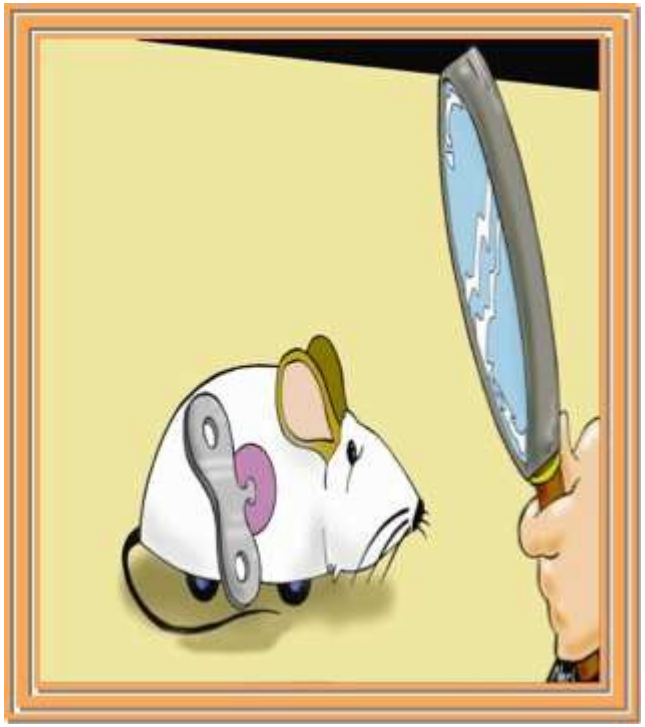

Considerazioni etiche nella scelta dei modelli animali

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DIRECTIVE 2010/63/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL OF 22 SEPTEMBER 2010 ON THE PROTECTION OF ANIMALS USED FOR SCIENTIFIC PURPOSES

- (10) While it is desirable to replace the use of live animals in procedures by other methods not entailing the use of live animals, the use of live animals continues to be necessary to protect human and animal health and the environment.

- (12) Animals have an intrinsic value which must be respected.

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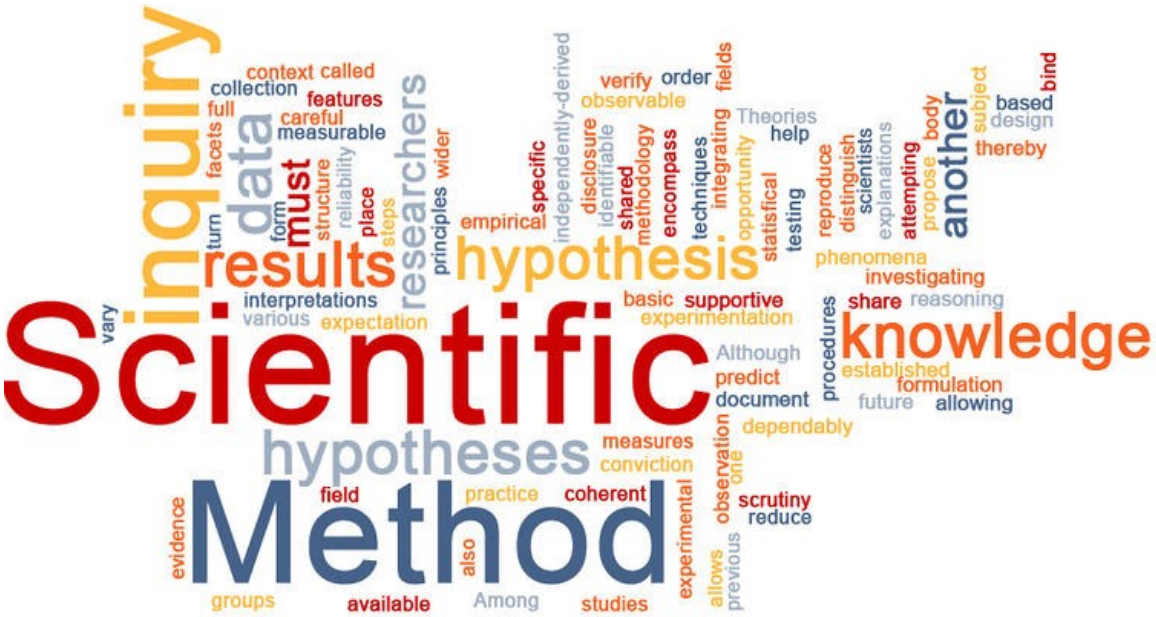
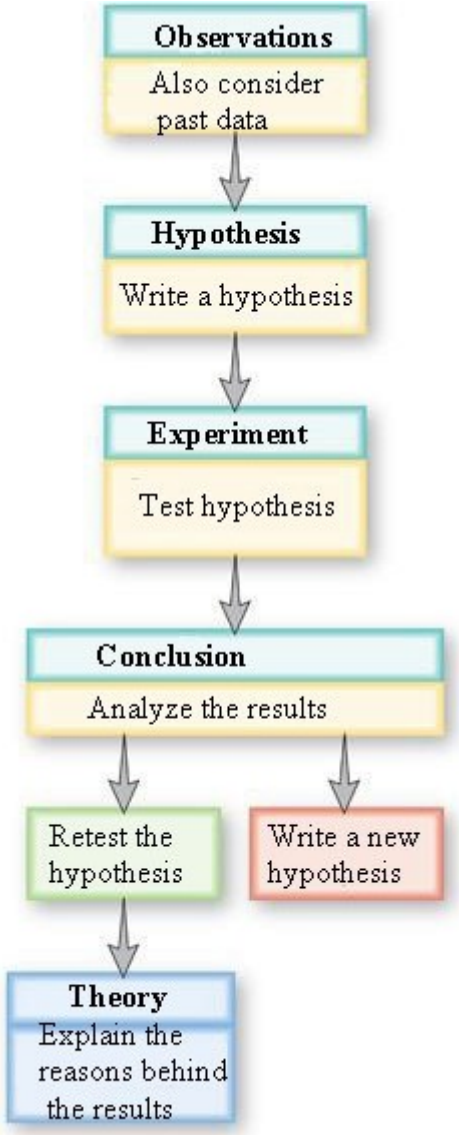
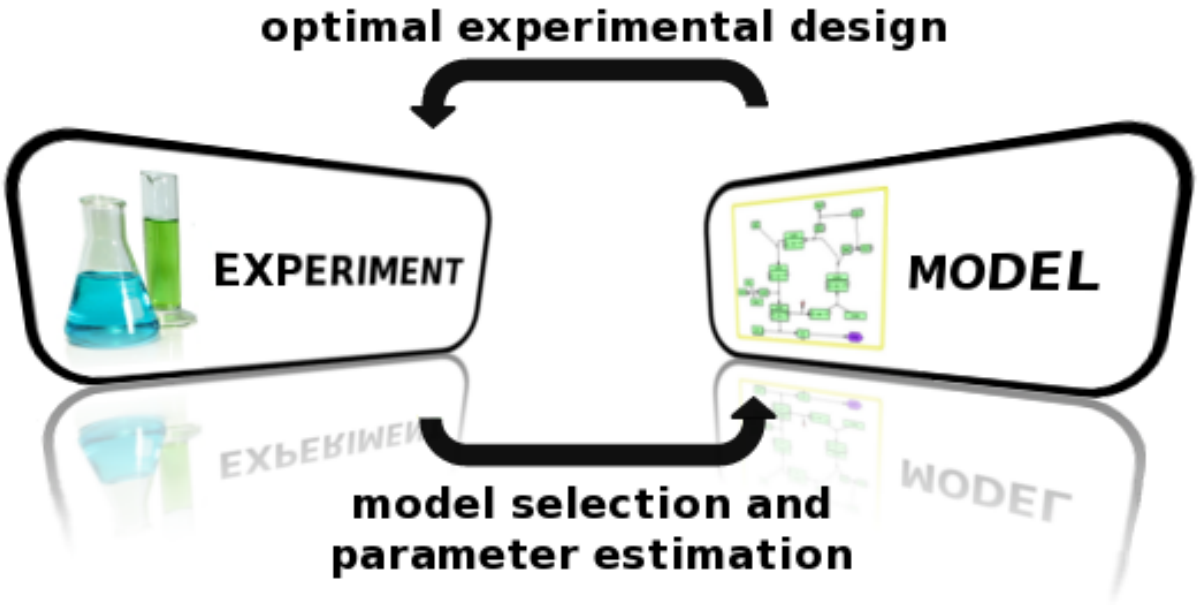
- (13) The choice of methods and the species to be used have a direct impact on both the numbers of animals used and their welfare. The choice of methods should therefore ensure the selection of the method that is able to provide the most satisfactory results and is likely to cause the minimum pain, suffering or distress. The methods selected should use the minimum number of animals that would provide reliable results and require the use of species with the lowest capacity to experience pain, suffering, distress or lasting harm that are optimal for extrapolation into target species.

Metodo scientifico






optimal experimental design
EXPERIMENT
MODEL
model selection and
parameter estimation

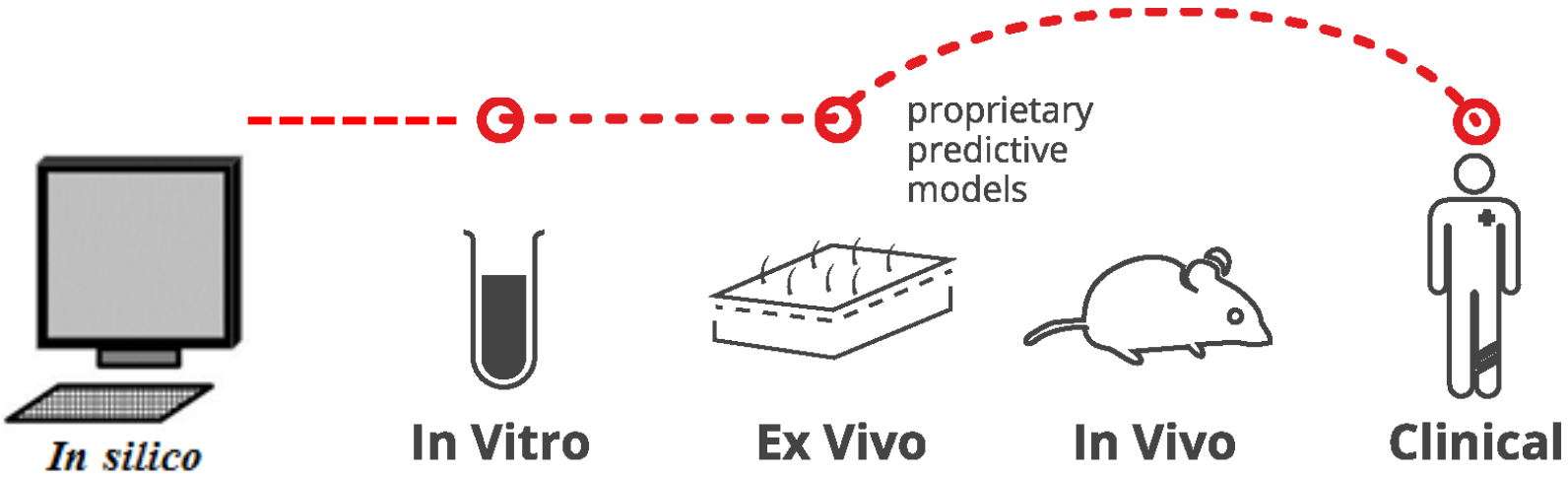
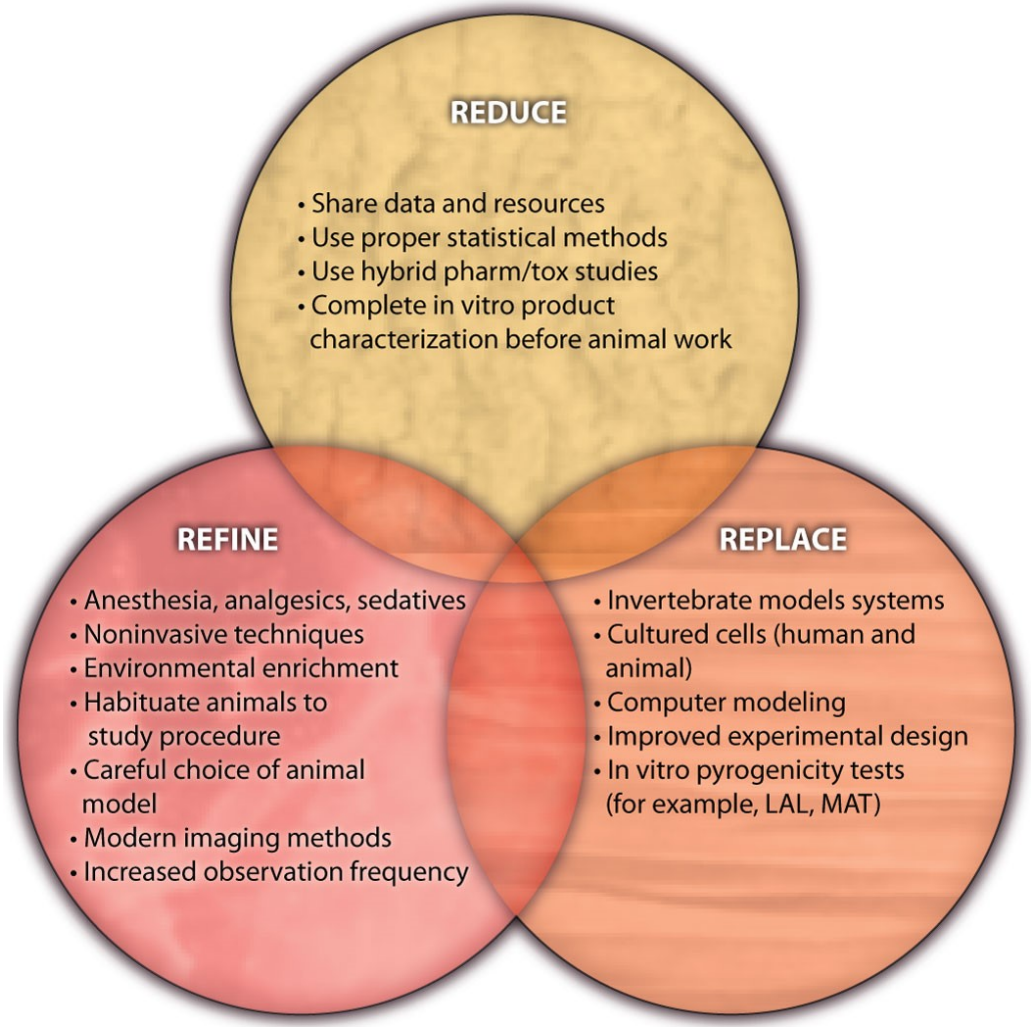

proprietary
predictive
models
In silico
In Vitro
Ex Vivo
In Vivo
Clinical

Fig. 1. Regenerative regulation.



Rebecca Robinson Sci Transl Med 2011;3:112fs11

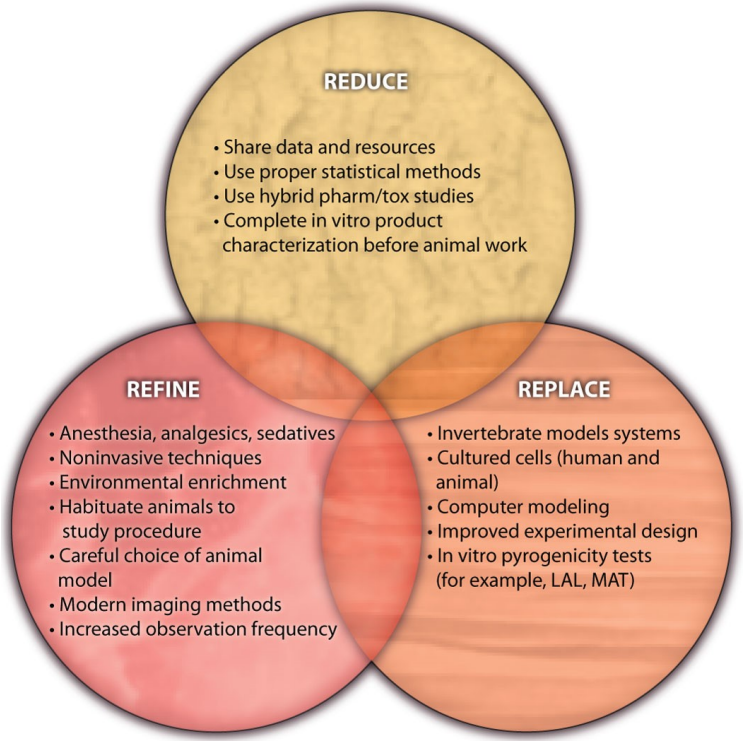
Science Translational Medicine
AAAS

DIRECTIVE 2010/63/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL OF 22 SEPTEMBER 2010 ON THE PROTECTION OF ANIMALS USED FOR SCIENTIFIC PURPOSES

- (11) When choosing methods, the principles of replacement, reduction and refinement should be implemented through a strict hierarchy of the requirement to use alternative methods. Where no alternative method is recognised by the legislation of the Union, the numbers of animals used may be reduced by resorting to other methods and by implementing testing strategies, such as the use of in vitro and other methods that would reduce and refine the use of animals.

It is in scientists' interest to adopt an ethical and humane approach to husbandry and experimental design, as healthy animals produce robust, reliable results, underlying valid scientific outputs

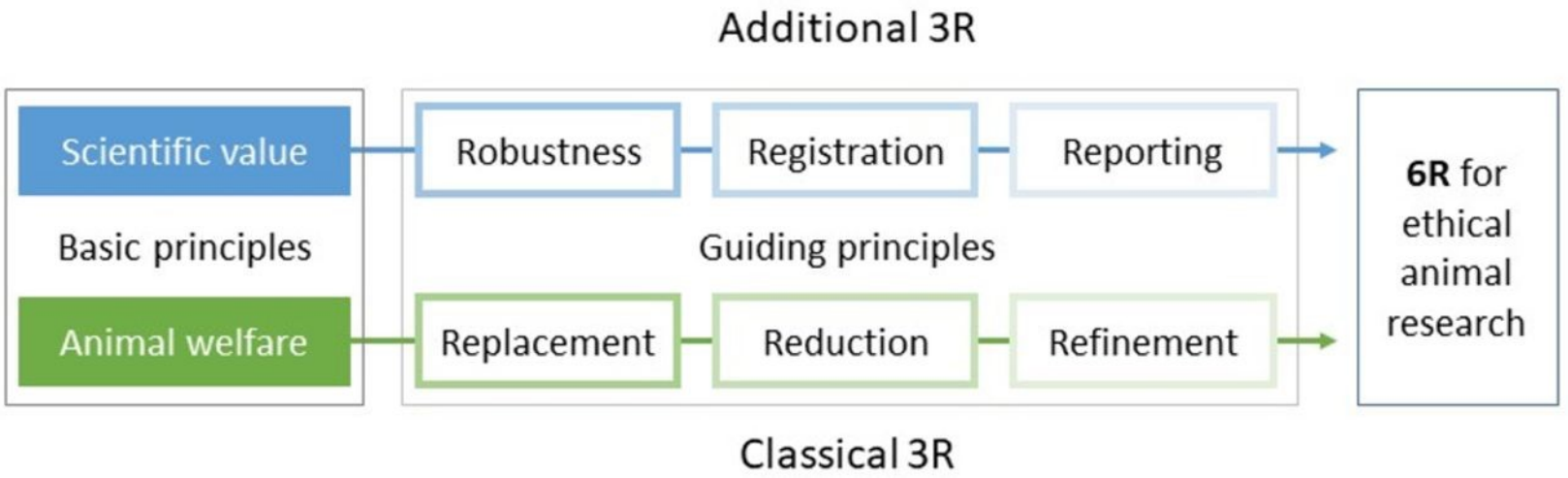
For example, improved husbandry and handling of rodents reduces stress and this leads to less-variable data and more meaningful results



Research on animals is only ethical if it generates value for science and society

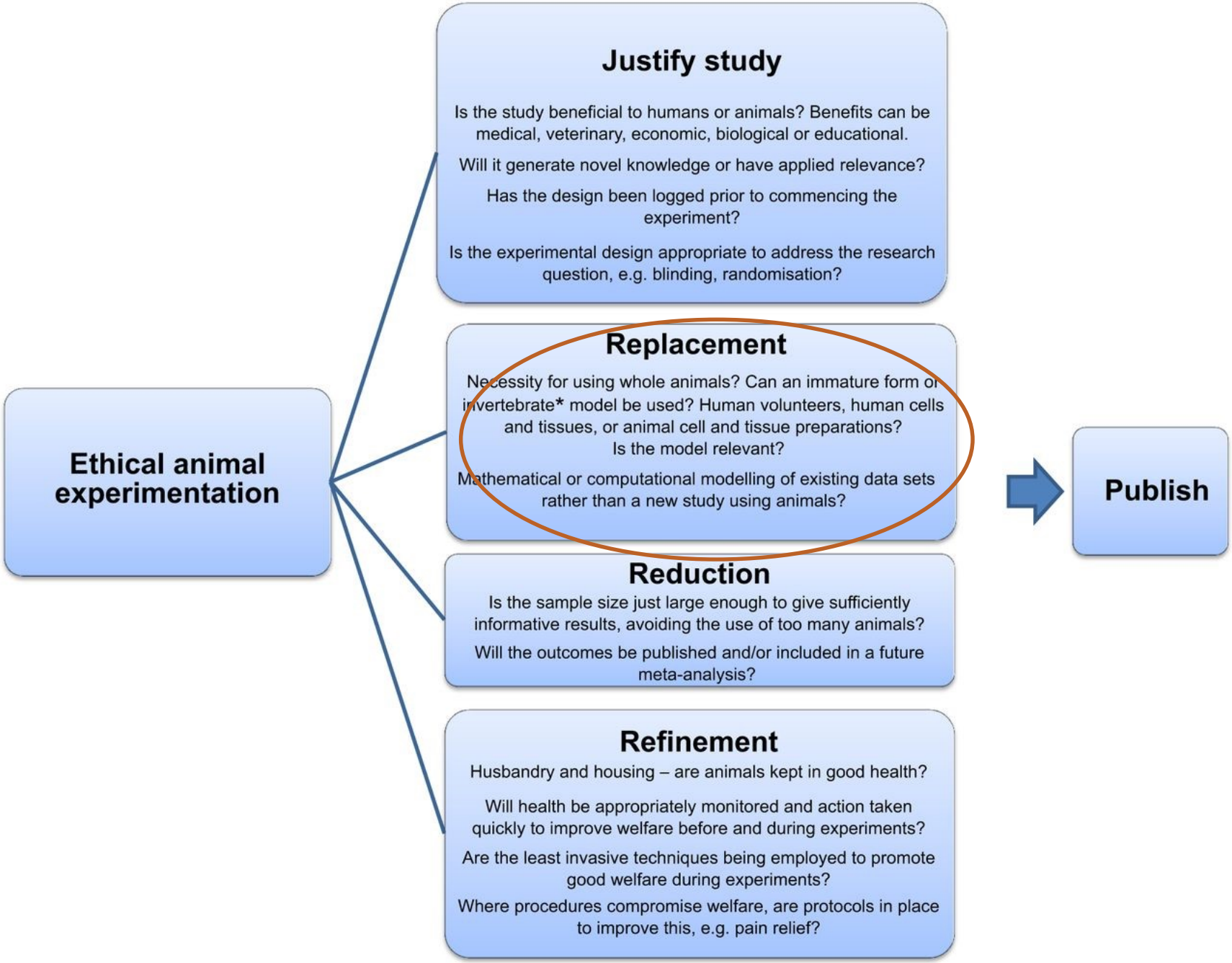
10.1136/bmjos-2018-000048

Two basic principles for animal research ethics translate into six practice-guiding principles (6R).



Daniel Strech, and Ulrich Dirnagl BMJ Open Science 2019;3:bmjos-2018-000048

BMJ Open Science


Ethical animal experimentation
Justify study
Is the study beneficial to humans or animals? Benefits can be medical, veterinary, economic, biological or educational.
Will it generate novel knowledge or have applied relevance?
Has the design been logged prior to commencing the experiment?
Is the experimental design appropriate to address the research question, e.g. blinding, randomisation?
Replacement
Necessity for using whole animals? Can an immature form of invertebrate* model be used? Human volunteers, human cells and tissues, or animal cell and tissue preparations?
Is the model relevant?
Mathematical or computational modelling of existing data sets rather than a new study using animals?
Reduction
Is the sample size just large enough to give sufficiently informative results, avoiding the use of too many animals?
Will the outcomes be published and/or included in a future meta-analysis?
Refinement
Husbandry and housing – are animals kept in good health?
Will health be appropriately monitored and action taken quickly to improve welfare before and during experiments?
Are the least invasive techniques being employed to promote good welfare during experiments?
Where procedures compromise welfare, are protocols in place to improve this, e.g. pain relief?
Publish

Replacing protected animals with

- less sentient forms or spieces
- cells
- tissues
- computer modelling approaches

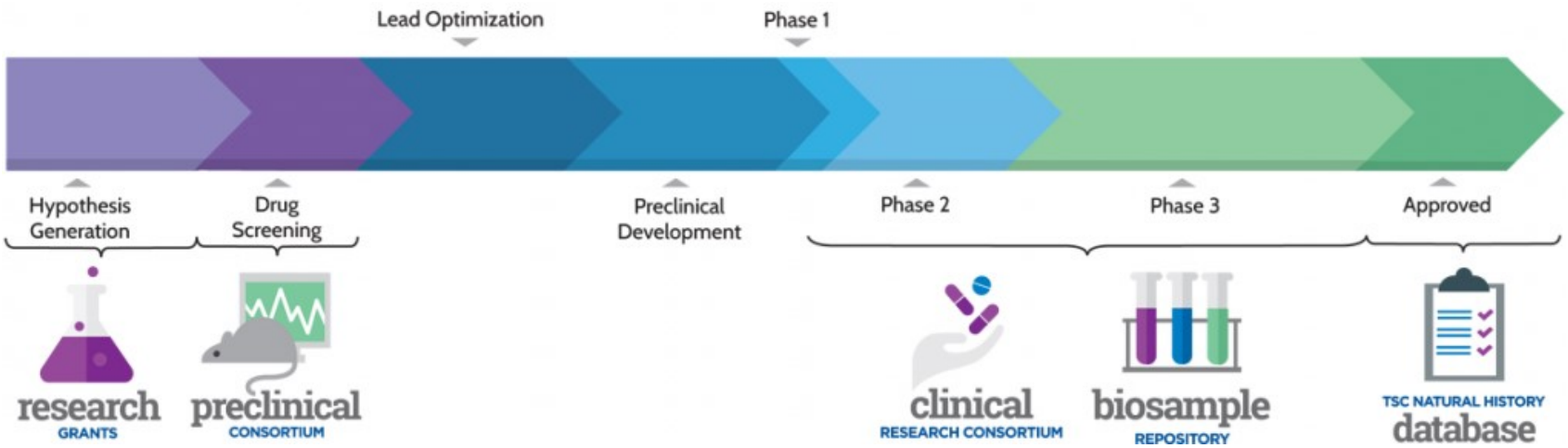
Robustness, scientific validity

Publical acceptability

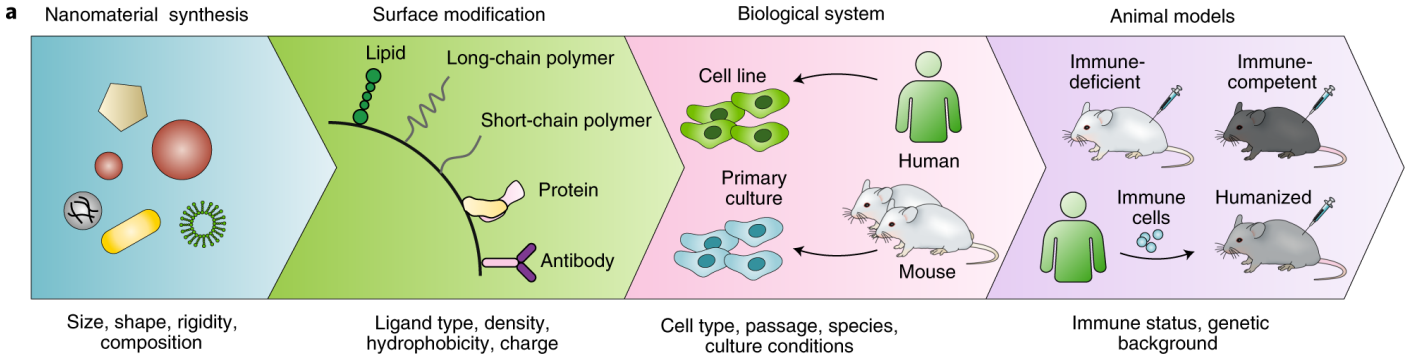
No stress, no distress

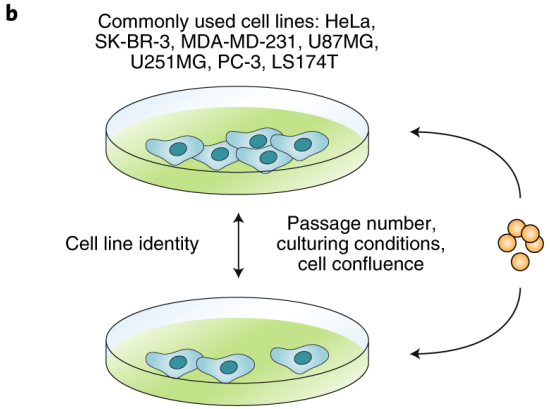
Knoledge, information, education

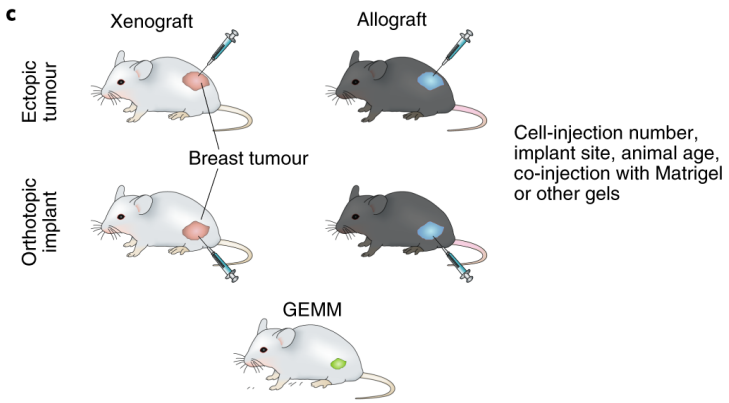
Pre-clinical Research



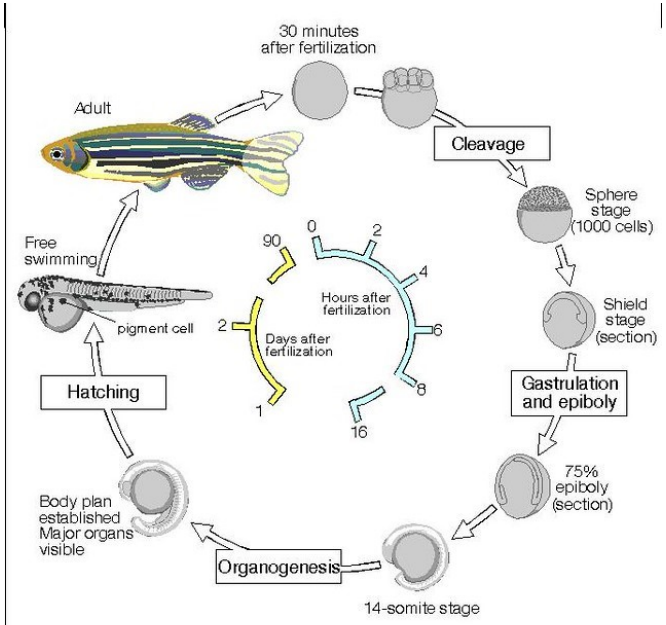
Pre-clinical research in nanomedicine

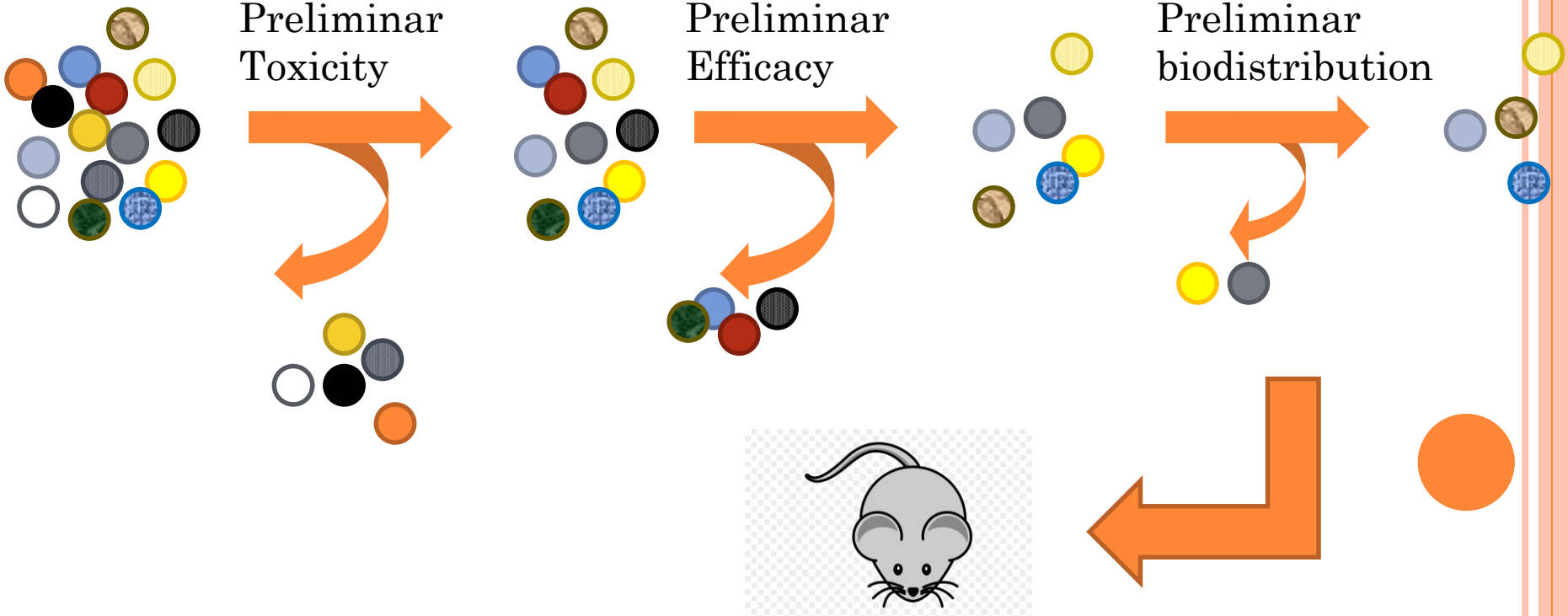




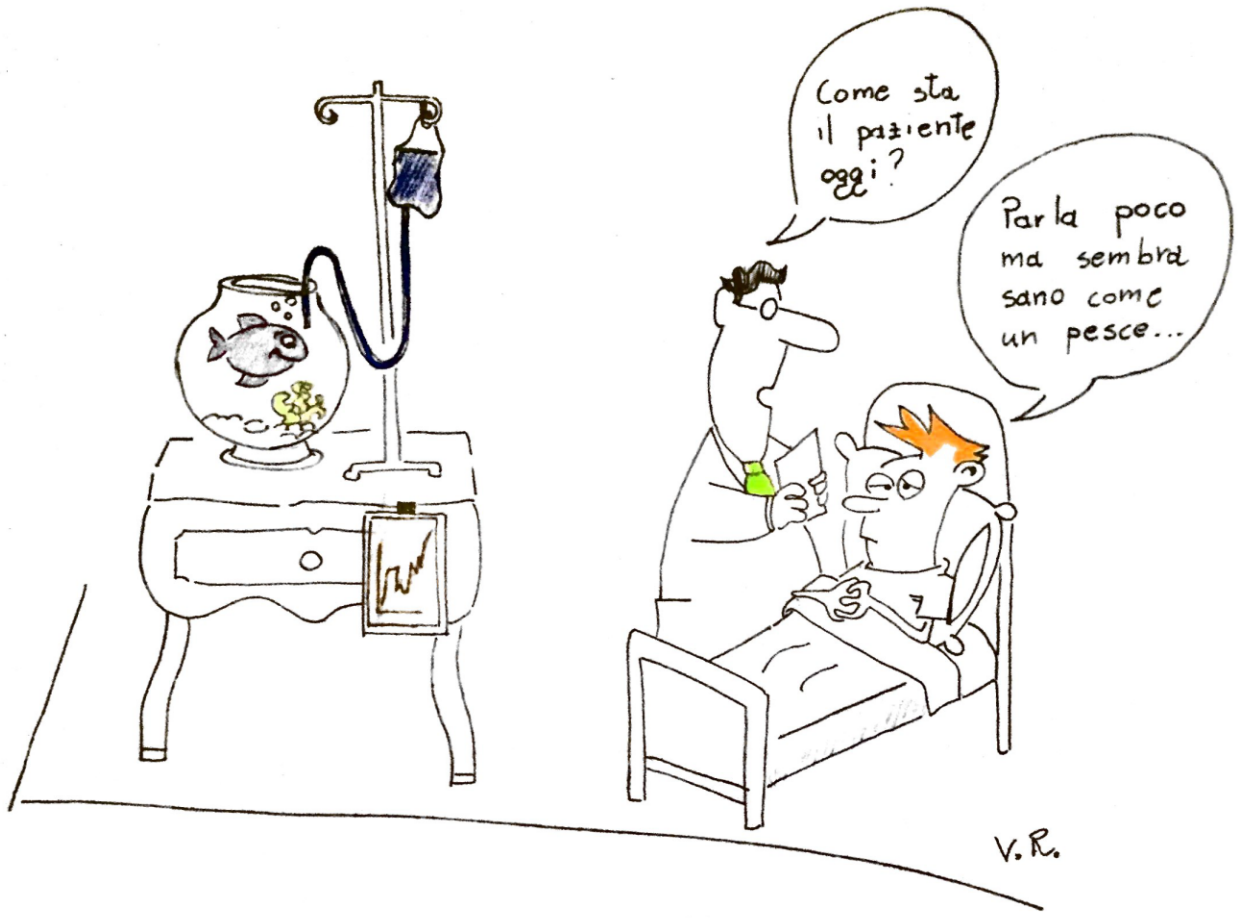


Zebrafish pre-screening

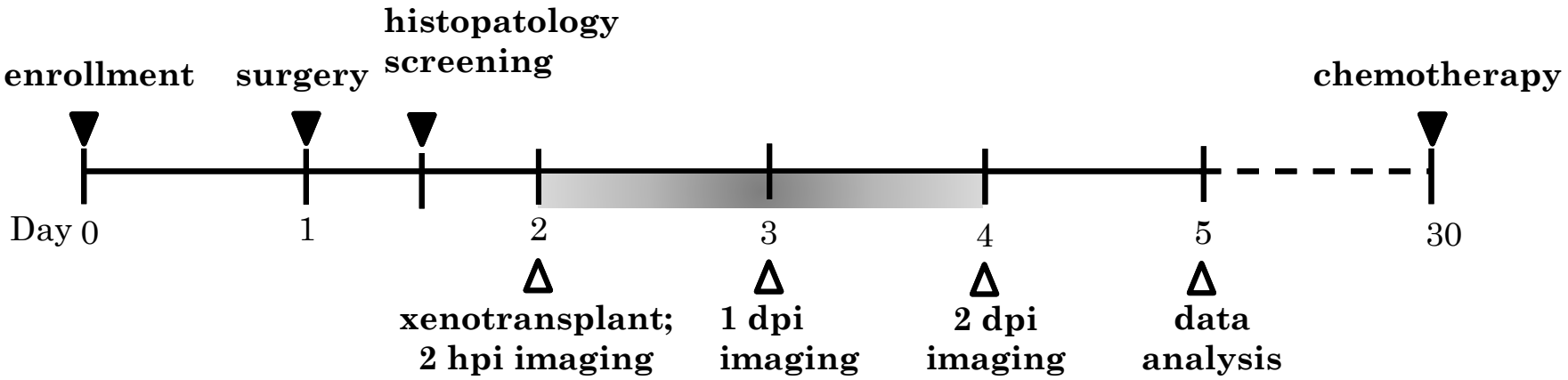




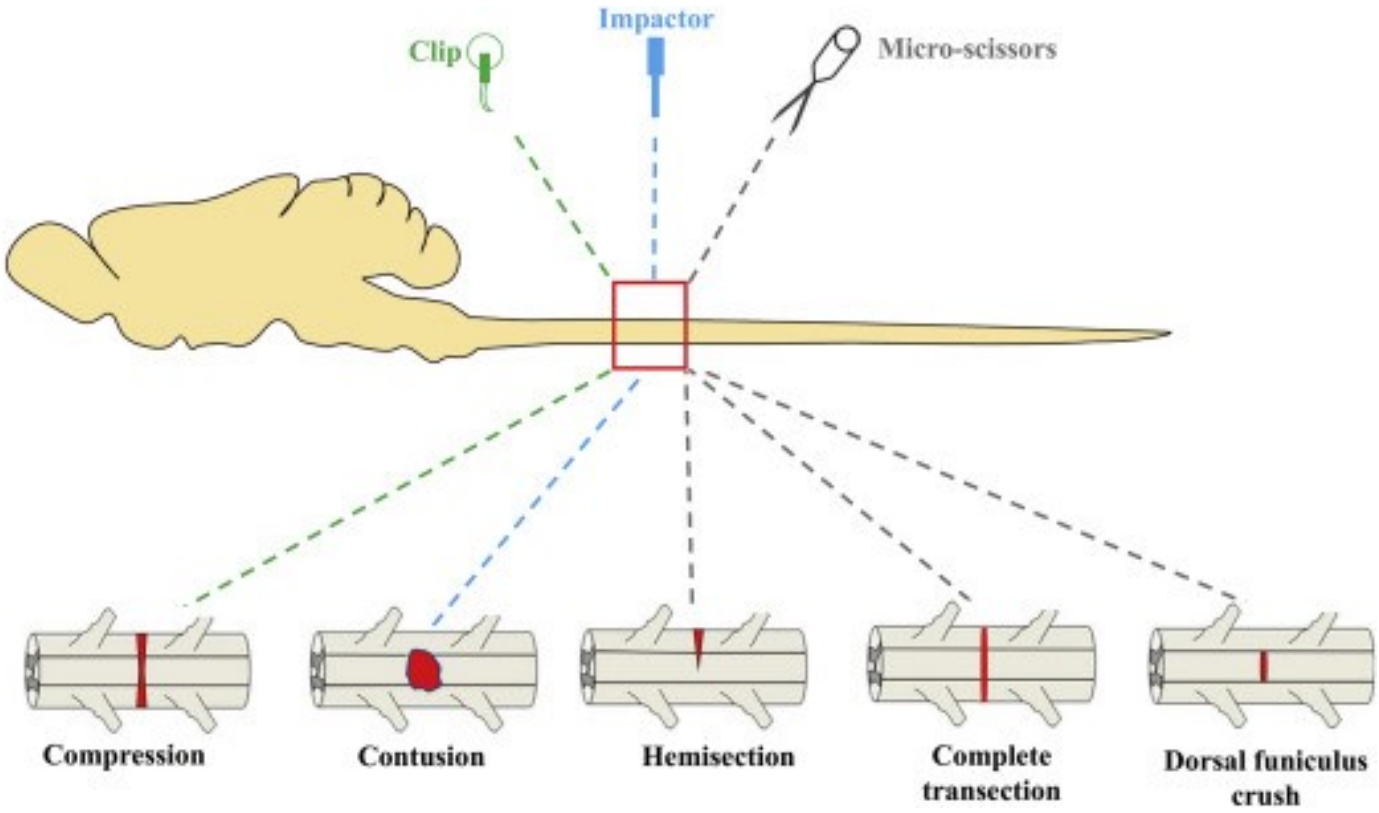
Xenotrapianto di cellule tumorali primarie in embrioni di zebrafish: nuovo approccio di medicina personalizzata



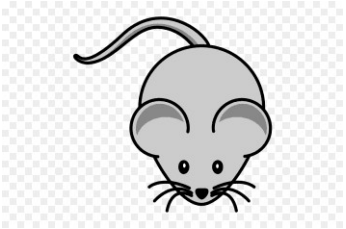
ZEBRAFISH & HUMAN CO-TRIAL

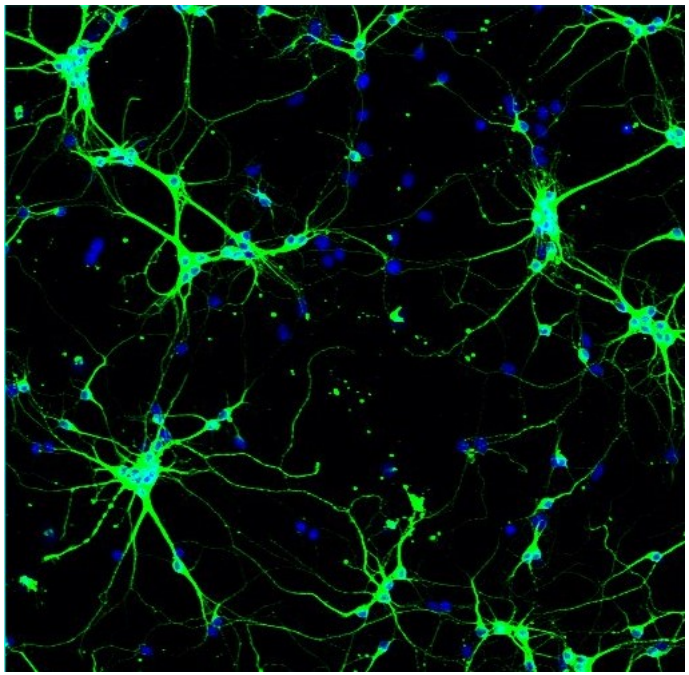


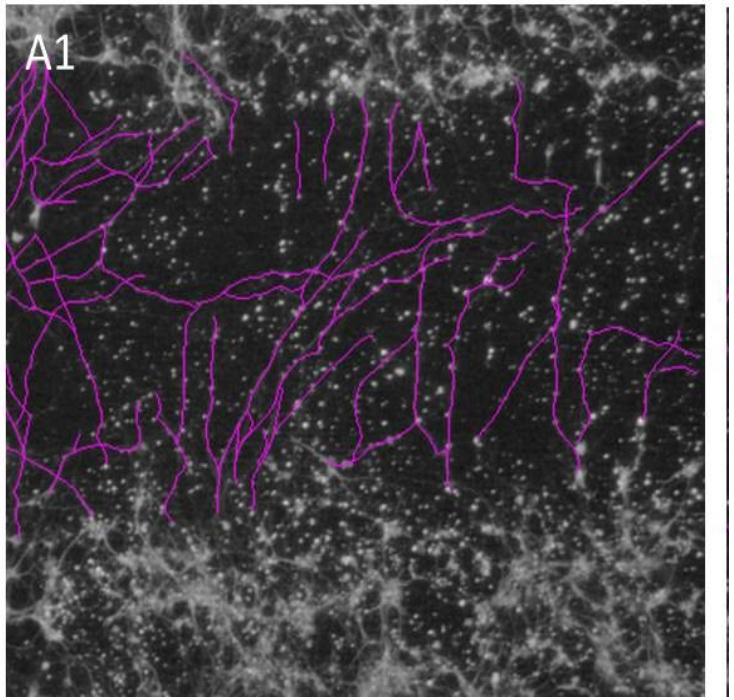
Mechanotransduction of neurons: a future strategy for the regeneration of spinal cord lesions?



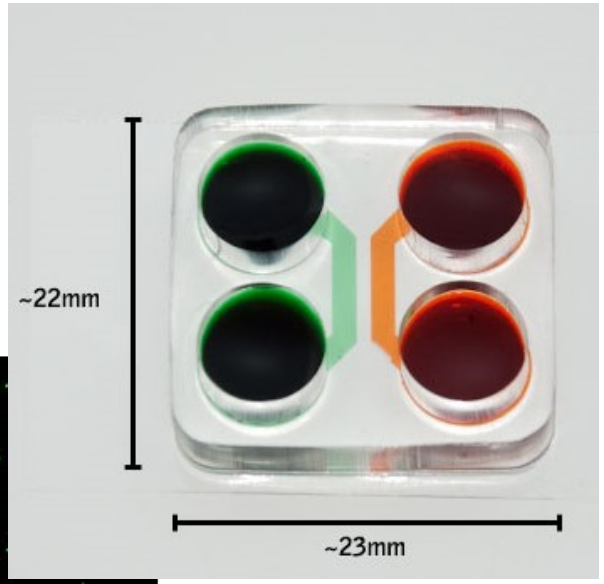
In vitro regeneration model

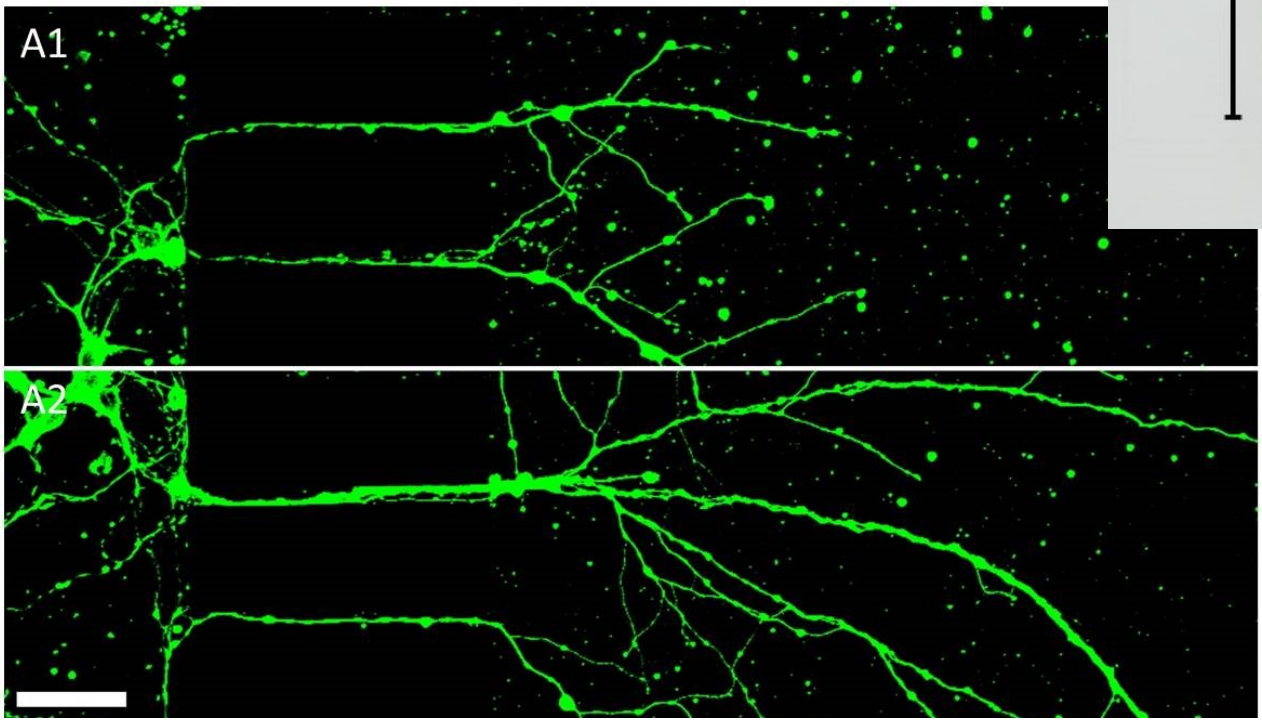




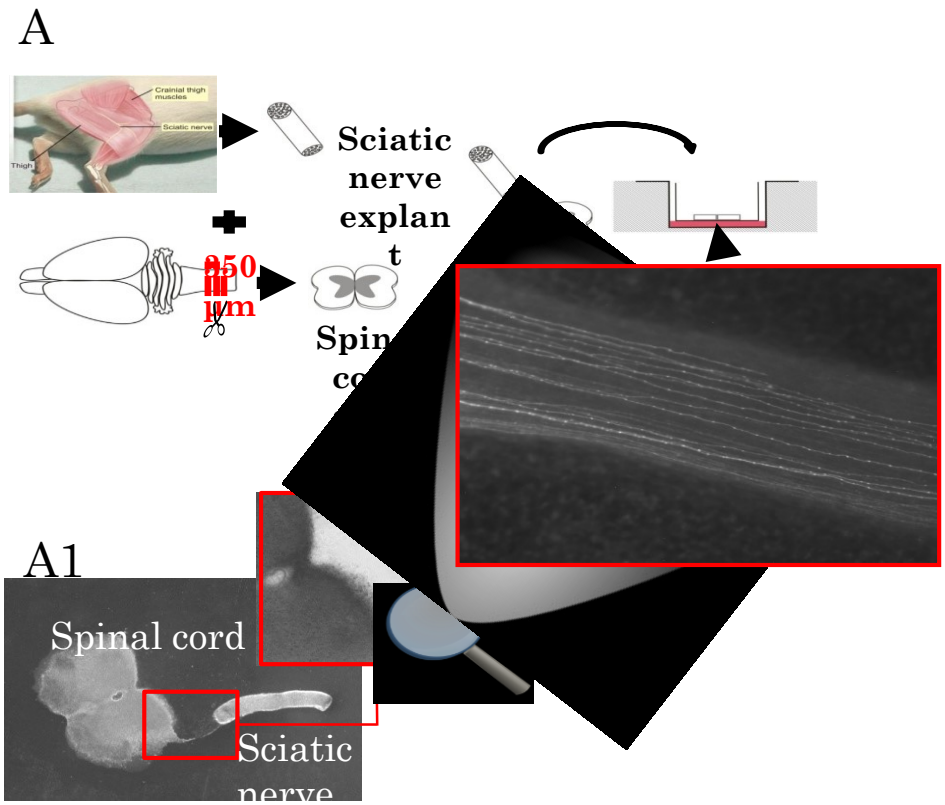


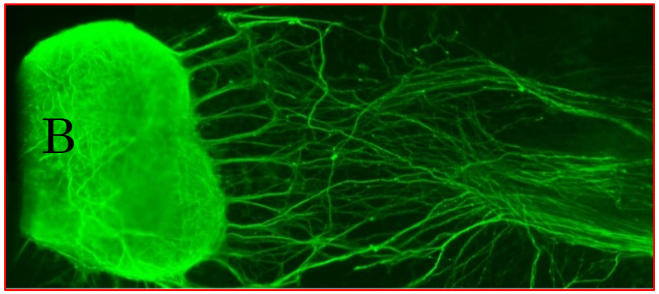
In vitro regeneration model





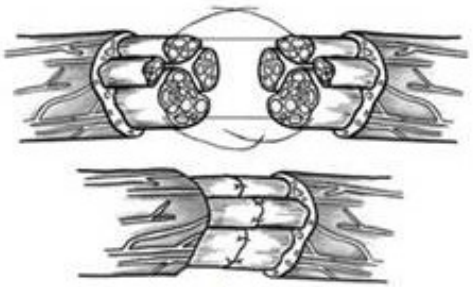
Ex-vivo regeneration model





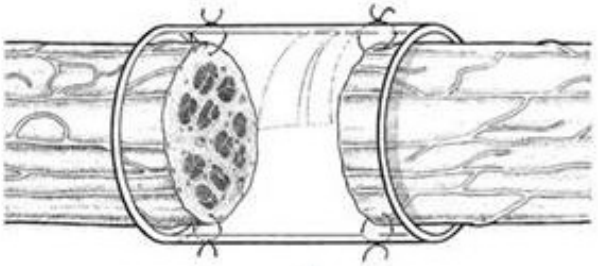
Peripheral nerve regeneration

Nerve lesion without gap

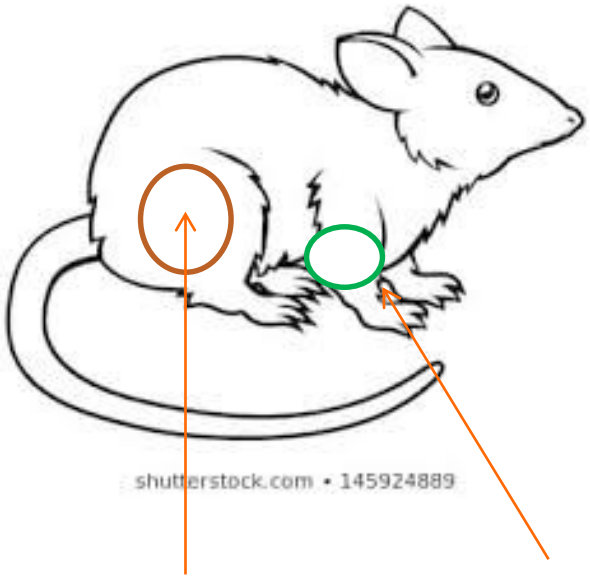


Suture

Nerve lesion with gap



Collagene conduit



Sciatic nerve

Median nerve

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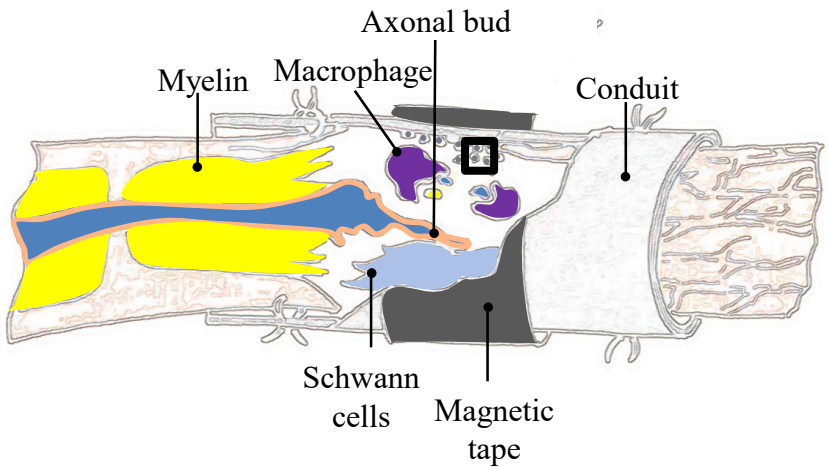
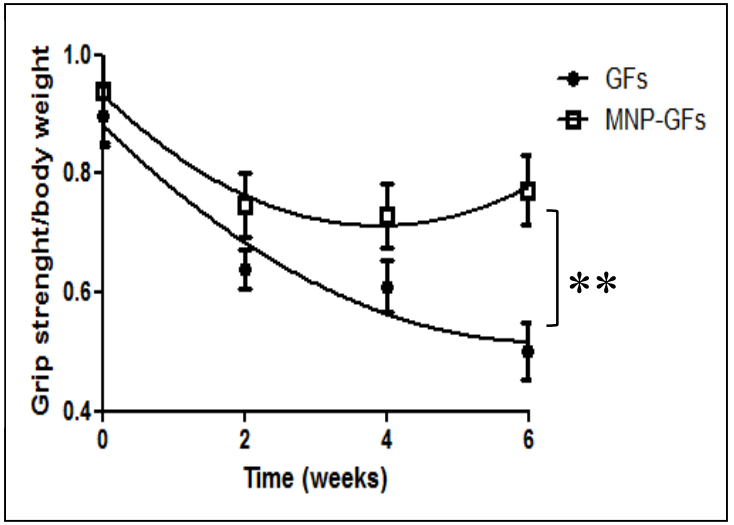
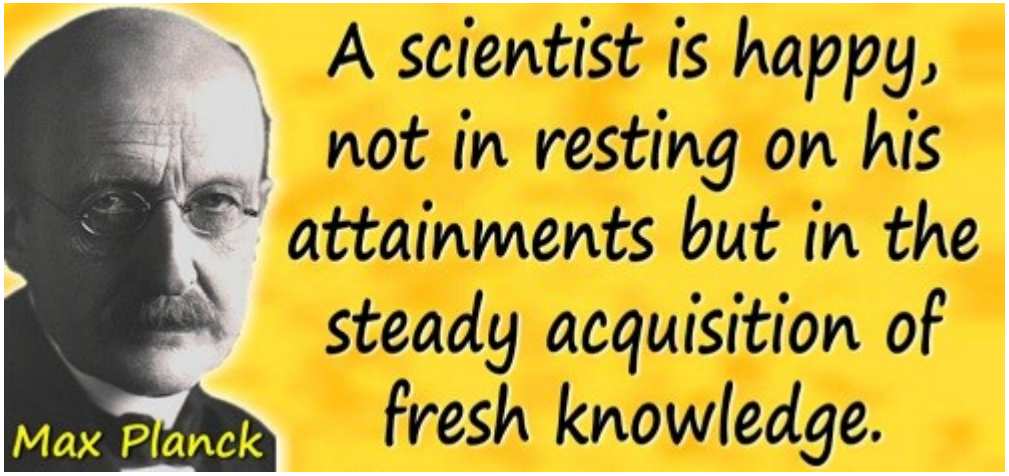
Magnetic Nanoparticles for Efficient Delivery of Growth Factors: Stimulation of Peripheral Nerve Regeneration

Martina Giannaccini, M. Pilar Calatayud, Andrea Poggetti, Silvia Corbianco, Michela Novelli, Melania Paoli, Pietro Battistini, Maura Castagna, Luciana Dente, Paolo Parchi, Michele Lisanti, Gabriella Cavallini , Concepción Junquera, Gerardo F. Goya, Vittoria Raffa






A scientist is happy, not in resting on his attainments but in the steady acquisition of fresh knowledge.
Max Planck