NORINA:

Models and simulators that can replace (or supplement) the use of live animals in education

norecopa.no/SUND

Adrian Smith
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https://norecopa.no

Norecopa

Norway's National Consensus Platform for the

Three Rs: Replacement, Reduction and Refinement

and a source of global 3R resources

https://norecopa.no

Norecopa: PREPARE for Better Science

I was responsible for the Laboratory Animal Unit at the Norwegian School of Veterinary Science in the 1990s when the use of mice, rats, frogs and guinea-pigs in preclinical physiology and pharmacology classes was hotly debated.

animal activists

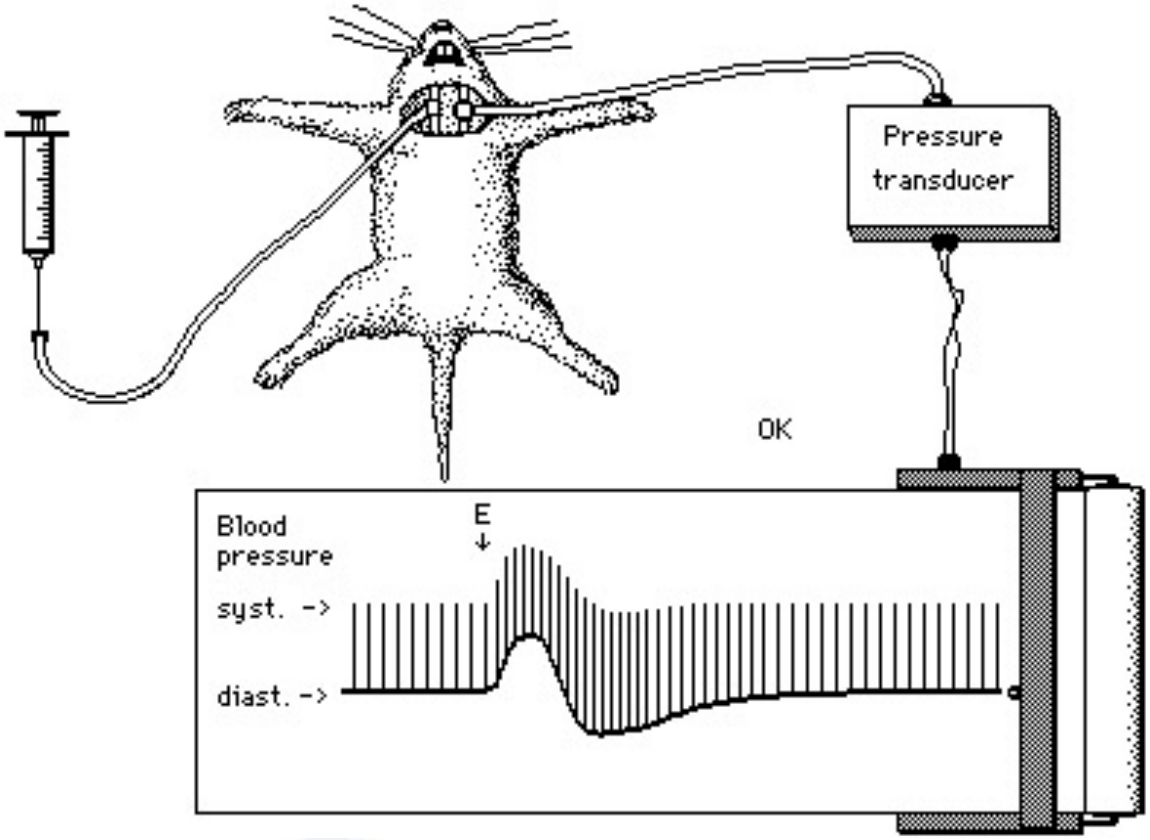
tutors &
students

lab animal technicians

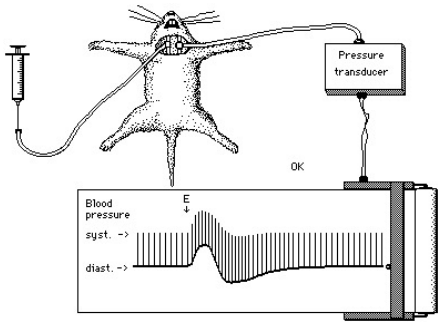
responsible person at the facility

Regulators

Harm-Benefit Assessment



Pharmatutor
Daniel Keller, ETH Zurich
1987



1991-: NORINA database

Richard Fosse
Karina Smith
Elisabeth Pagels

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Doubt:

'Der kan her sættes spørgsmål ved, om den nødvendige læring ikke i lige så høj grad vil kunne opnås uden brug af dyr'.

In my experience, the tutors were convinced that animal use was the best learning environment for the students, while those against were equally convinced of the opposite.
Student majority views could vary from one class to the next!

Arguments that a practical was a good introduction to surgical technique were in my opinion incorrect.

https://3rcenter.dk/fileadmin/user_upload/Editor/images/Om_Danmarks_3R-Center/Udtalelser/Brug_af_dyr_i_undervisning-_til_offentliggoerelse_paa_hjemmeside.pdf

Council of Europe Convention (ETS123), 1986:

Article 25, point 3:

Procedures shall be restricted to those absolutely necessary for the purpose of the education or training concerned and permitted only if their objective cannot be achieved by comparably effective audio-visual or other suitable methods.

Choose your teaching objectives!

You can't decide whether or not there is an alternative until you know the aim of the experiment.

Teaching

- laboratory skills
- **preparation-specific animal skills**
- **general animal handling skills**

• imparting good ethical thinking
• data handling skills
• experimental design skills
• communication skills (oral, written)
• group work
• staff-student interaction

EU Directive 2010/63

Article 1:

This Directive establishes measures for the protection of animals used for scientific or educational purposes.

Article 5:

Procedures may be carried out for the following purposes only:
... higher education, or training for the acquisition, maintenance or improvement of vocational skills;

Recital 12:

The use of animals for scientific or educational purposes should therefore only be considered where a non-animal alternative is unavailable.

Russell & Burch: The Principles of Humane Experimental Technique (1959)

- Replacement
- Reduction
- Refinement

’We may need the animals, as it were, on the night; but the machines will do very well at rehearsals’

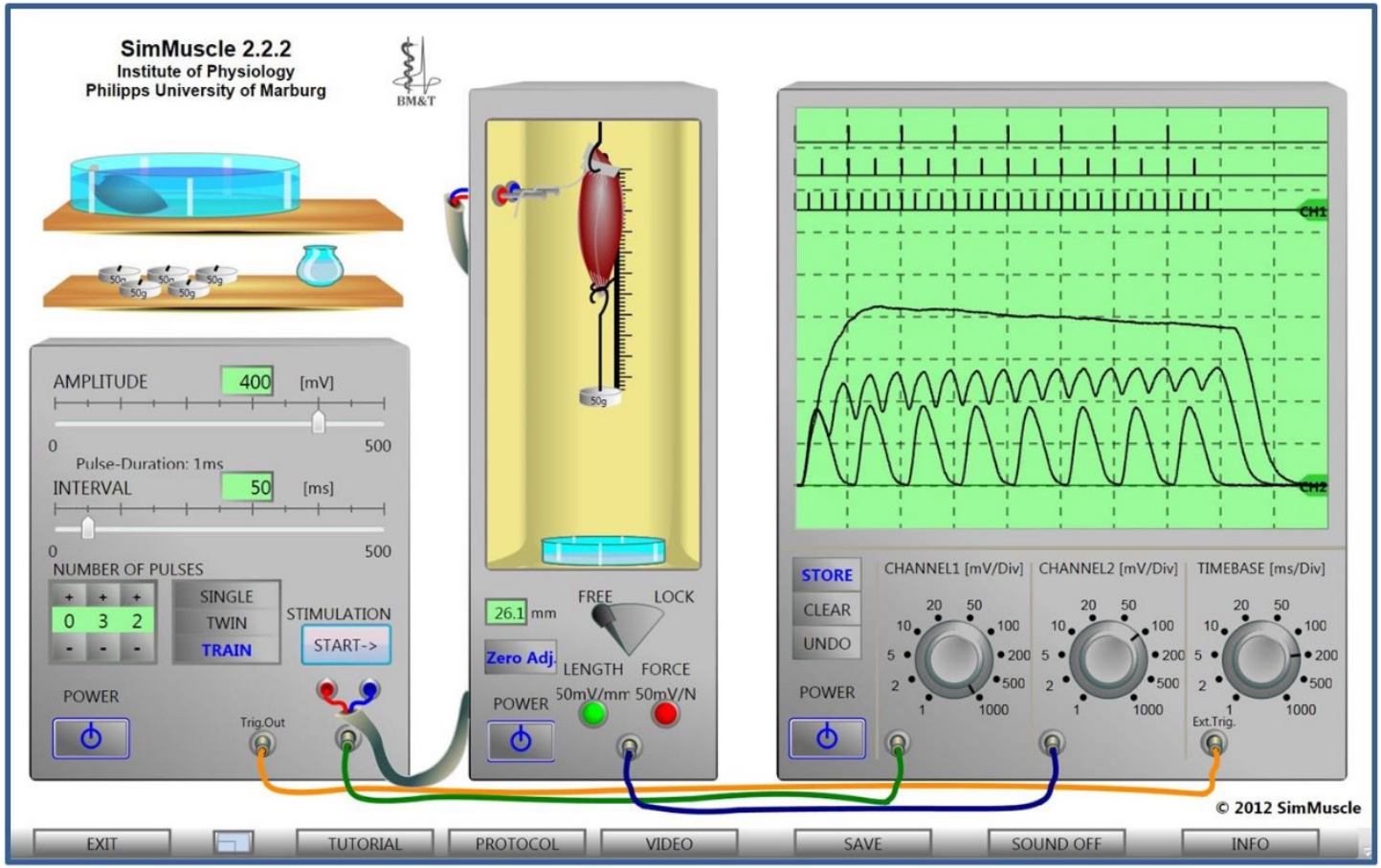
”Alternatives” may be too poor to replace animals totally, but may be excellent as briefing or debriefing aids:

Make your worst mistakes on an inanimate object, not a living animal!

No doubt:

‘Ud over frøene som brukes til selve undervisningen, er der et stort antal frøer, der mister livet – både under transporten til Danmark og i forbindelse med den efterfølgende opstaldning’.

https://3rcenter.dk/fileadmin/user_upload/Editor/images/Om_Danmarks_3R-Center/Udtalelser/Brug_af_dyr_i_undervisning-_til_offentliggoerelse_paa_hjemmeside.pdf



SimMuscle

Hans Braun, Marberg virtual-physiology.com

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The tutor loses control over the content...

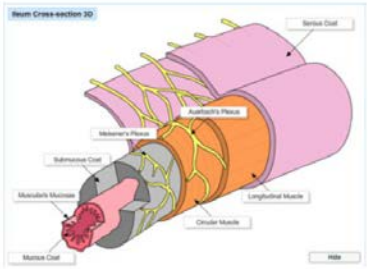
The tutor cannot decide the drugs to be used

Guinea Pig Ileum

By David Dewhurst; Philip Larkman and Stewart Cromar

Record number: 5830d (legacy id: 855)
Category: Pharmacology
Type: Computer Program

A computer simulation program to teach the effects of drugs and electrical stimulation on the enteric nervous system. Type of record: Computer Program. Category: Pharmacology (animal).

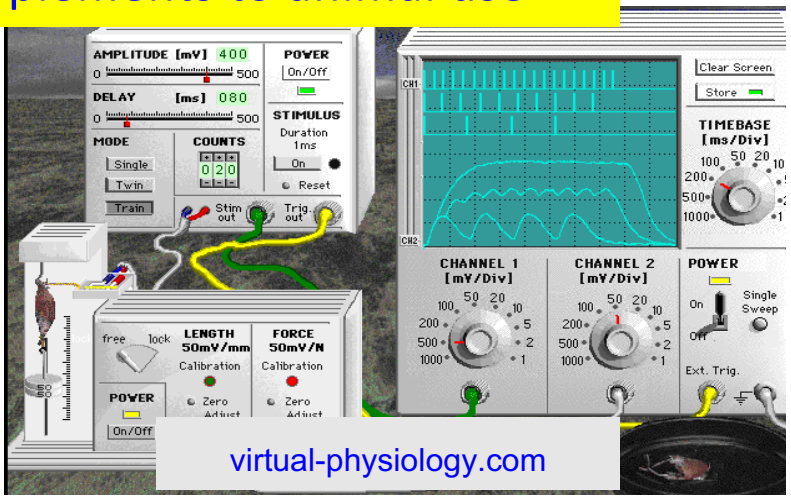


A computer simulation program to teach the effects of drugs and electrical stimulation on the enteric nervous system.

This program simulates an isolated preparation of the guinea pig ileum, a smooth muscle preparation exhibiting little spontaneous contractile activity, which is extensively used for pharmacological studies. Its aim is to enable the exploration of the effects of drugs and electrical stimulation on the release of, and response to, neurotransmitters in the enteric nervous system. Simulated responses are derived from a model which presents the contractile response of the ileum both to added drugs and to transmural electrical stimulation. Learning is through exploration and the program places at the disposal of the user a range of DRUGS (acetylcholine, histamine, clonidine, morphine, naloxone, phentolamine, atropine, mepyramine) which may be added alone or in combination to the organ bath in a range of DOSES, and an electrical STIMULATOR. A 'magic' WASH facility instantly removes all traces of added drugs and greatly speeds up the process of data collection compared to the real experiment. Simulated contractions of the gut are presented on a scrolling display comparable to that of a chart recorder. Students may take measurements directly from the monitor.

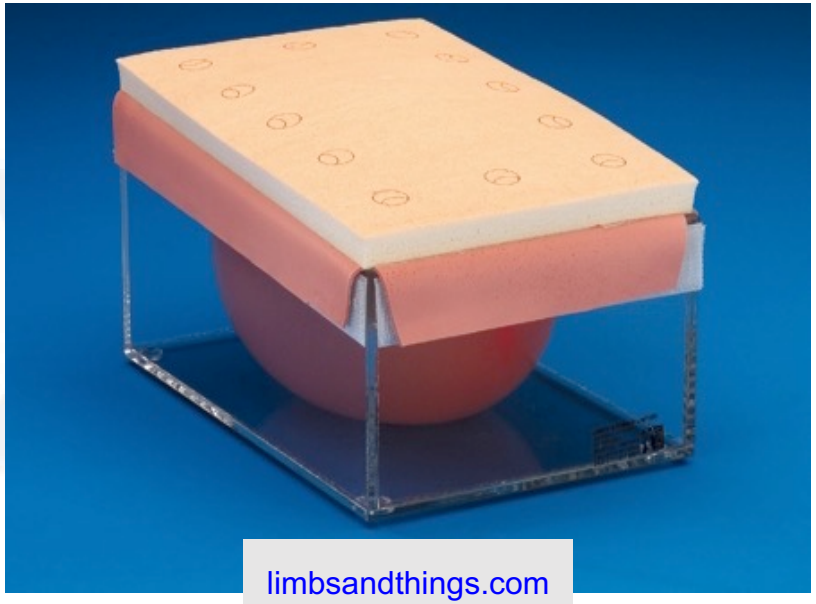
norecopa.no/NORINA 3,000 alternatives/supplements to animal use

frogvirtualdissection.com



virtual-physiology.com

rescuecritters.com

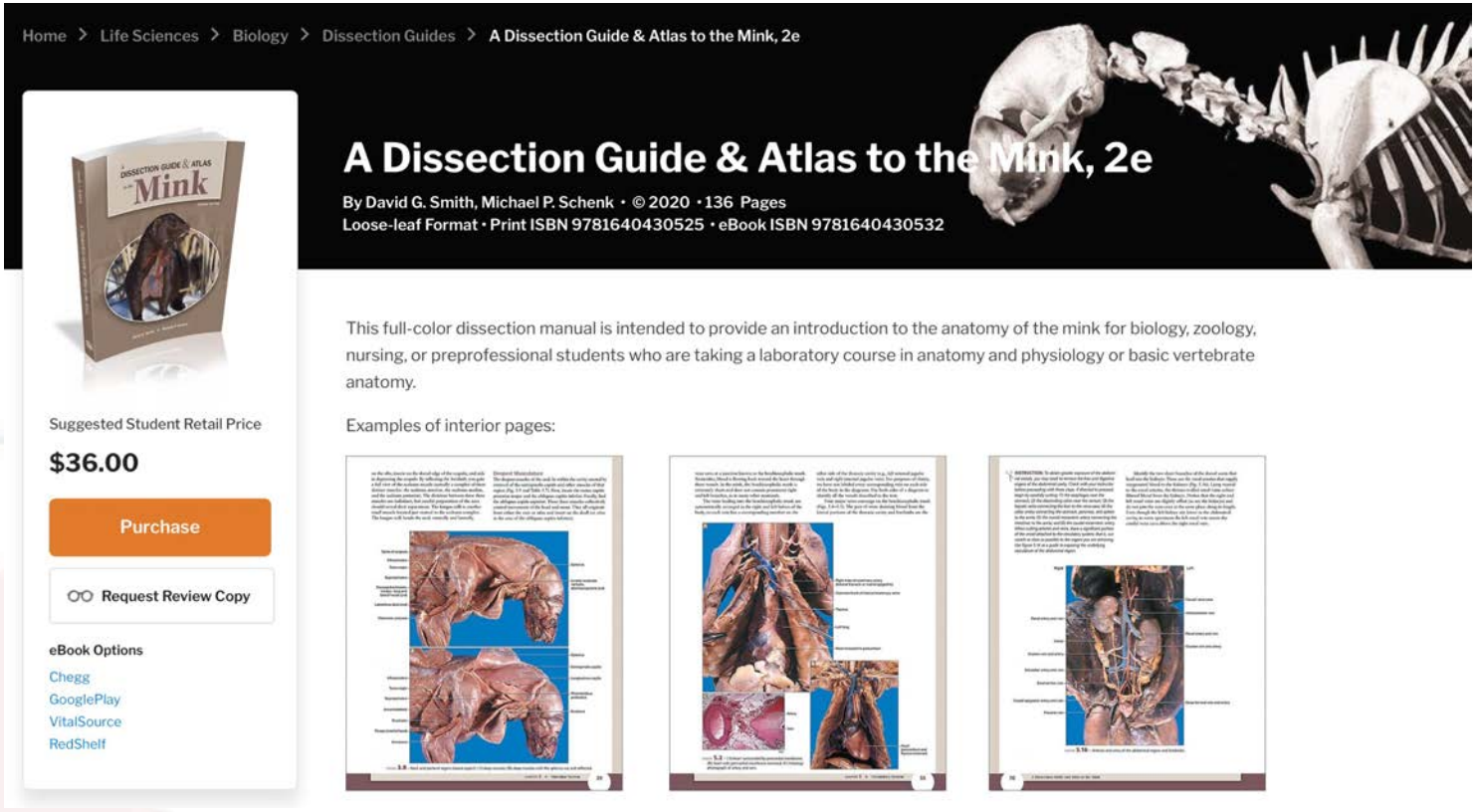


limbsandthings.com

TextBase:

1,500 books

norecopa.no/textbase



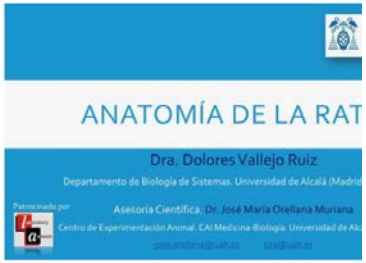
https://www.morton-pub.com/product/a-dissection-guide-atlas-to-the-mink-2e

norecopa.no/education-training/films-and-slide-shows

norecopa

Rat s.c. injection
Norecopa | 1,380 views

Rat i.p. injection (method 2)
Norecopa | 1,280 views



Anatomia de la rata
Norecopa | 977 views

Testing anaesthetic depth in the chicken
Norecopa | 598 views

Blood collection from the saphenous vein in the mouse
Norecopa | 6,777 views

Subcutaneous injection in the rat - Technique 1
Norecopa | 2,249 views

Blood san
Norecop

Blood san
Norecop

Blood san
Norecop

Blood sampling from the pig
Norecopa | 3,914 views

Intravenous injection in a rabbit
Norecopa | 2,025 views

Lifting a rabbit
Norecopa | 2,420 views

Subcutaneous injection in the rabbit
Norecopa | 1,479 views

Subcutaneous injection in the chicken
Norecopa | 1,806 views

Immobilisation of the rabbit
Norecopa | 2,072 views

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norecopa.no/education-training/films-and-slide-shows

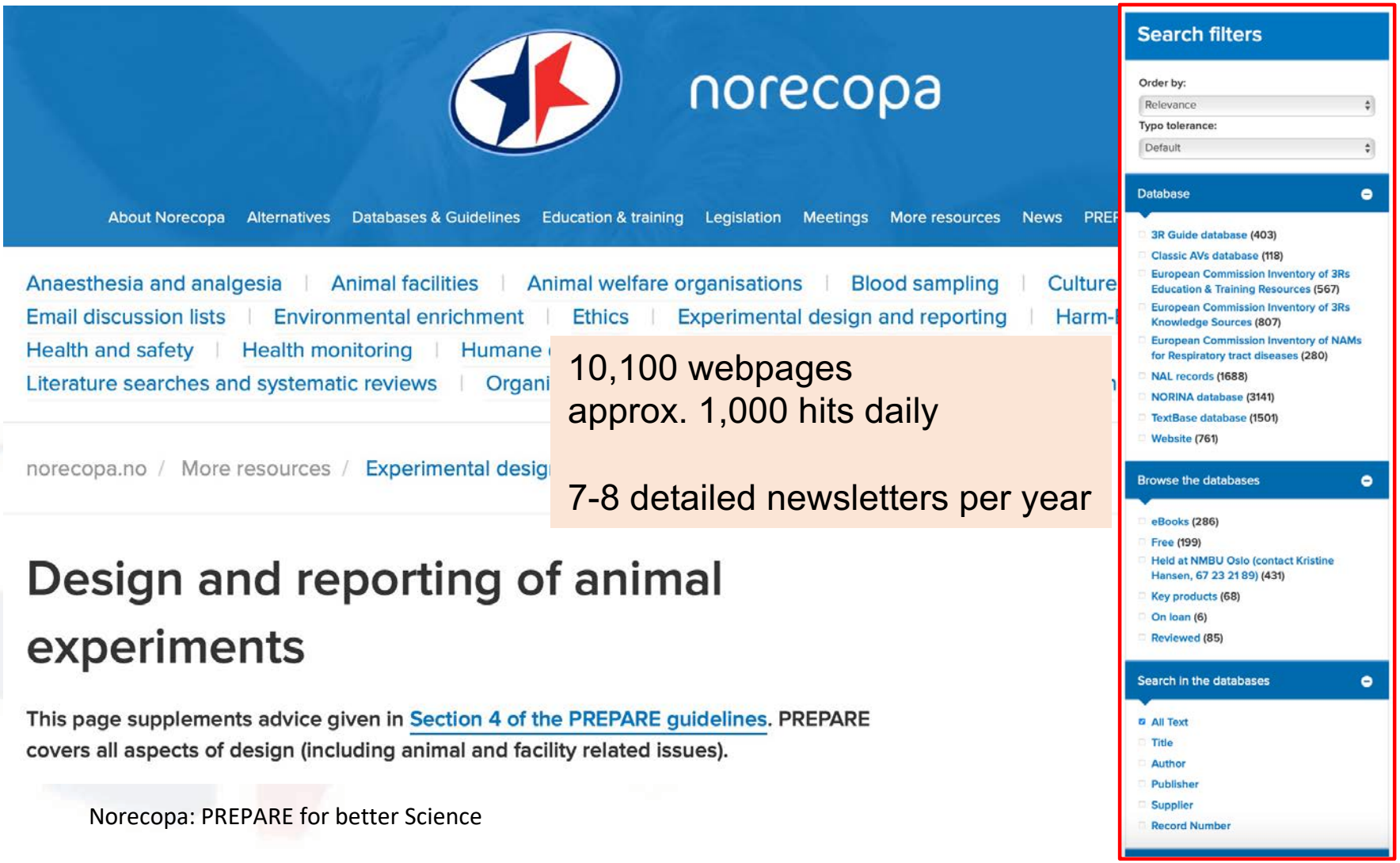
Hen:
Handling and blood sampling; s.c. injection and cardiac puncture

Mink:
i.v. injection
Blood sampling from the saphenous vein

Mouse:
Blood sampling from the saphenous vein
Immobilisation and blood sampling from the saphenous vein (NB older method of handling); i.p. injection; s.c. injection and oral gavage
Links to other resources
Housing, handling and training mice at RISE (Research Institutes of Sweden) - includes refinement of oral gavaging, saphenous venepuncture of mice and blood sampling from the tail of mice and rats (see also their film *Refinement work at RISE*)
Intravenous injections
Refinement of the scruffing technique
Refinement of mouse handling - video clips (NC3Rs webpage)
Refinement of mouse handling (NA3RsC webpage)
Handling techniques to reduce stress in mice (Marcotte *et al.*, 2021; JOVE video)
Mouse handling posters (NC3Rs), A2 size, for display in animal facilities (English, Chinese, French, German, Spanish & Greek)
Webinar: Mouse handling made easy - Reducing anxiety in mice and their handlers
Advice on rodent housing from NA3RsC
Oral gavage training (Instech)
Automated blood sampling (Instech)
Videos of anaesthesia, blood pressure measurements, oximetry and warming of rodents, by Kent Scientific
Online Refined Mouse Handling Course (3RsC & NC3Rs)

Pig:
Blood sampling techniques (Framstad *et al.*)
Immobilisation and blood sampling
Links to other resources:
Pig blood sampling (NC3Rs)
Pig handling and housing (NC3Rs)
O'Malley et al. (2022): Refining restraint techniques for research pigs through habituation
The Panepinto Sling for minipigs and other animals up to 150 kg
Handling, Dosing and Training of the Göttingen Minipig
Ellegaard Göttingen Minipigs Science Base
Panepinto (2020): Prioritizing humane minimum-stress methods in swine facility and protocol design

norecopa.no : "an up-to-date overview of global 3R resources"



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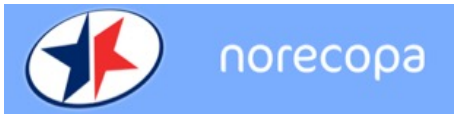

There are submenus under all the headings above

Current number of pages : 9464

rat bleeding

228 results

Rat Blood Pressure

NORINA database/af1a4 (legacy id: 4447)

An interactive computer simulation of experiments to study the effects of a number of pharmacological agents on rat blood pressure in vivo . Type: Computer Program. Category: Pharmacology (animal) & Physiology (animal).

Author: Ian E. Hughes David Dewhurst and Alan Williams

Supplier: Sheffield BioScience Programs, Dr. David Dewhurst

A refined method of repeated blood sampling in mice

NAL records/b2d28 (legacy id: 3828971)

Journal: Animal technology : journal of the Institute of Animal Technicians,

Author: Kitching, A.

Search filters

Order by:

Relevance

Typo tolerance:

Default

Database

- 3R Guide database (12)
- Classic AVs database (6)
- European Commission Inventory of 3Rs Education & Training Resources (19)
- European Commission Inventory of 3Rs Knowledge Sources (1)
- European Commission Inventory of NAMs for Cardiovascular diseases
- European Commission Inventory of NAMs for Respiratory tract diseases
- NAL records (49)
- NORINA database (38)
- TextBase database (42)
- Website (61)

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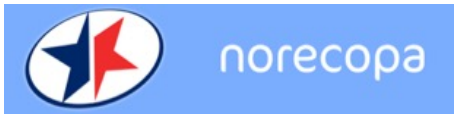


Category

- 3R Center (1)
- Agricultural animals (3)
- Anaesthesia (1)
- Anaesthesia and analgesia (2)
- Anatomy (6)
- Aquatic animals (2)
- Behaviour
- Behavioural research (2)
- Biochemistry (3)
- Biology
- Birds (3)
- Blood sampling (6)
- Cancer research (2)
- Design (4)
- Disease research (3)
- Dissection
- Education and training (4)

Type

- App
- Audio Tape
- Book
- CD-ROM (5)
- Chart/Diagram (1)
- Computer Program (4)
- Contact Person
- Databases
- Discussion forums
- Display Mounts (1)
- DVD (8)
- Film
- Filmstrip
- Guidelines (11)
- Information centres (2)
- Journals
- Microslides (4)
- Miscellaneous
- Model

Workshop in 2018: norecopa.no/education-training/homemade-educational-materials

Norecopa

norecopa.no/media/8099/langebæk.pdf

Simulation and Clinical Skills at University of Copenhagen

Rikke Langebæk
Associate professor, DVM, PhD
Department of Veterinary Clinical Science
Faculty of Health Sciences

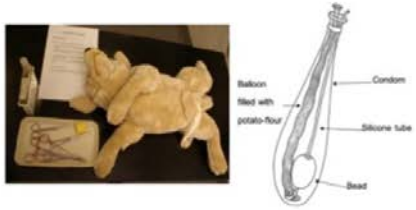
UNIVERSITY OF COPENHAGEN

Figure of Eight Ligature

Record number: bf05e
Category: Surgery
Type: Simulator

This model uses a stuffed toy dog with a "vaginal tunic" (condom), a "pampiniform plexus" (balloon with corn flour) and a "ductus deferens" (silicone tube) placed in the "prescrotal" area.

This model uses a stuffed toy dog with a "vaginal tunic" (condom), a "pampiniform plexus" (balloon with corn flour) and a "ductus deferens" (silicone tube) placed in the "prescrotal" area.



Assignment:

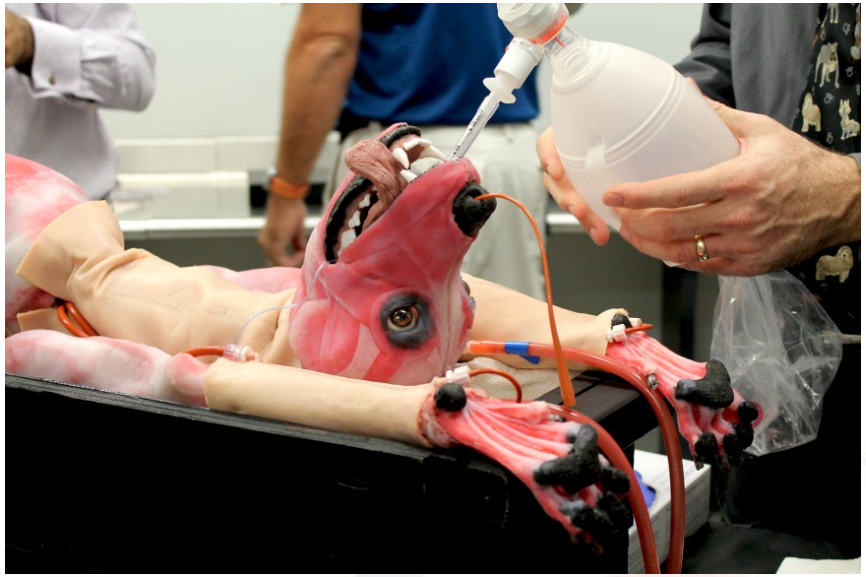
Using a needle and suture, a figure of eight ligature is placed through the *tunica vaginalis*, encircling the ductus and the plexus respectively.

Materials:

- A stuffed toy dog. The dog is equipped with a metal clip in the prescrotal area. The clip is covered with a piece of "skin/fur" – a flap - that permits access to the clip from the cranial as well as the caudal side
- Plexus pampiniformis: a long balloon (20cm) filled with corn starch
- Ductus deferens: a rubber tube (diameter 3mm) from a bicycle shop
- Tunica vaginalis: a plain condom, regular
- Testicle: a wooden bead, 4 x 2.5 cm
- Tape

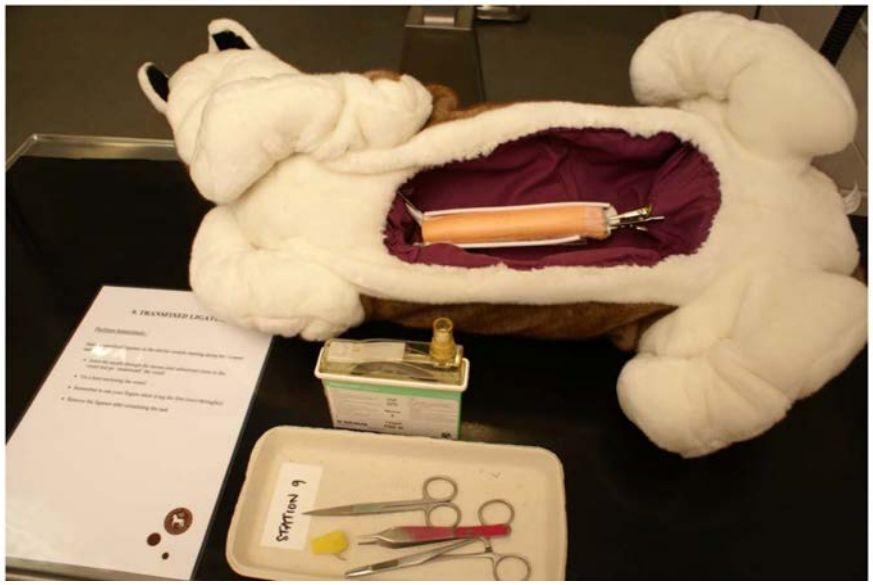
norecopa.no/norina/figure-of-eight-ligature

Fidelity and Discrimination



https://syndaver.com

High Fidelity, Low Discrimination



Rikke Langebæk, University of Copenhagen

Low Fidelity, High Discrimination

The 3Rs in microsurgery training

PROFESSOR MICHAEL AXELSSON

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Gothenburg, Sweden

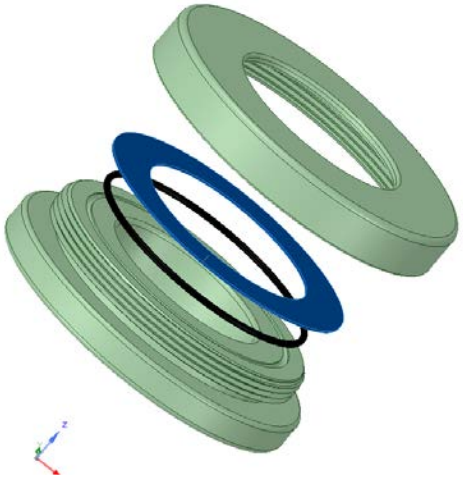
Phone: +46 31-786 3689, Mobile: +46766-183689
E-mail: michael.axelsson@gu.se
Web: http://www.bioenv.gu.se/personal/Axelsson_Michael/

First instrument suturing

Banana peel is useful

Sun-Lee disk in a modern 3D printed design

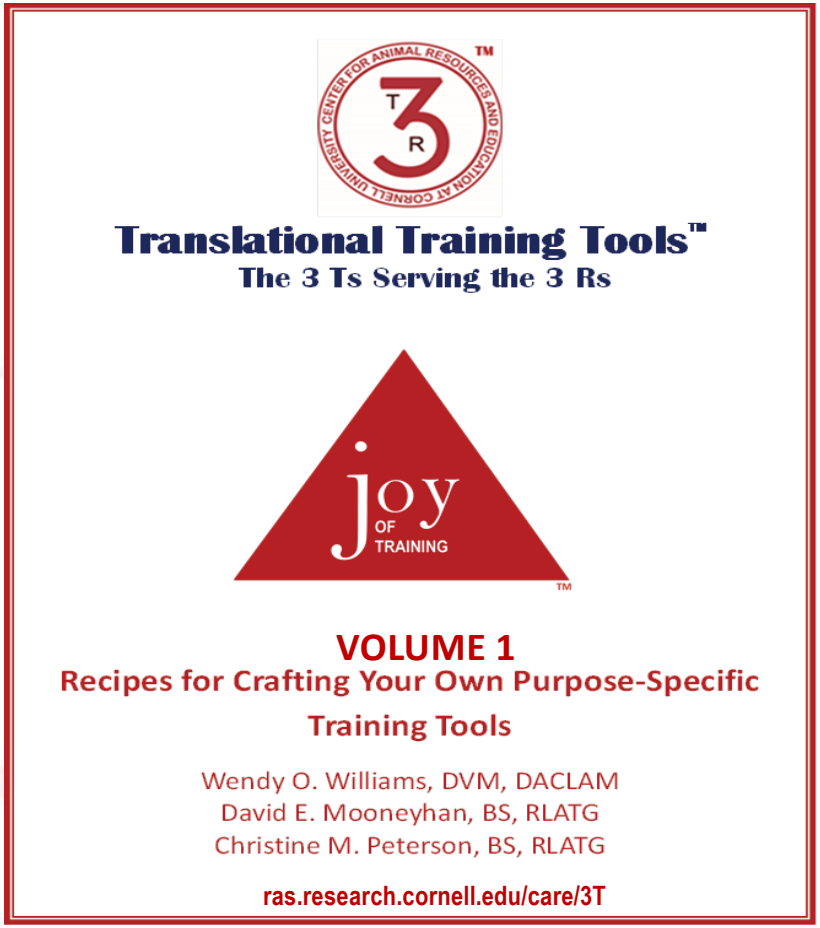
Suturing in latex membrane



SUN LEE, MD, and WARD J. COPPERSMITH, BS MICROSURGERY 4~67-69 1983

norecopa.no/education-training/homemade-educational-materials

LAWTE Laboratory Animal Welfare Training Exchange



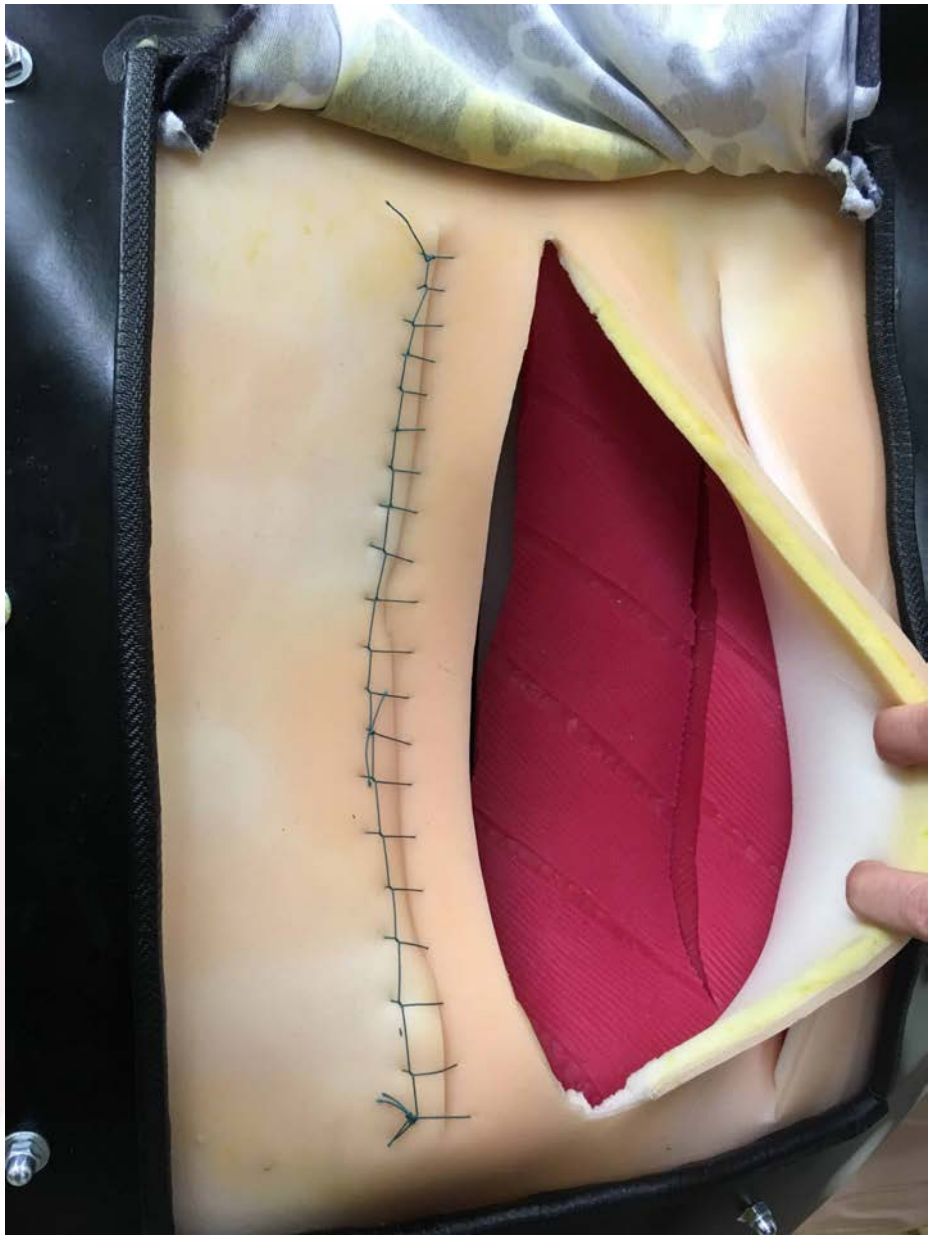
Veterinary Skills Network, Freie Universität Berlin

vet skills net

Development of veterinary simulators as an interactive teaching method

Laura Schüller

C-section simulator

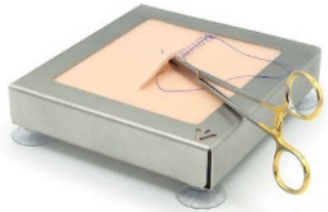


C-section simulator

C-section simulator


metacam

vetiqo.com/en/products/



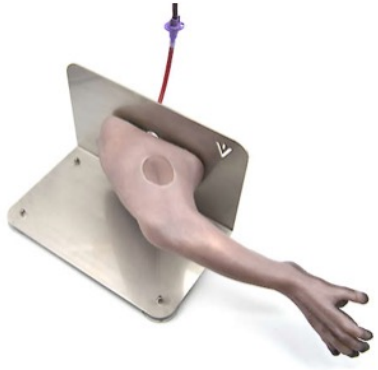
Suture skills

Injection skills

Bones

Gyndog

Castro & Weany



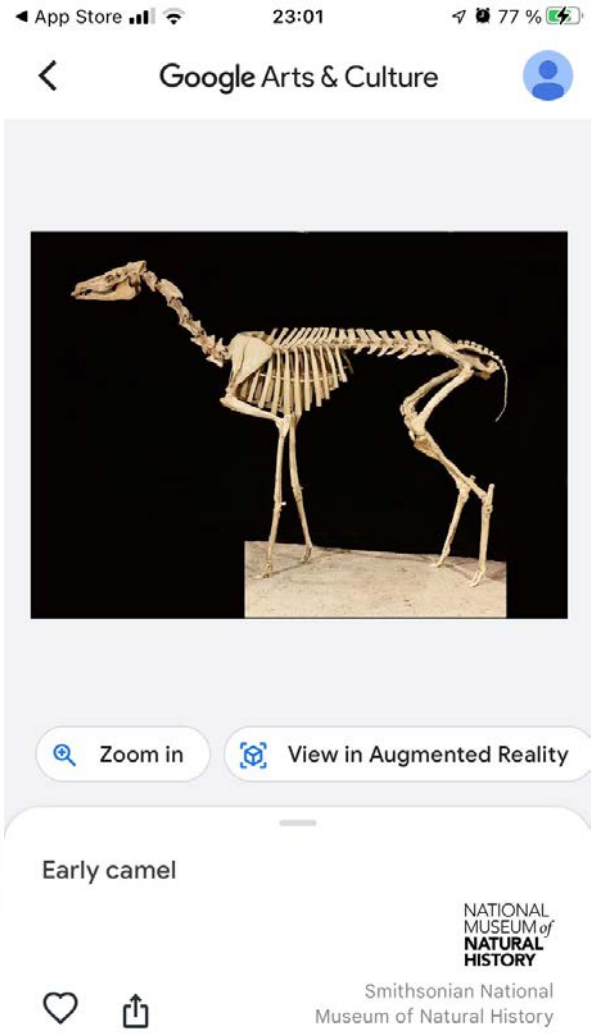
Rita Rhesus

Augmented Reality (AR)

A digital experience superimposed on the real world

Virtual Reality (VR)

A totally virtual digital world



Google Arts and Culture App


App Store
23:01
77 %
Google Arts & Culture
Zoom in
View in Augmented Reality
Early camel
NATIONAL MUSEUM of NATURAL HISTORY
Smithsonian National Museum of Natural History

3d4medical.com/student

Virtual Anatomy | Healthcare Simulation | HealthySimulation.com

Besøk

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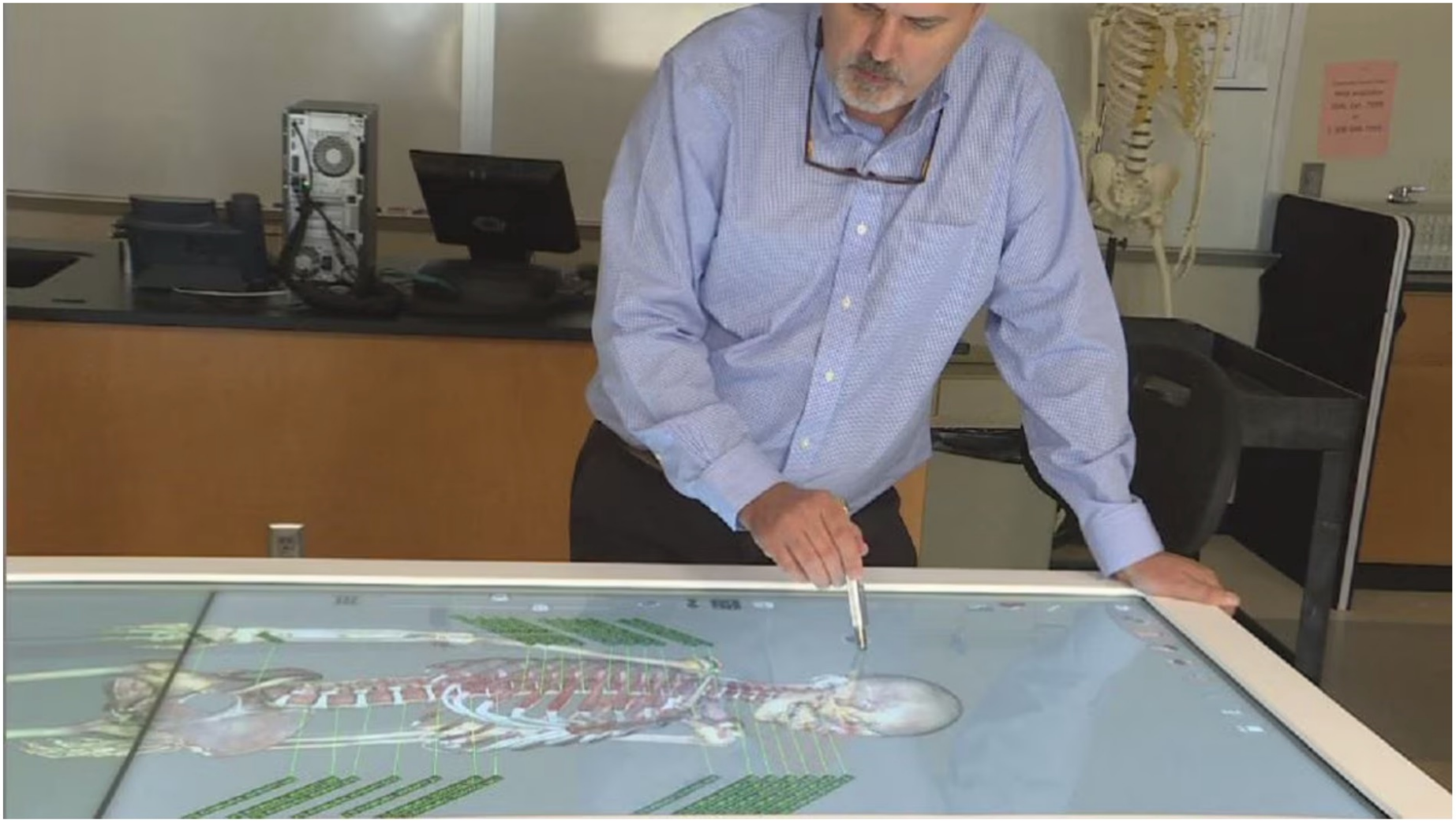
How Effective is Virtual Reality in Teaching Human Anatomy?

https://www.ixrlabs.com/blog/how-effective-is-virtual-reality-in-teaching-human-anatomy/

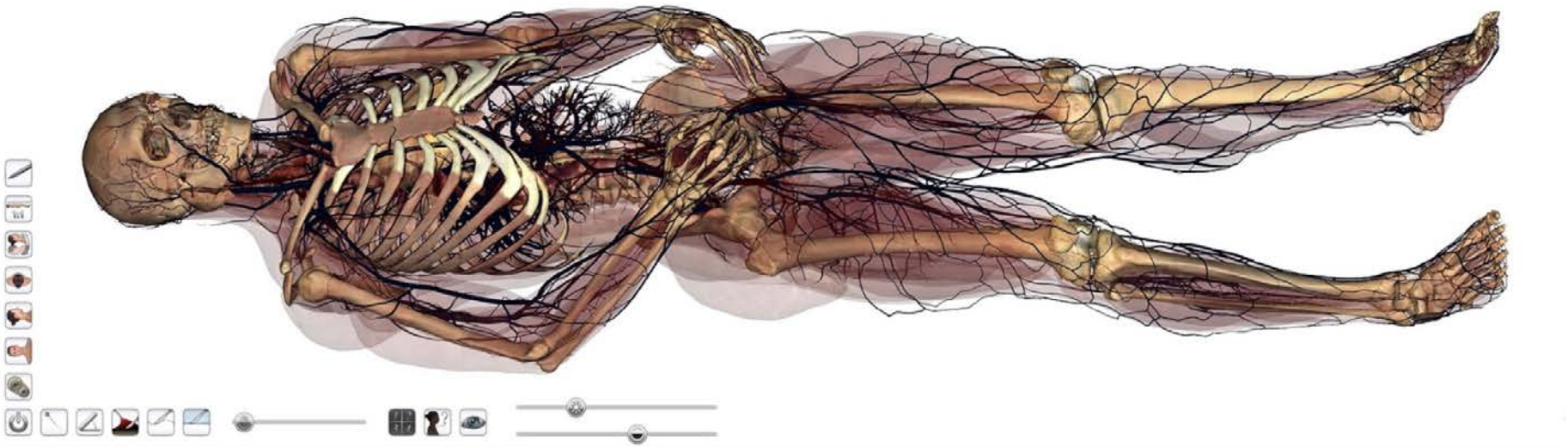
1. Using VR for complex organs can be disorienting and frustrating.
2. Students could also feel cybersickness, blurry vision and feel disoriented.
3. The cost of VR will have to be considered while applying it in medical colleges.



Central Community College - Grand Island instructors introduces Anatomage Table to their biology students. (Hailey Mach, KSNB)

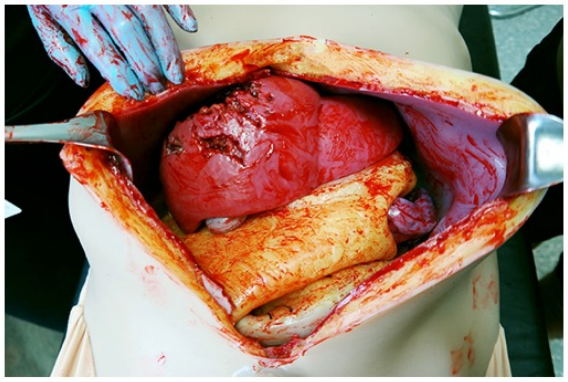
https://www.ksnblocal4.com/2021/09/28/central-community-college-adds-anatomage-table-biology-classroom

anatomage.com



anatomage.com

Trauma suits worn by actors



https://www.strategic-operations.com

https://www.strategic-operations.com

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Conclusions

- Models are considered useful educational tools prior to live animal surgery*
- Training on models reduces anxiety before live animal surgery**
- Training a skill on a simulator/model increases student self-efficacy (ability to master skills)***
- For training basic skills, the low-fidelity models fulfill their purpose*
- Improved learning outcome
- A more ethical use of research animals

*Langebaek et al, VetRec (2012)
** Langebaek et al, JVME (2012)
*** Langebaek et al, JVME (2015)

English-language newsletters