear in any order) Ex: **"cage*" N8 rodent*** results in "Variation in bacterial contamination of microisolation **cage** tops according to **rodent** species and housing system" W# (Within) (first word appears before the second) Ex: **"cage*" W8 rodent*** results in "Effect of **cage**-change frequency on **rodent** breeding performance"	
ProQuest	NEAR/# or N/# (words will appear in any order) Ex: **monkey NEAR/5 stud*** results in "Eight-year toxicity **study** in **monkeys** and reproduction **studies** in rats and rabbits treated with probucol." PRE/# or P/# ('PRE' means 'precedes' which means the first word will appear before the second) Ex: **monkey PRE/5 stud*** results in "Monoclonal Antibodies Against Zika Show Promise in **Monkey Study**"	

Conducting an Alternatives Literature Search

Duplicative vs. Alternatives Search

Duplication search: seeks to find published research like the protocol. This is to prevent possible duplication of animal studies that have already been performed.

Alternatives search: seeks to find non-animal models for the research described in the protocol *OR* find methods to improve animal welfare and reduce pain and distress.

Identifying Alternatives In Protocols Exercise

Step 1: Identify Opportunities for Alternatives in the Protocol

The objective of the study is to develop a vaccine for the H5N1 avian influenza virus using ferrets.

Materials and Methods

- Ferrets are housed individually in bioclean portable laminar flow clean room enclosures.
- Challenge: Ferrets will be anesthetized with ketamine, xylazine, and atropine by the intramuscular route, then held vertically and 0.5 to 1 ml of the virus suspension will be pipetted into their nostrils. Control animals will receive an equivalent dilution (1:30) of noninfectious allantoic fluid in place of the virus.
- Nasal flushes: On days 1, 3, 5, and sometimes 7, post-challenge, ferrets will again be lightly anesthetized so that they can be restrained. The nasal secretions will be collected in a dish.
- 1mL of blood is collected from awake ferrets on the same days as the nasal flushes.
- Animals are euthanized at the end of the study. Two animals will be euthanized on days 1, 3, 5, and 7 days post-challenge to internally evaluate the progression of the disease.

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- Animals are euthanized at the end of the study (typically 14 days post-challenge). Two animals will be euthanized on days 1, 3, 5, and 7 days post-challenge to internally evaluate the progression of the disease.

Let's Review

Remember to Ask Yourself:

- **Number and species of animals:** Are the number and species of animals appropriate for this type of research? Could a non-animal model be used?
- **Housing and husbandry:** How are animals housed and handled in the study and is it appropriate for this species? Are there improvements/enhancements that will improve animal well-being?
- **Procedures:** What procedures performed on these animals might cause physical or emotional pain or distress? Are there alternative procedures?
- **Endpoints:** What are the study's endpoints? Are humane endpoints in place if needed?

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Example Search from Ferret Protocol

Challenge: Ferrets will be anesthetized with ketamine, xylazine, and atropine by the intramuscular route, then held vertically and 0.5 to 1 ml of the virus suspension will be pipetted into their nostrils. Control animals will receive an equivalent dilution (1:30) of noninfectious allantoic fluid in place of the virus.

The alternative: Is there a less invasive way of administering the challenge virus?

Step 2: Identify Key Concepts/Keywords

Challenge: Ferrets will be anesthetized with ketamine, xylazine, and atropine by the intramuscular route, then held vertically and 0.5 to 1 ml of the virus suspension will be pipetted into their nostrils. Control animals will receive an equivalent dilution (1:30) of noninfectious allantoic fluid in place of the virus.

Is there a less invasive way of administering the challenge virus?

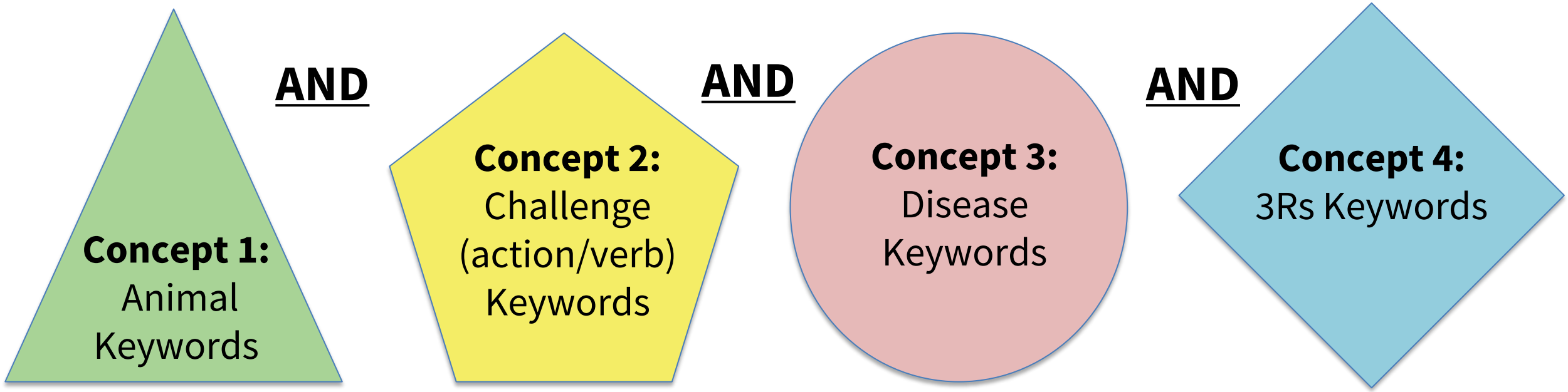
Concept/Keyword Type	Search Terms/Keyword
Animal	ferret*
Challenge (action/verb)	challenge
Disease	"H5N1 influenza"
3Rs	"less invasive"

Step 3: Identify Synonyms/Related Terms to Keywords

Concept/Keyword Type	Keywords and Synonyms/Related Terms
Animal	ferret* OR "Mustela putorius furo" OR "Mustela putorius"
Challenge (action/verb)	Challenge OR infect* OR administ* OR inoculat* OR expos*
Disease	"H5N1 influenza" OR "avian influenza" OR "avian flu" OR "bird flu" OR "avian flu virus*" OR "bird flu virus*" OR "H5N1 virus"
3Rs	"less invasive" OR noninvasive OR "minimally invasive" OR "stress-free" OR welfare OR "well-being" OR refinement OR 3Rs OR "three rs" OR "non-aversive" OR painless OR "less aversive" OR "low stress" OR humane OR method* OR procedure*

Creating a Search String

Think of a search string as a sentence composed of phrases. Each "concept" contains a set of terms/keywords joined by **OR**. The concepts are joined by **AND** to create your search string.



Step 4: Combining The Search Strings

Animal: ferret* OR "Mustela putorius furo" OR "Mustela putorius"

AND

Challenge: Challenge OR infect* OR administ* OR inoculat* OR expos*

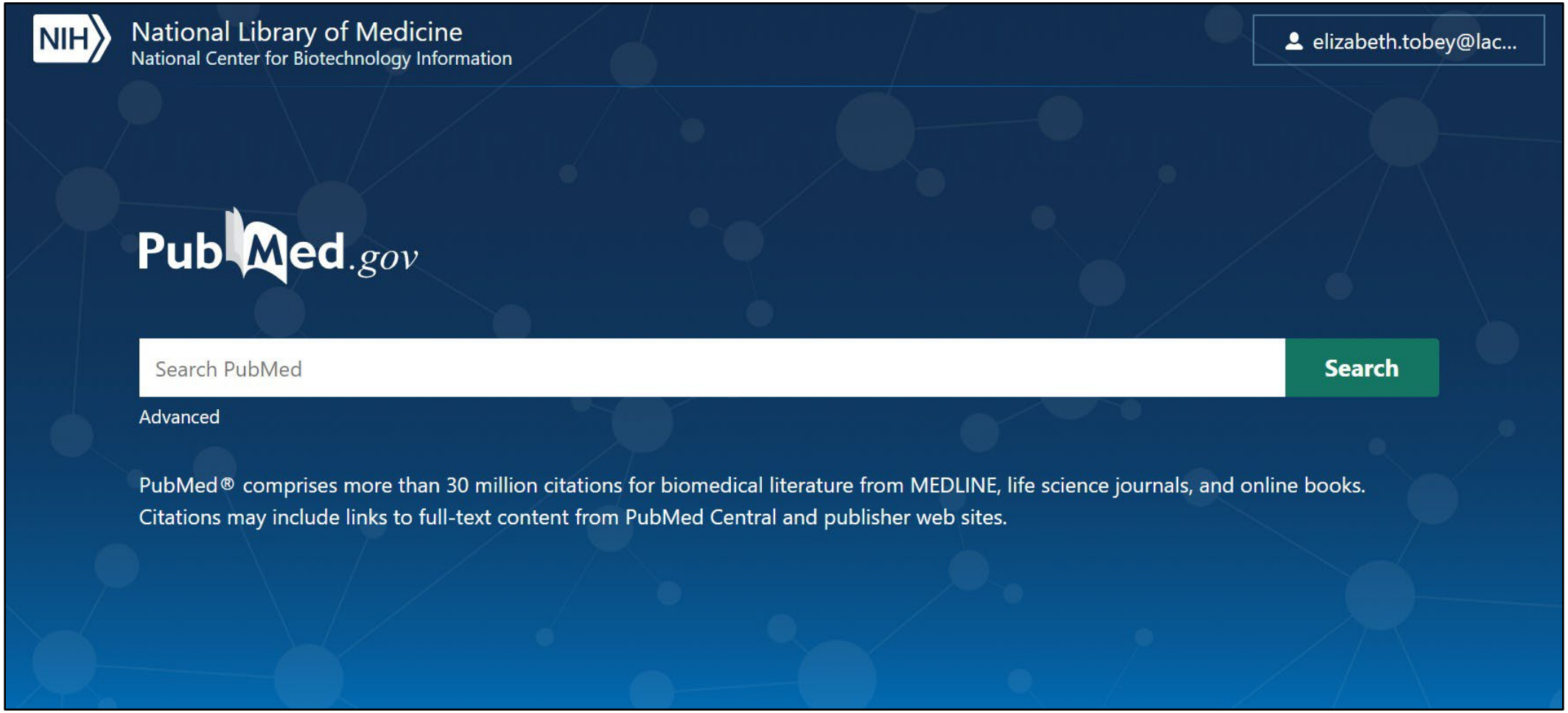
AND

Disease: "H5N1 influenza" OR "avian influenza" OR "avian flu" OR "bird flu" OR "avian flu virus*" OR "bird flu virus*" OR "H5N1 virus"

AND

3Rs: "less invasive" OR noninvasive OR "minimally invasive" OR "stress-free" OR welfare OR "well-being" OR refinement OR 3Rs OR "three rs" OR "non-aversive" OR painless OR "less aversive" OR "low stress" OR humane OR method* OR procedure*

Step 5: Search in Database (PubMed)



https://pubmed.ncbi.nlm.nih.gov/

Original Search String

(((ferret*[Title/Abstract] OR "Mustela putorius furo"[Title/Abstract] OR "Mustela putorius"[Title/Abstract])) AND (Challenge[Title/Abstract] OR infect*[Title/Abstract] OR administ*[Title/Abstract] OR inoculat*[Title/Abstract] OR expos*[Title/Abstract])) AND ((("H5N1 influenza"[Title/Abstract] OR "avian influenza"[Title/Abstract] OR "avian flu"[Title/Abstract] OR "bird flu"[Title/Abstract] OR "avian flu virus*"[Title/Abstract] OR "bird flu virus*"[Title/Abstract] OR "H5N1 virus"[Title/Abstract]))) AND (("less invasive"[Title/Abstract] OR noninvasive[Title/Abstract] OR "minimally invasive"[Title/Abstract] OR "stress-free"[Title/Abstract] OR welfare[Title/Abstract] OR "well-being"[Title/Abstract] OR refinement[Title/Abstract] OR 3Rs[Title/Abstract] OR "three rs"[Title/Abstract] OR "non-aversive"[Title/Abstract] OR painless[Title/Abstract] OR "less aversive"[Title/Abstract] OR "low stress"[Title/Abstract] OR humane[Title/Abstract] OR method*[Title/Abstract] OR procedure*[Title/Abstract]))

Yields 59 results

Step 6: Evaluate and Refine the Search Based on Results

- If most of the results are relevant, the search strategy might be fine as is.
- If the results are too broad, consider limits:
  - Publication year.
  - Specific field (e.g., title, keywords, abstract).
  - Refine your concepts' keywords.
  - Add new terms found while searching the literature.
  - Add additional search strings.
- Fix what you can
  - Add a NOT group of things to exclude.
  - Fix any "unfortunate" truncations.
    *Refer to truncation slide

Final Search String

(((ferret*[Title] OR "Mustela putorius furo"[Title] OR "Mustela putorius"[Title]) AND (Challenge[Title/Abstract] OR infect*[Title/Abstract] OR administ*[Title/Abstract] OR inoculat*[Title/Abstract] OR expos*[Title/Abstract])) AND ("H5N1 influenza"[Title/Abstract] OR "avian influenza"[Title/Abstract] OR "avian flu"[Title/Abstract] OR "bird flu"[Title/Abstract] OR "avian flu virus*"[Title/Abstract] OR "bird flu virus*"[Title/Abstract] OR "H5N1 virus"[Title/Abstract])) AND ("less invasive"[Title/Abstract] OR noninvasive[Title/Abstract] OR "minimally invasive"[Title/Abstract] OR "stress-free"[Title/Abstract] OR welfare[Title/Abstract] OR "well-being"[Title/Abstract] OR refinement[Title/Abstract] OR 3Rs[Title/Abstract] OR "three rs"[Title/Abstract] OR "non-aversive"[Title/Abstract] OR painless[Title/Abstract] OR "less aversive"[Title/Abstract] OR "low stress"[Title/Abstract] OR humane[Title/Abstract] OR method*[Title/Abstract] OR procedure*[Title/Abstract] OR natural[Title/Abstract] OR aerosol*[Title/Abstract] OR airborne[Title/Abstract])

Yields 43 results

*highlighted text shows how the string changed from the initial search

Example of Citation that Answers Search Question

This article describes an aerosol inoculation of ferrets with H5N1 virus using an eye mask.

This is an example of another way of challenging ferrets that may be less invasive.

J Virol. 2014 Sep 1;88(17):9647-54. doi: 10.1128/JVI.01067-14. Epub 2014 Jun 11.

Influenza virus infectivity and virulence following ocular-only aerosol inoculation of ferrets

Jessica A Belser [1], Kortney M Gustin [1], Jacqueline M Katz [1], Taronna R Maines [1], Terrence M Tumpey [2]

Affiliations + expand

PMID: 24920819 PMCID: PMC4136304 DOI: 10.1128/JVI.01067-14

Free PMC article

Abstract

Respiratory pathogens have traditionally been studied by examining the exposure and **infection** of respiratory tract tissues. However, these studies typically overlook the role of ocular surfaces, which represent both a potential site of virus replication and a portal of entry for the establishment of a respiratory **infection**. To model transocular virus entry in a mammalian species, we established a novel inoculation **method** that delivers an aerosol inoculum exclusively to the **ferret** ocular surface. Using **influenza** virus as a representative respiratory pathogen, we found that both human and **avian** viruses mounted productive respiratory **infections** in **ferrets** following ocular-only aerosol inoculation, and we demonstrated that **H5N1** virus can result in a fatal **infection** at doses below 10 PFU or with exposure times as short as 2 min. **Ferrets** inoculated by the ocular aerosol route with an

Step 7: Document Your Search

Citation Managers:

- ❑ Endnote
- ❑ Refworks
- ❑ Mendeley
- ❑ Zotero

ProQuest RefWorks

Clarivate Analytics | EndNote

Ferret Protocol Keywords and Synonyms

Concept/Keyword Type	Keywords and Synonyms
Animal	ferret or mustela putorius furo
Disease	H5N1 OR influenza OR flu
Housing	cage design OR enclosure OR cage
3Rs Alternatives	social OR pair OR housing OR enrichment
Procedure	challenge OR infect OR introduce
3Rs Alternatives	less invasive OR noninvasive
Procedure	blood collection OR blood sampling
3Rs Alternatives	awake OR conscious OR refinement
Procedure	imaging OR scan OR MRI
3Rs Alternatives	less invasive or stress-free

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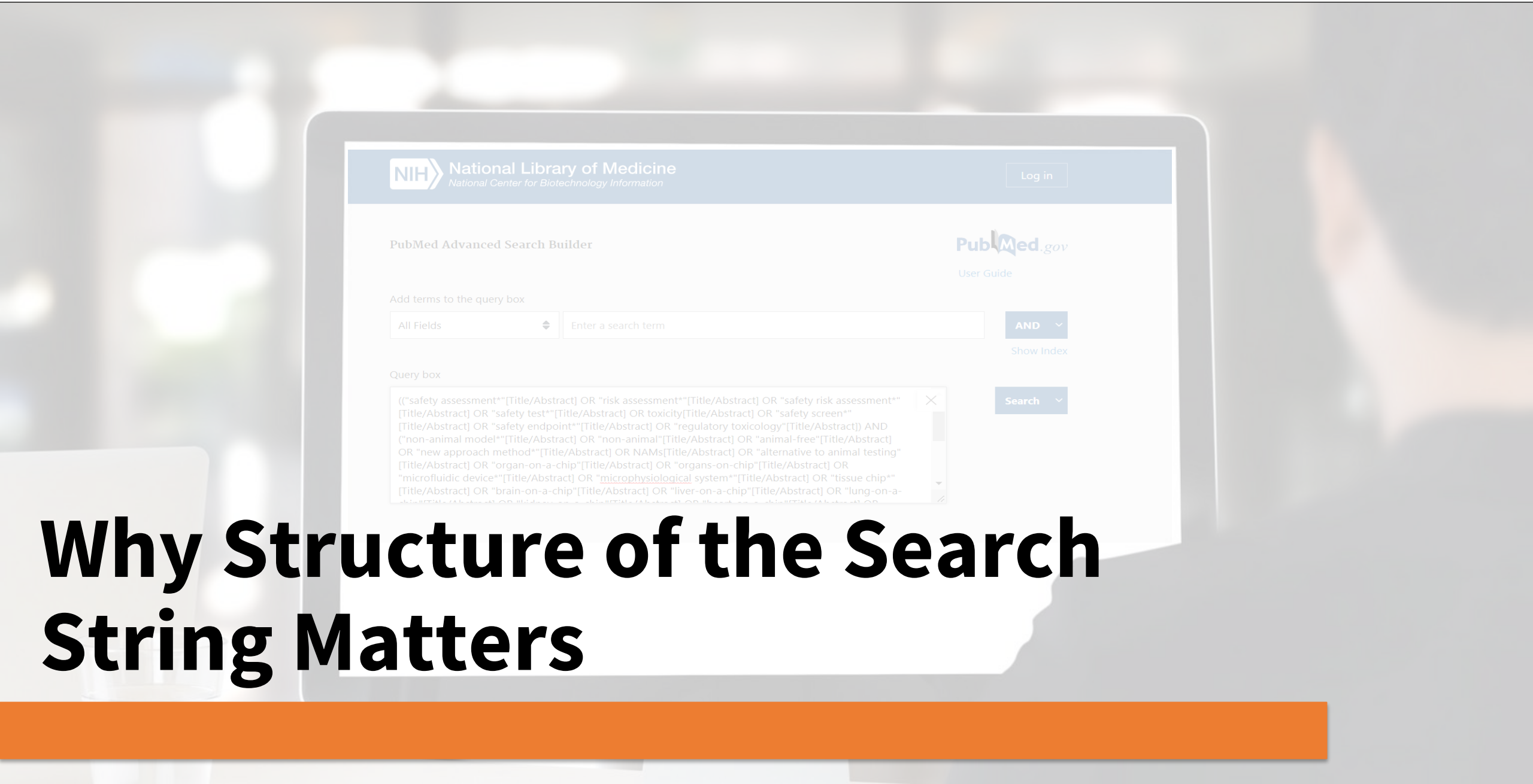


Why Structure of the Search String Matters

"Good" vs. "Bad" Search & Why it Matters

Bad or unrefined search:

- Not including search tools/syntax (i.e., Boolean operators, quotation marks etc.)
- Throwing keywords into the search with no specific order
- Using only terms like 'replacement', 'reduction,' 'refinement' or 'alternatives'

Good or refined search:

- Synonymous terms grouped with parentheses
- Use of search tools/syntax
- Not only using the procedure/method you're trying to **replace**

GOAL: To show you the differences in search results with an unrefined search versus a refined search

Unrefined Search String = Irrelevant Results

- Search string = **Alternatives metabolic cages rodents** in TOPIC (Title-Abstract-Keywords) on Basic search screen in WOS.
  - Yielded 43 results, with 1 relevant citation.
  - Suggests shorter periods in metabolic cages, but does not eliminate them.

Abstract

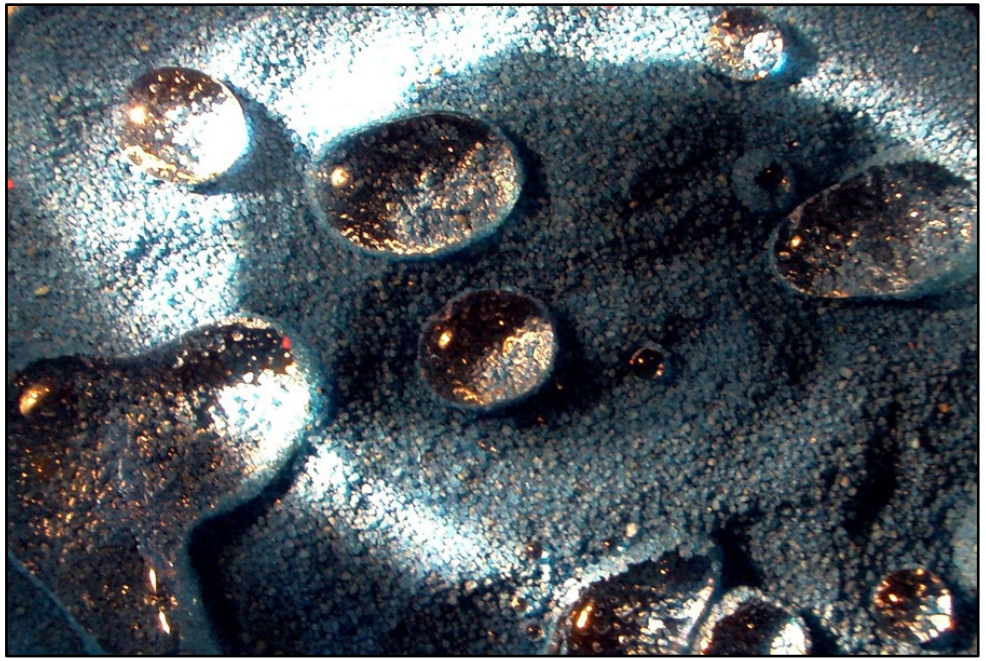
In mouse (Mus musculus) models of diabetic nephropathy (DN), one of the most important read-outs is the 24-h urinary albumin excretion (UAE). The 24-h urine collection is usually performed by single housing mice in metabolic cages on wire mesh without enrichment. This is known to be stressful for the mice. Therefore, it was investigated if shorter urine collections would be sufficient to get reliable assessments of albuminuria. Twenty-one diabetic (C57BLKS-Lepr(db/db)) and ten non-diabetic mice (C57BLKS-Leprd(b/+)) were placed in metabolic cages at 15 and 20 weeks of age (WoA) for 24 h. Urine samples were taken at 4, 6, 18 and 24 h and albumin and creatinine concentration were measured. Four- and 6-h UAE was found to correlate significantly with 24-h UAE. Furthermore, a significant correlation was found between 24-h UAE and albumin:creatinine ratio (ACR) in the 4-h sample. However, the

Nørgaard, S. A., Sand, F. W., Sørensen, D. B., & Søndergaard, H. (2020). Four- And six-hour urinary albumin excretion is a valuable alternative to 24-h urinary albumin excretion in male db/db mice. *Animal Welfare*, *29*(2), 143–149. Scopus. https://doi.org/10.7120/09627286.29.2.143

Refined Search String = Relevant Results

- Search string = TI=(("urine collection" OR "urine sampl*")NEAR/5(mice OR mouse OR mus OR murine OR rat OR rodent* OR rattus)) in WoS.
  - Yielded 51 results, with 5 relevant citations.
- May need multiple strings to get ALL relevant results.

From abstract:…**Our results suggest that hydrophobic sand is a refinement of urine collection methods for rats that decreases isolation time, risk of injury, and stress and maintains the integrity of urine samples.**



Hoffman, J. F., Fan, A. X., Neuendorf, E. H., Vergara, V. B., & Kalinich, J. F. (2018). Hydrophobic Sand Versus Metabolic Cages: A Comparison of Urine Collection Methods for Rats (Rattus norvegicus). *Journal of the American Association for Laboratory Animal Science*, *57*(1), 51–57.

Another Refined Search String

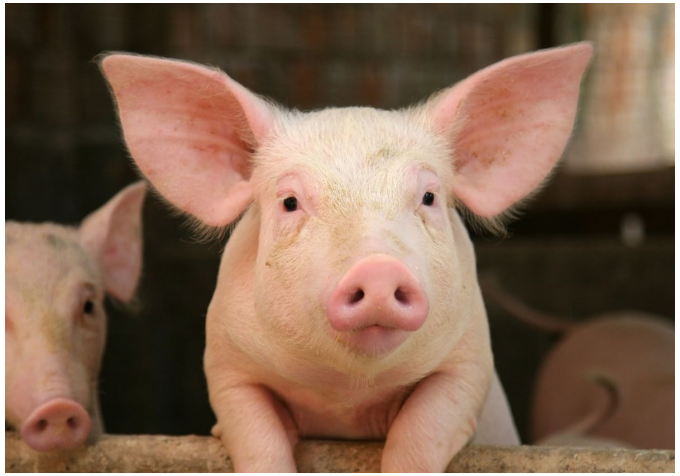
- Search string = **TS=("non-invasive" OR "less invasive" OR stress OR distress) AND** TI=(("urine collection" OR "urine sampl*")NEAR/5(mice OR mouse OR mus OR murine OR rat OR rodent* OR rattus)) in WOS.
  - Yielded 4 results, 2 were relevant.

From abstract:…We found no significant differences in particle size, particle concentration, total RNA, or the type and abundance of miRNAs contained within the urine EVs due to urine collection method, suggesting hydrophobic sand represents an easy-to-use, non-invasive method to collect rodent urine for EVs and biomarker studies.

Hoffman, J. F., Vechetti, I. J., Alimov, A. P., Kalinich, J. F., McCarthy, J. J., & Peterson, C. A. (2019). Hydrophobic sand is a viable method of urine collection from the rat for extracellular vesicle biomarker analysis. *Molecular Genetics and Metabolism Reports*, *21*, 100505. https://doi.org/10.1016/j.ymgmr.2019.100505

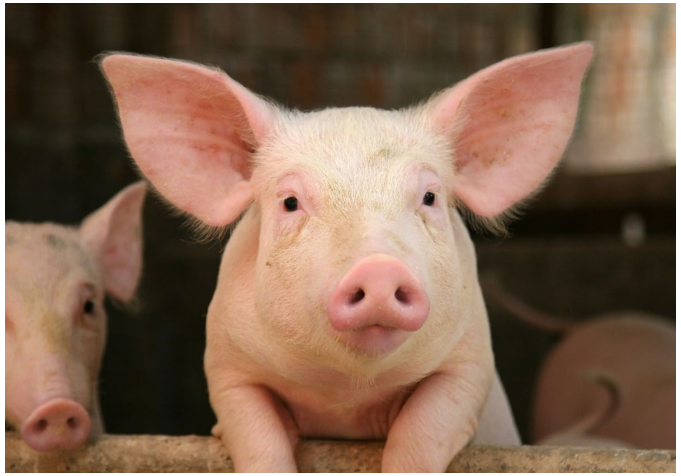
Exercise:
Creating Synonymous Terms

Pig



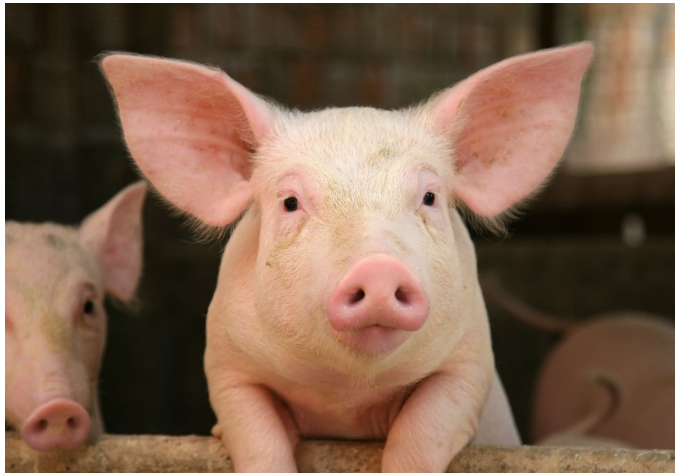
OR

Swine

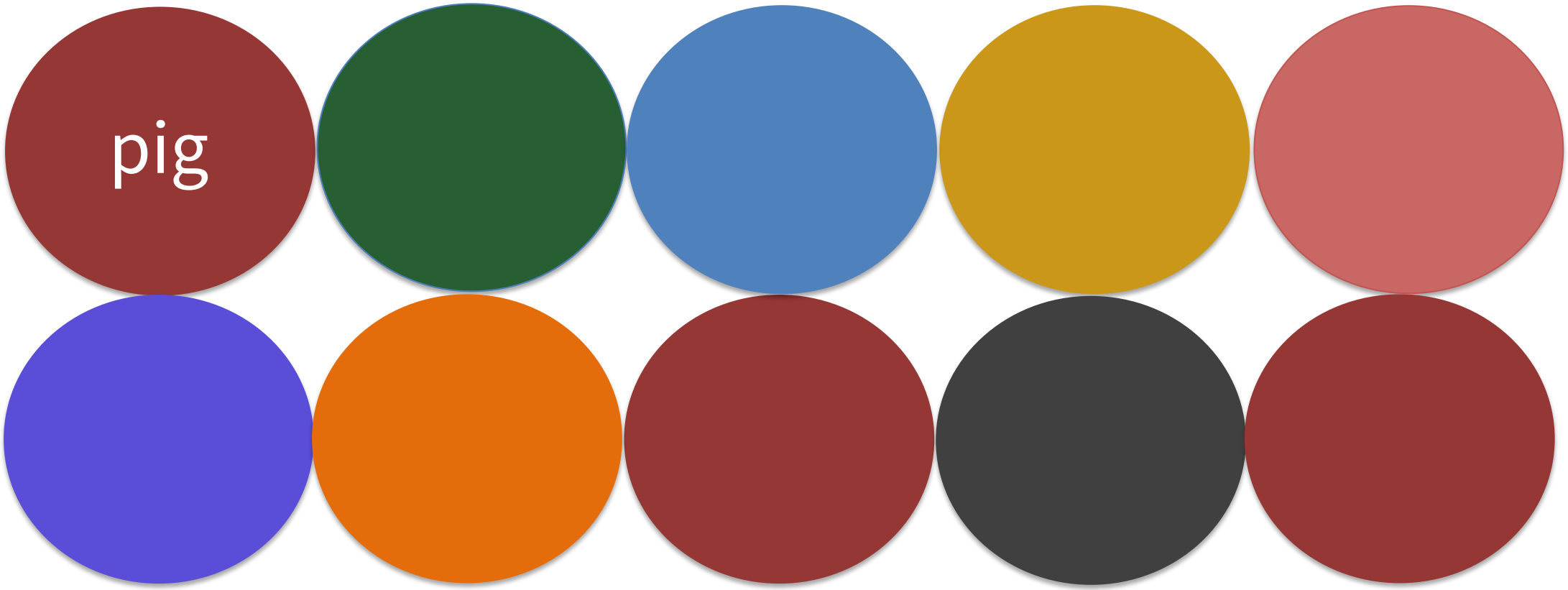


OR

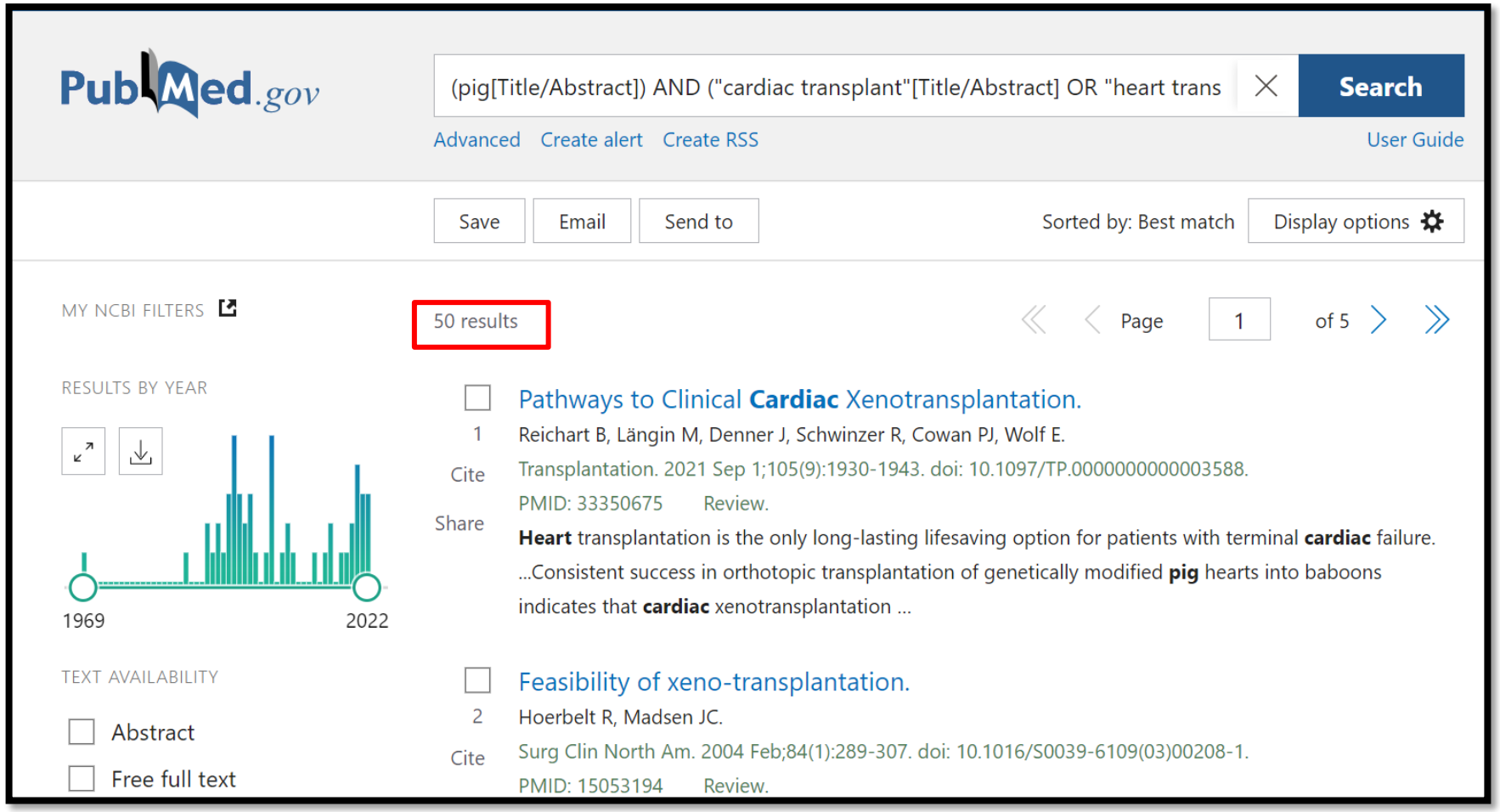
Porcine



Why Synonymous Terms are Important



(pig) AND ("cardiac transplant" OR "heart transplant")



Why Synonymous Terms are Important

(pig OR pigs OR porcine OR "sus scrofa" OR piglet OR sow OR boar OR hog OR gilt OR barrow) AND ("cardiac transplant" OR "heart transplant")

Where to Find Synonymous/Related Terms for Keywords

- Within your protocol
- AWIC's examples of 3Rs keywords
- AWIC webpages
- 3Rs organization websites
- Papers published on related topics
- Wikipedia articles
- Google
- National Agricultural Library Thesaurus
- PubMed's Medical Subject Headings (MeSH) Thesaurus

MeSH Terms for "Animal Use Alternatives"

Animal Use Alternatives

Alternatives to the use of animals in research, testing, and education. The alternatives may include reduction in the number of animals used, replacement of animals with a non-animal model or with animals of a species lower phylogenetically, or refinement of methods to minimize pain and distress of animals used.

Year introduced: 2001

PubMed search builder options

Subheadings:

- ☐ classification
- ☐ economics
- ☐ education
- ☐ ethics
- ☐ history
- ☐ instrumentation
- ☐ legislation and jurisprudence
- ☐ methods
- ☐ organization and administration
- ☐ standards
- ☐ statistics and numerical data
- ☐ trends

☐ Restrict to MeSH Major Topic.

☐ Do not include MeSH terms found below this term in the MeSH hierarchy.

Tree Number(s): E05.017.080

MeSH Unique ID: D023401

Entry Terms:

- Alternative, Animal Use
- Alternatives, Animal Use
- Animal Use Alternative
- Use Alternative, Animal
- Use Alternatives, Animal
- Animal Testing Reduction, Refinement and Replacement

See Also:

- Animal Welfare
- Animal Experimentation

All MeSH Categories
Analytical, Diagnostic and Therapeutic Techniques and Equipment Category
Investigative Techniques
Animal Experimentation
Animal Use Alternatives
Animal Testing Alternatives

Other MeSH Terms Helpful for Finding 3Rs Alternatives

- Alternatives to animal testing
- Anesthesia and analgesia
- Analgesia
- Animals, laboratory
- Animal welfare
- Behavior, Animal
- Biomarkers
- Blood specimen collection
- Cell culture techniques
- Computer simulation
- Euthanasia, animal
- Diagnostic imaging
- Organ culture techniques
- Laboratory animal science
- In vitro techniques
- Injections
- Virtual reality
- Organoids
- Lab-on-a-chip devices
- Manikins
- Telemetry
- Tissue banks
- Research Design
- Toxicology
- Ecotoxicology

Creating Synonymous Terms

A research lab is planning multiple studies using a strain of common laboratory white mice. They are planning to house the mice in stacked wire cages with feeders/waterers. Mice are individually housed in steel cages with no bedding or other enrichments. What 3Rs modifications could be made to this housing model to improve animal well-being and reduce stress?

Mice: mus OR murine OR mouse OR rodent OR “mus musculus” or “m. musculus”

Housing: cage* or enclosure or pen or bedding or shelter or “play pen”

3Rs Alternatives: enrichment or “group housing” or “pair* housing” or “solid bottom housing” or “social housing” or toys

Creating Synonymous Terms: Answers

A research lab is planning multiple studies using a strain of common laboratory white mice. They are planning to house the mice in stacked wire cages with feeders/waterers. Mice are individually housed in steel cages with no bedding or other enrichments. What 3Rs modifications could be made to this housing model to improve animal well-being and reduce stress?

Mice: mice OR mouse OR mus OR murine

Housing: housing OR cage* OR enclosure*

3Rs Alternatives: "social housing" OR "group housing" OR "social enrichment*" OR "environmental enrichment*" OR toy* OR bedding OR "nesting material*" OR "reduce stress" OR "animal welfare" OR "well-being"

Suggestions to PIs and IACUCs for Protocol Review

Both PIs and IACUCs should ask:

- Is the protocol written in a **clear way** to gather the information needed for the study?
- Was the literature search done ***before*** the protocol was written? Literature search should shape the protocol rather than be an "afterthought"
- Is there a librarian on the IACUC committee who can **review the search strategies**?

Watch for "Red Flags":

- Only one database searched
- Missing synonymous terms/keywords
- Search syntax errors or misspellings
- Using only "alternatives", "refinement", "reduction", or "replacement" as keywords
- Insufficient years of coverage
- Only 1 search strategy for multiple procedures

Interactive Team Activity

10 Minute Break

(Stretch!)

AWIC's Products and Services

Reference & Literature Search Assistance

AWIC assists patrons with animal welfare and 3Rs questions and conducts alternatives literature searches for free.

https://www.nal.usda.gov/services/literature-searching-animal-use-alternatives

Need assistance with a literature search? Complete a request form!

https://www.nal.usda.gov/sites/default/files/page-files/AWIC_alternatives_literature_search_request_form.pdf

AWIC Workshops

To register: https://www.nal.usda.gov/about-us/events/awic-workshop

AWIC Workshop & Trainings

Meeting the Requirements of the Animal Welfare Act

This in-person workshop is intended for the regulated community (any personnel working with animals in research, testing, or education) and is typically held at the National Agricultural Library (NAL) in Beltsville, Maryland. However, due to COVID-19, AWIC is offering this workshop through a virtual platform.

About the Workshop

The regulati… require that investigat… …stitutional Animal Care …mittees (IACU… …onstrati… …dures tha… m…

October 19, 2022 (virtual)

March 8, 2023 (virtual)

May 3, 2023 (virtual)

What You'll Cover

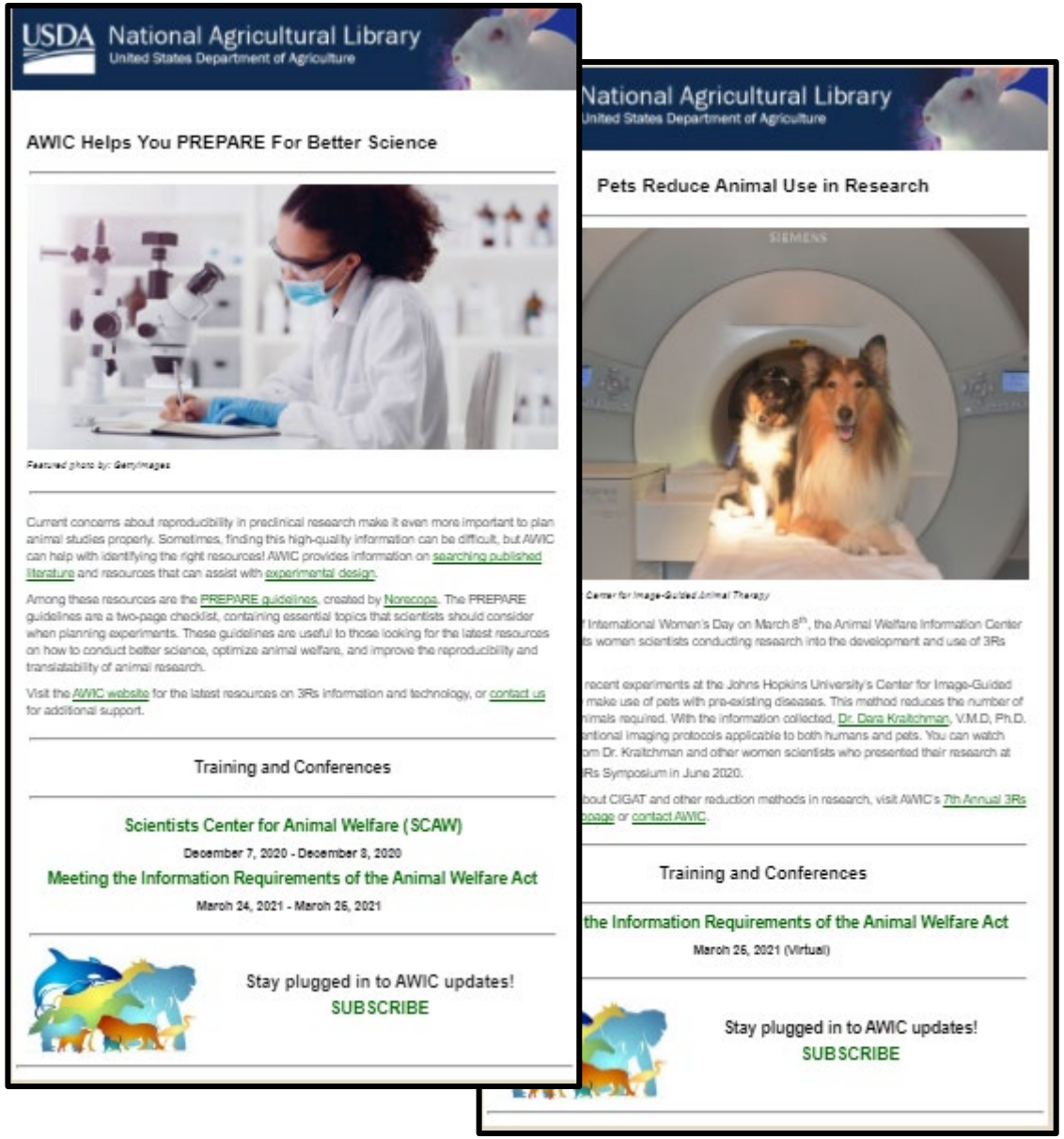
- A historical overview of the Animal Welfare Act (AWA), and regulations
- What is meant by the Information requirements of the Animal Welfare Act (AWA).
- 3Rs Alternatives of Reduction, Refinement, and Replacement
- Databases and resources available to access scientific literature
- A systematic approach to accessing information and creating effective literature search strategies.

Access Anytime!

Customizable Trainings

Freely provided upon request

- Information Requirements of the AWA
- History of the Animal Welfare Act
- 3Rs Alternatives/Resources
- Conducting a Literature Search
- Animal Welfare Information Center (AWIC)



AWIC Newsletter

- New 3Rs research
- Literature searching tips
- 3Rs conferences/trainings
- New AWIC products & services

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