



Lush Prize for Young Researchers - 2015

Research Paper

1 Executive Summary

The Lush Prize is the largest yearly international award devoted to ending animal testing and promoting the field of animal-free toxicology, as well as the development of alternative methods to animal testing.

Now in its fourth year, the total annual fund is £250,000. This year will see the Lush Prize award a total of £1 million in scientific research and lobbying funding to date, since its groundbreaking launch in 2012. The prize awards individuals and organisations across six categories; Science, Public Awareness, Lobbying, Training, Young Researchers and finally, the 'Black Box' prize, where in any one year the total £250,000 may be awarded for a key breakthrough in human toxicity pathways research using 21st-century techniques¹.

The purpose of this research paper is to focus on one of these categories - the Young Researcher (YR) Award², which is open to young scientists (up to 35 years old at the time of application) with a desire to fund the next stage of a career focussed on an animal-test free future.

As the aim of Lush Prize research papers is to build on information found in previous years, it is recommended that the Young Researcher papers from 2012-2014 are also reviewed.

The YR award offers a yearly total of £50,000 to several researchers (usually four or five candidates) for outstanding contributions to the field of research and development of non-animal methods in safety (toxicity) testing. The first three years of the YR award have seen a total of £150,000 of international research funding allocated to thirteen early career scientists from Austria, Germany, Italy, Portugal, UK, Denmark, the Netherlands, Sweden, the USA and Brazil.

This research paper includes the following:

- Some brief background on the 3Rs and alternatives to animal testing
- Review and updates on the Lush Prize Young Researcher Award
- The Young Researcher (YR) Outreach project and activity to date
- Prize winning Young Researcher projects so far
- How does winning the Lush Prize help young researchers?
- Facts and figures
- YR outreach for 2014 - the Lush Prize conference and future activity
- As in previous research papers, a comprehensive reference section (updated for 2015) is provided for further information

2 Some brief background: the 3Rs and alternatives to animal testing

1 Langley, G. (2015) The LUSH Black Box Prize and the skin sensitisation adverse outcome pathway
2 <http://www.lushprize.org/awards/young-researcher-prize/>

The term 'alternatives' is broadly used to describe the 3Rs methods, historically defined by Russell and Burch³ and widely used as follows;

- **Refinement:** minimise suffering and distress to animals
- **Reduction:** minimise the number of animals used
- **Replacement:** avoid and/or replace the use of living animals

The Lush Prize continues its focus on only the final 'R' (replacement) being a genuine alternative to animal testing. No other prize is devoted solely to the '1R' of replacements to toxicity tests using animals. Furthermore, all research projects must be entirely animal free (rather than only 'live' animal free) to be considered for the prize. Lush Prize receives nominations for projects which use animal tissues/cells/sera and these are considered ineligible.

The remaining '2Rs' (reduction and refinement) still involve animals and in many situations are 'as good as it gets'. For example, a '2Rs' at best approach is applied to the use of non-human primates in laboratories and relatively little funding has been devoted to their genuine replacement to date. To illustrate, almost 4,500 monkeys were imported from Mauritius during 2014 for use in research by several European countries considered the worst offenders for the numbers of animals they use in experiments (France, Germany, Spain and the UK). The number of monkeys imported represents a staggering 33% increase on the previous year⁴. Almost 3,500 monkeys are used in toxicity tests and a further 2,500 in other types of research each year in the EU alone.

Interpretation of the 3Rs varies widely in the scientific industry (even 'replacing' monkeys with other species claimed to be less sentient is also considered as being in the spirit of the 3Rs by some)⁵. There is also increasing concern at how some species are now considered as 'alternatives', for example zebrafish and even genetically modified mice, the use of which grows at an alarming rate each year⁶.

The use of terms such as 'alternatives' or 'replacement' methods remain necessary, but are not intended by Lush Prize to suggest that animal testing is the 'gold standard', especially when the scientific industry itself confirms that, aside from the suffering involved, animal tests do not reliably predict human responses. The most appropriate term may therefore be 'non-animal methods'.

It is also very important to note that, from a regulatory perspective, not all animal tests 'need' replacing and can simply end or be prevented. For example, after an extensive campaign to modify drug testing guidelines issued by the EMA (European Medicines Agency), a single dose toxicity test on animals was deleted, after it was agreed that such data could be obtained from other tests.⁷ Similarly, the ECEAE (European Coalition to End Animal Experiments) estimates that its efforts on the EU chemicals testing programme REACH (Registration Evaluation and Authorisation of

3 Russell, W. and Burch. R (1959) The Principles of Humane Experimental Technique

4 Europe shown to be main importer of monkeys from Mauritius. BUAV 09/04/2015

5 Silverman, J. (2008) Sentience and sensation *.Lab Animal.* 37(10) 465-467

6 Home Office Statistics on Lab Animal Used Released FRAME (07/2014)

7 EMA (2010) Questions and answers on the withdrawal of the 'Note for guidance on single dose toxicity'

Chemicals) have saved 18,000 animals to date, by investing in toxicological expertise to systematically comment on animal testing proposals to provide alternative evidence and prevent the tests going ahead⁸.

3 The Young Researcher (YR) Outreach Project

The objectives of the Lush Prize YR outreach project are:

- 1 Communicating individually with potential applicants
- 2 Interviewing previous winners
- 3 Identifying effective new communication channels for the Young Researcher Award

To achieve the above objectives, ongoing project activities include:

- Making new contacts in academia and industry at institutions across Europe, the USA, South America and Asia (for example research supervisors, students and teams in toxicology and pharmacology schools of universities) to raise awareness of the YR award
- Another aim of the YR outreach project is to maintain and monitor year-round awareness of the Young Researcher Awards, by effective communication with stakeholders, academia, industry experts, previous prize winners and social media (for example LinkedIn and Facebook)
- Engaging in dialogue and establishing relationships with such stakeholders is aimed at maximising the number of Young Researcher nominations received during each yearly prize cycle

3.1 Methodology of the YR Outreach project

To enable outreach to new contacts, research teams and potential young researcher nominees, extensive searches continue to be made for toxicology and pharmacology schools and faculties at academic institutions across Europe, the USA, South America and Asia. Where possible, specific individuals have been contacted by email, but where no contact name is publicly available email addresses and website enquiry forms of schools and colleges have been used.

Using a systematic 'drill down' approach, the YR outreach project has moved from one level of detail to the next to continue to identify relevant '*cold*' contacts:

- List of universities by country
- Search of list of faculties by university
- Search of medical schools, pharmacology and toxicology departments
- Search of research teams, heads of department, supervisors and individual early career scientists

⁸ ECEAE claims 18,000 animals saved through REACH testing proposals process

- Extensive internet searches have also been made, as well as set up of web alerts on relevant key phrases, for example on 'young scientists'; 'young researchers'; 'early career research'; 'replacement of animal models' and 'alternatives to animal testing', as well as review and research of potential contacts at all relevant conferences and forums

This is an ongoing, long-term outreach project. Therefore, to provide some initial focus, institutions or faculties have been searched for which already appear to have initiatives in the replacement of animals in research or (for example) teaching modules on alternatives to the use of animals, as well as known experts and contacts within the field (who might be termed '*warm*' contacts).

Some very helpful resources can also be used. For example Humane Research Australia, a 2014 Lush Prize winner, has contacted all national universities and compiled a database of their policies on animal research, to aid potential students and other scientific researchers⁹, based on the following three questions:

- Does your institution have a Conscientious Objection Policy?
- Does it offer any incentive (such as financial awards or funding grants) for students to replace animals in research?
- Are there any other ways in which you demonstrate commitment to the replacement and reduction of animal use?

Any projects which have already received any grants or other research prize funding are also given due consideration, but the YR outreach project is mindful of sourcing and prioritising new initiatives which are in need of funding.

However, outreach also continues more widely to promote the YRA to as many students, research supervisors and teams as possible.

4 Prize winning Young Researcher Award (YRA) projects so far

Winners of the YR Award to date span a broad range of research interests which include the following:

- 1 Pioneering *in-vitro* immunotoxicology tests in the detection of protein and chemical sensitizers in the skin to replace the use of animals in the cosmetic, food and pharmaceutical industries. This award winning project has since continued development within industry¹⁰
- 2 International awareness and training initiatives to replace animal use in educational research, as well as encouraging conscientious objection to the use of animals and replacement with humane alternative teaching and research techniques with the establishment of a new '1R' institute in Brazil¹¹ in March this year

9 Want to know what your University's position is on animal experimentation? Humane Research Australia

10 SenzaGen AB (2015) -GARD (Genomic Allergen Rapid Detection) Assay

11 <http://www.instituto1r.org/>

- 3 3D cell culture techniques to replace animals used in neurotoxicity and cytotoxicity testing
- 4 Biomonitoring - the measurement and analysis of biomarkers directly in human volunteers instead of animals, across 17 countries, to test for levels of cosmetic substances and environmental chemicals found in samples of hair, blood and urine, such as parabens and trace metals
- 5 Research on alternative test systems using human neuronal cells, for the assessment of the developmental neurotoxicology (DNT) profile of thousands of chemicals, to replace high numbers of animals, combined with 'omics' technologies to identify new adverse outcome pathways (AOPs)
- 6 EU-wide research initiatives to promote human placental tissue within industry as a vital resource in the replacement of animals in toxicity testing, which has been vastly underused to date
- 7 Pioneering research on human retinal cells *in-vitro* to investigate treatments for blindness

As is the case across all Lush Prize categories, selecting the winning Young Researcher projects remains a tough decision, with a high calibre of nominations. In addition to the winning nominations, many excellent projects were shortlisted in 2014, including

- Investigation into the addictive properties of alcohol and nicotine using human clinical and epidemiological studies and large scale survey data analysis, instead of animals
- Validation of exciting, new *in-vitro* replacement methods to advance the study of hepatic (liver) toxicity and metabolism, without the use of animals

5 How does winning the Lush Prize help Young Researchers?

As part of the young researcher outreach project and to inform this paper for the 2015 prize cycle, previous YR winners were asked to provide feedback on how winning the prize has helped or continues to help in their research.

A key point made was that the prize provides opportunities to communicate research in non-animal methods to wider audiences (both scientific and non-scientific) and make them aware of both the facts about animal testing and initiatives to replace it.

The misuse and unnecessary use of animals in toxicity testing is still highlighted as an ongoing problem. It was also felt by winners generally that the message needs to be continually communicated that development of 21st Century, non-animal technologies in toxicity testing will not only continue to ensure human safety, but will

be superior to the use of animals in doing so. Concerns were raised that public opinion is well informed on the ethical issues of animal testing, but needs to be provided with more information from a scientific perspective, on how the results of animal tests are irrelevant to the answers sought in predicting human toxicity. This is particularly relevant in countries where alternatives are less discussed and are still considered inadequate by some, when compared to animal testing.

Several winners outlined how barriers still exist in getting tests validated for use, as well as the ongoing issue of how long it can take to achieve validation and getting regulators to understand and approve the applicability of specific methods, even where data clearly demonstrates their validity.

It is also important to reflect feedback in how new, non-animal, methods must be robust and stand up to their claims in exactly what prediction capabilities they offer and not promise 'too much too soon', as this may have a damaging effect on the reputation of research in this field. Another key issue is still a much needed shift in emphasis from the '3R's to the '1R' of replacement. This remains the key objective of the Lush Prize and the reason for its creation.

Winners also identified how the Lush Prize has justified the importance of their research to replace animals in toxicity testing to peers and how the positive effects and influence remain long after the prize has been won. Even display of the award itself has stimulated questions and discussion on the issue.

Attitudes towards replacement of animals in research are changing at an encouraging rate. However, animal testing still remains the mainstream preference, as noted by most winners, based on convention or tradition with, in some cases, an entrenched view of animal testing as the 'gold standard' (for example, even requesting that successful, human-based models be tested in animals). In many other cases, however, animal testing is still used, not because it is necessarily felt to be the best, rather that it has 'always been done like this', paired with a reluctance to innovate and act as a driving force in demonstrating how modern non-animal methods and the data they provide are superior. Instead, a reactive rather than proactive attitude exists, with a willingness to use such methods only once they have (finally) been approved by regulators. This large scale resistance to replacing outmoded and unreliable animal tests could not be further in contrast to the mission of 'research and innovation' within science.

This year, a paper by Lush Prize and published in ATLA (Alternatives to Laboratory Animals) entitled 'The Cost of Standing Strong for Replacement' collated interview feedback and opinion from early YR winners and asked "to what extent does maintaining a stand against the use of animals in experiments harm the career of a young researcher today?"¹².

However, while attitudes to animal testing in mainstream toxicology remain an issue, there was also the positive view from 2014 winners that with each new generation of researchers, attitudes and awareness of non-animal methods can only improve. On this note, the idea of Lush Prize workshops and mentor programmes being

12 Brown, K. (2015) The Cost of Standing Strong for Replacement . *ATLA* 43; 5-7.

organised to allow early career scientists to network with senior level experts in replacement methods was also suggested.

Further feedback highlighted the environmental burden of animal testing and how this reinforced the argument for replacement with more viable, high throughput 21st Century techniques.

Another very helpful and critical point raised by several YR winners is the importance of seeing the potential of resources and techniques which are already available, but remain underused. These are not new 'alternatives' as such but still mean that the use of animals is prevented. Examples include opportunities to conduct large scale, volunteer-based clinical or epidemiological studies, or the use of readily available human samples, such as unwanted tissue that would otherwise be discarded after surgery, or consent to use placental tissue following childbirth. The use of human tissue has been highlighted as a clearly viable replacement to animal tests and in some cases is only limited by practical factors such as timing of staff and availability in operating theatres, to ensure the tissue is extracted, prepared and stored appropriately for use¹³.

It was also felt that receiving a Young Researcher Award, while not a sum that would fund any long term large scale projects, acts as an excellent starting point for research, boosting self-confidence and, most critically, encouraging further development. Winning the award has also broadened networking opportunities, with winners being contacted by new scientific peers.

Other winning projects have provided the foundation for continuing research within industry, following on from academic research, enabling further opportunities and outreach within the scientific community into replacement of animal tests with more accurate, human relevant techniques.

Most winners are also driven by their personal interest in replacing animals in research and remain in this field after receiving the prize, with subsequent publications on their work continuing to reach a wider audience¹⁴.

6 Facts and figures

Feedback from YR winners emphasising how conventional attitudes ensure the continued, large scale use of animals in toxicity testing is also reflected in statistics on animal experiments.

The most recently published EU-wide figures from the Commission (for 2011) are now somewhat out of date. Instead, national figures available for 2013 for several countries are shown below. Perhaps the most directly relevant to the YR Award are the numbers used in 'training and education'. However, the broader categories are

13 Sanger, G., Knowles, C. et al. (2013) Translational neuropharmacology: the use of human isolated gastrointestinal tissues *Br J Pharmacol.* 168(1):28-43

14 Mathiesen, L. et al (2014) Modelling of human transplacental transport as performed in Copenhagen, Denmark *Basic Clin Pharmacol Toxicol.* 115(1):93-100

also critical in showing the overall picture of the number of animals used not just in toxicity testing, but basic or 'fundamental' research.

Country	Total number of animals used (2013)	Total number of animals used in toxicity testing*	Total number of animals used in training /further education/higher education
Germany ¹⁵	2,997,152	154,011	64,603
Austria ¹⁶	208,559	63,918	3,795
Netherlands ¹⁷	526,593	49,335	21,926
Switzerland ¹⁸	590,245	20,830 **	6,660
UK ¹⁹	4,017,758	366,565	1,910
USA ^{20***}	891,161	??????	??????

* does not include animals killed for their cells/tissues

** described as 'protection of humans, animals and the environment'

*** US statistics do not include mice, rats, fish or birds, so this is not the true figure and is a vast underestimate of the genuine number of animals used, which is estimated to be 18-20 times more²¹

7 Lush Prize and Young Researcher Outreach in 2014

7.1 The 2014 Lush Prize conference

The second Lush Prize conference, held in November 2014, was a success and received widespread positive feedback. The overall theme of the day asked 'Is 1R the new 3Rs?' and a variety of sessions from international representatives focussed on the scientific, campaigning and welfare aspects of replacing and ending animal testing.

Keynote speakers²² were invited to present on a variety of topics, including the utility of animal tests to date and available replacement methods, as well as the promise

15 http://www.bmel.de/SharedDocs/Downloads/Tier/Tierschutz/2013-TierversuchszahlenGesamt.pdf?__blob=publicationFile

16 http://wissenschaft.bmfwf.gv.at/fileadmin/user_upload/Studien_und_Berichte/Tierversuchstatistik_2013.pdf

17 <http://www.rijksoverheid.nl/documenten-en-publicaties/jaarverslagen/2014/11/19/zo-doende-2013.html>

18 <http://tv-statistik.ch/de/statistik/index.php#a1>

19 Statistics of scientific procedures on living animals, Great Britain 2013[Home Office]

20 <https://speakingofresearch.files.wordpress.com/2008/03/usda-animal-research-use-2011-13.pdf>

21 USA: Experimental Animal Numbers

http://www.altex.ch/resources/altex_2015_1_071_076_News11.pdf

22 The 2014 Lush Prize Conference Agenda

and challenges of the biotechnology and bioinformatics revolution; new approaches and alternatives to animal tests in addressing the challenge of environmental exposures to chemicals and adverse health outcomes in reproduction, neurobehavioral, metabolic diseases and immunology as well as presentations on the way forward in implementing the 3Rs (with specific emphasis on *replacement*) into research, regulatory practice and academic education.

During the conference, a number of breakout sessions were held to allow attendees to hear from guest speakers and winners of the Young Researcher, Science, Training and Lobbying awards to provide background to their research and ongoing efforts in replacement. These included the YR projects summarised earlier, as well as pioneering non-animal initiatives in lung and inhalation toxicity methods and chemical risk assessment using QSAR (quantitative structure activity relationships) to replace animal use and finally, presentation sessions from award-winning animal rights campaigners and lobbyists from Africa, Taiwan, Australia and New Zealand.

The audience was also invited to put questions to our expert panel and interviews were held with keynote speakers and winners throughout the day. As in previous years, the conference was followed in the evening by a formal awards ceremony.

Following the success of the 2014 conference, the Lush Prize Team is organising this year's conference for the end of the year with a similar focus, to again engage with international experts, stimulate discussion on the scientific and ethical imperatives to replacing animal testing and bring the Lush Prize to an ever wider audience.

8 Lush Prize and Young Researcher outreach during 2014 and future activity

The Lush Prize team attended and exhibited at several conferences during 2014. In August, the 9th World Congress on Alternatives and Animal use in the life sciences was held in Prague²³. Lush Prize attended as an exhibitor and presented a Poster, networking with a number of experts, potential future nominees and previous prizewinners²⁴.

One of the WC9 sessions of particular relevance to the YR project included the Young Scientists Travel Award Short Presentations. The WC9 (sponsored in a joint venture by the Alternative Congress Trust Germany and the German Foundation SET) provided 41 travel grants to students and young scientists whose abstracts were chosen for either oral or poster presentation. Oral presentations included updates on advances in multi-organ chip methods to replace animals in the testing of substances, 3D cell systems for investigating lung inflammation and developmental neurotoxicity (DNT), *in-vitro* skin corrosion testing using reconstructed human epidermis (RHE) and *in-vitro* bone fracture healing models using human cells to replace painful tests in rats.

23 <http://www.wc9prague.org/>

24 <http://www.lushprize.org/wc9/>

In November, Lush Prize also sponsored and exhibited at the very successful second 'Animal Replacement Science' conference in London, organised by the Dr Hadwen Trust (DHT). Many attendees were interested to find out about the Prize and potential YR nominees also visited the stand to discuss how they could apply.

In May this year, Lush Prize also attended the International Conference of Alternatives to Animal Experimentation (ICAAE) hosted by The Portuguese Society for Humane Education SPEDH²⁵ in Lisbon.

In preparation for the launch of this year's prize nominations, contact has been made with academic institutions, toxicology departments and research teams to raise awareness of the Young Researcher Award. Outreach continues via mailouts and social media (for example to various experts in replacement of animal testing as well as numerous toxicology and other scientific forums on LinkedIn) to maintain momentum via alerts, regular blog postings and the countdown until nominations close on July 24th 2015.

In September this year, Lush Prize will be busy at two further conferences as part of the Young Researcher outreach project. The first is EUROTOX 2015 – the 51st Congress of the European Societies of Toxicology²⁶. EUROTOX incorporates a number of national societies of toxicology across Europe, with approximately 7,000 members. EUROTOX also has more than 200 individual members from 50 countries. It therefore represents a major network of communication across the toxicological industry. The theme of this year's conference is 'Bridging Sciences for Safety' with, among other stated objectives, acting as a stage for 'opening minds for new concepts and paradigms in Toxicology'. Of particular interest at EUROTOX 2015 will be the CECs (Continuing Education Courses), which are well attended by young scientists. Courses on the '3Rs in Toxicology' will also be attended by Lush Prize to see what information is on offer, as well as other Young Scientist network events during the conference.

Lush Prize will also attend the 16th Congress hosted by the European Society for Alternatives to Animal Testing (EUSAAT) in Linz²⁷. A number of very valuable sessions will be held in Linz, including a free communications session on Young Scientists which Lush Prize will attend and present at. EUSAAT 2015 will also hold another 'Practical Training Course on Alternative Methods'²⁸, which will be focusing on established *in-vitro* methods for assessing the eye irritation/corrosion hazard potential of chemicals and finished products. The two day intensive training course is free of charge and open to all participants of the congress but "especially addressing students and young scientists, interested in gaining knowledge and practical experience on advanced non-animal methods for toxicology testing". The regulatory acceptance of *in-vitro* assays will be discussed and the practical part of the course will be supervised by experienced scientists.

25 <http://www.spedh.com/>

26 <http://www.eurotox2015.com/>

27 <http://www.eusaat.org/>

28 <http://eusaat-congress.eu/index.php/congress/2015/2015-practical-training-course>

9 Conclusion

Lush Prize will continue its Young Researcher outreach well into the 2015 prize cycle. Further YR activity, which is anticipated to extend into the 2016 prize cycle and beyond includes targeted outreach to student unions and related contacts at universities across Europe and worldwide, for example to request Lush Prize information to be included in 'freshers week' packs for new science students.

10 Further references

10.1 Alternatives Research and Development

<http://www.ardf-online.org>

The mission of the Alternatives Research and Development Foundation is to fund and promote the development, validation and adoption of non-animal methods in biomedical research, product testing and education.

10.2 AltTox

<http://www.alttox.org/>

AltTox.org is a website dedicated to advancing non-animal methods of toxicity testing through online discussion and information exchange.

10.3 Animal Aid

<http://www.animalaid.org.uk>

Animal Aid is the UK's largest animal rights group and one of the longest established in the world, campaigning peacefully against all forms of animal abuse and promoting a cruelty-free lifestyle. Animal Aid investigates and exposes animal cruelty, and the evidence found is often used by the media, bringing these issues to public attention. Animal Aid continues its very successful 'Victims of Charity' campaign to raise public awareness of medical research charities which continue to fund or conduct animal testing (www.victimsofcharity.org)

10.4 Asterand (UK and USA)

<http://www.asterand.com>

Asterand is the leading global provider of high quality, well characterised human tissue and human tissue-based research solutions to drug discovery scientists. Their mission is to provide human-based solutions to accelerate the identification and validation of drug targets and enhance the selection of drug candidates with an increased likelihood of clinical success.

10.5 Biopta (UK)

<http://www.biopta.com>

Biopta is the leading company focussed on the use of fresh functional human tissues in drug development. Based in Glasgow, UK, and Maryland, USA, the Biopta Group has been providing contract research services to the pharmaceutical industry since 2002 and has established itself as the world leader in the use of fresh functional human tissues to improve prediction of drug activity prior to clinical trials.

10.6 Björn Ekwall Memorial Foundation

<http://www.bemf.eu/>

The Scandinavian Society for Cell Toxicology (SSCT) established the Björn Ekwall Memorial Foundation in 2001. The main goal of the BEMF is to honour the memory of Dr Björn Ekwall by giving a reward to the scientists who have substantially contributed to the field of cell toxicology, e.g. by developing new in vitro tests, or via mechanistic or validation studies.

10.7 British Toxicology Society

<http://www.thebts.org/>

The BTS is a learned society for toxicologists in the UK and represents the interests of approximately 1,000 members.

10.8 Cruelty Free international (formerly BUAV)

<http://www.crueltyfreeinternational.org/>

Cruelty Free International is the global campaign to end animal testing for cosmetics, calling on governments and regulators around the world to introduce a ban on the testing of animals for cosmetic products and ingredients. Also acts as secretariat to the ECEAE (European Coalition to End Animal Experiments).

10.9 DAAE (Doctors Against Animal Experiments)

<http://www.aerzte-gegen-tierversuche.de>

DAAE, based in Germany, is a charitable organisation of several hundred doctors and scientists who work in the medical field. DAAE supports the immediate abolition of all animal experiments on ethical and scientific grounds. In order to make the cruel and unscientific nature of animal experiments public, they provide scientifically based information on animal experiments both for doctors and scientists, as well as for the general public.

10.10 Dr Hadwen Trust for Humane Research

<http://www.drhadwentrust.org>

The Dr Hadwen Trust for Humane Research (DHT) is the UK's leading medical research charity that funds and promotes the development of techniques and procedures to replace the use of animals in biomedical research and testing.

10.11 European Consensus Platform for Alternatives (ECOPA)

<http://www.ecopa.eu>

ECOPA is a consensus between animal welfare, industry, academia and governmental institutions in various countries as an efficient way to stimulate research into alternatives to animal experiments and enforce the acceptance of alternatives in experimental practice.

10.12 European Centre for Ecotoxicology and Toxicology of Chemicals

<http://www.ecetoc.org/>

ECETOC is Europe's leading industry association for developing and promoting top quality science in human and environmental risk assessment of chemicals.

10.13 EURL-ECVAM (The European Union Reference Laboratory for Alternatives to Animal Testing)

http://ihcp.jrc.ec.europa.eu/our_labs/eurl-ecvam

EURL-ECVAM was established in 2011, due to the increasing need for new methods to be developed and proposed for validation in the European Union.

10.14 EUROECOTOX

<http://www.euroecotox.eu/>

Euroecotox is a European Network established to promote the integration of European activities on the replacement and reduction of animal experiments in ecotoxicology.

10.15 The European Partnership for Alternative Approaches to Animal Testing (EPAA)

http://ec.europa.eu/enterprise/epaa/index_en.htm

A voluntary collaboration between the European Commission, European trade associations, and companies from seven industry sectors. The partners are committed to pooling knowledge and resources to accelerate the development, validation and acceptance of alternative approaches to further the replacement, reduction and refinement (3Rs) of animal use in regulatory testing.

10.16 FICAM (The Finnish Centre for Alternative Methods)

<http://www.ficam.fi>

FICAM is the centre of expertise for alternative methods to animal experimentation in Finland. FICAM develops and validates human-cell-based tissue/organ models, shares information on alternative methods, educates experts, and acts as the Finnish reference laboratory for EURL-ECVAM (European Union Reference Laboratory for Alternatives to Animal Testing).

10.17 Fund for the Replacement of Animals in Medical Experiments (FRAME)

www.frame.org.uk

The ultimate aim of FRAME is the elimination of the need to use laboratory animals in any kind of medical or scientific procedures. FRAME is dedicated to the development of new and valid methods that will replace the need for laboratory animals in medical and scientific research, education, and testing.

10.18 HemiBio

<http://www.hemibio.eu/>

HemiBio is one of six projects funded under the SEURAT programme. The aim of HeMiBio is to generate a liver-simulating device (Hepatic Microfluidic Bioreactor) mimicking the structure and function of the human liver. HemiBio states that there is a great need for suitable human cells to be used in toxicity testing, due to the often poor concordance between animal models and toxic effects in humans. The project was set up in 2011 as part of the drive to find suitable non-animal methods to meet the requirements of the (then) forthcoming marketing ban on animal tested cosmetics. HemiBio also plans a series of education and training opportunities for young scientists. Workshops and courses cover topics such as cell biology, genetic engineering of stem cells and 2D or 3D-culture devices. HemiBio also promotes job and study opportunities as well as events including Summer and Winter Schools for young scientists

10.19 The Humane Research Trust (UK)

www.humaneresearch.org.uk

The Humane Research Trust is a registered charity dedicated to medical research without animals. The Trust raises the necessary finance to fund and promote pioneering medical research into human disease without the use of animals or animal tissue. Their aim is to eliminate the need for animals in human medical research. The Humane Research Trust works with scientists, funding a wide range of research at a number of UK hospitals and universities. The Trust also funds lectureships and studentships, which help to spread the message that humane research is the cost effective way to promote human health, quickly and with a clear conscience.

10.20 Humane Society International (HSI)

<http://www.hsi.org/>

HSI is one of the only international animal protection organizations in the world working to protect all animals - including animals in laboratories, farm animals, companion animals, and wildlife. HSI has recently seen huge success in Asia with its Be Cruelty Free campaign and engagement with stakeholders in China and Korea to bring an end to animal testing and promote use of non-animal methods.

10.21 The International Foundation for Ethical Research (IFER)

<http://www.ifer.org>

IFER supports the development, validation and implementation of innovative scientific methodologies that advance science and replace the use of animals in research, testing and education.

10.22 INTERNICHE (International Network for Humane Education)

<http://www.interniche.org>

The aim of INTERNICHE is to achieve high quality, fully humane education and training in medicine, veterinary medicine and biological science. They support progressive science teaching and the replacement of animal experiments by working with teachers to introduce alternatives and with students to support freedom of conscience.

10.23 Institute for In Vitro Sciences

<http://www.iivs.org/>

The Institute for In Vitro Sciences, Inc. is a non-profit research and testing laboratory dedicated to the advancement of in vitro (non-animal) methods worldwide.

10.24 In Vitro Jobs

<http://www.invitrojobs.com/>

Many researchers have a strong interest in animal-free research, but find information on institutions and research groups who use animal-free methods hard to come by. InVitro Jobs was set up by People for Animal Rights (Menschen für Tierrechte - Bundesverband der Tierversuchsgegner) in Germany. The aim is to enable researchers to access animal-free research easily. The site includes an up-to-date list of research groups active in the development of animal-free techniques and, job vacancies. The site also aims to provide students with the opportunities to contact research groups to obtain information for their studies and to promote co-operation, networking and the exchange of ideas between researchers.

10.25 1R Institute Brazil

<http://www.instituto1r.org/>

The 1R institute has been newly established in Brazil in March 2015. The purpose of the Institute is to encourage discussion and promotion of the development of methods to replace the use of animals in teaching activities, research and testing and production of biological products.

10.26 John Hopkins University Centre for Alternatives to Animal Testing (CAAT)

<http://caat.jhsph.edu/>

CAAT believes the best science is humane science. Their programs seek to provide a better, safer, more humane future for people and animals.

10.27 Kirkstall Ltd

<http://kirkstall.org/>

Kirkstall is a UK-based biotech company founded in 2006, with an exclusive world-wide licence to patented cell culture technology (Quasi-Vivo[®]) from the University of Pisa. The technology is the outcome of over 10 years of research by an interdisciplinary research team in Pisa. Kirkstall has developed this research into a commercially available inter-connected cell culture system, which can be set up so that it mimics the human metabolism, resulting in high quality, rather than just high throughput screening.

Kirkstall is continuing the development of a range of products, both instruments and consumables, for cell culture which will have applications in safety and toxicity screening as well as in stem cell research and tissue engineering.

10.28 Lord Dowding Fund for Humane Research (LDF)

<http://www.ldf.org.uk>

The objectives of the LDF are to support, sponsor, and fund better methods of scientific and medical research for testing products and curing disease, which replace the use of animals and fund areas of non-animal fundamental research which lead to the adoption of non-animal research methodology.

10.29 Medical Advances Without Animals Trust (MAWA)

<http://mawa-trust.org.au/>

MAWA is a registered charity which aims to advance medical science to improve human health and therapeutic outcomes without using animals or animal products. The Trust provides “research and equipment grants, fellowships, scholarships, bursaries and sponsorships to scientists and scholars throughout Australia in a competitive award process, and funds a range of other initiatives to further MAWA’s goals

10.30 The Marchig Animal Welfare Trust

<http://www.marchigtrust.org>

Based in Scotland, the Marchig Animal Welfare Trust is a charity which focuses on all areas of animal protection from cruelty and abuse. Established in 1989 by Madame Jeanne Marchig of Geneva, because of her deep concern for nature and animals, the trust awards grants to a wide variety of projects including "promoting alternative methods to animal experimentation and their practical implementation".

10.31 National Anti-Vivisection Society (NAVS)

<http://www.navs.org.uk>

The National Anti-Vivisection Society, founded in 1875, is the world's first body to challenge the use of animals in research and continues to lead the campaign today. NAVS has spearheaded the adoption of advanced, non-animal methods; exposed laboratory animal suffering and breaches of regulations with undercover investigations; funded non-animal scientific and medical research; educated public and media about the flaws of animal research and lobbied government in support of the replacement of animals in research with advanced methods. The NAVS group is one of four NGOs working to end the suffering of animals: the National Anti-Vivisection Society; Animal Defenders International; the Lord Dowding Fund for Humane Research; and the Animal+World Show.

10.32 The National Centre for the Replacement, Refinement and Reduction of Animals in Research (NC3Rs)

<http://www.nc3rs.org.uk/>

The National Centre for the Replacement, Refinement and Reduction of Animals in Research (NC3Rs) is a scientific organisation, tasked by the Government with supporting the UK science base through the application of the 3Rs. The NC3Rs is the UK's largest funder of 3Rs research. NC3Rs is also behind www.crackit.org.uk a programme designed to replace, reduce and refine (the 3Rs) the use of animals in research. It includes a funding competition for research and development to solve 3Rs challenges identified with sponsors from the industrial and academic sectors, and a technology partnering hub to accelerate the sharing, validation and uptake of potential 3Rs methods.

10.33 The Netherlands Knowledge Centre on Alternatives to Animal Use (NKCA)

<http://www.nkca.nl/>

NKCA promotes the application of the 3Rs in the Netherlands. The Centre is a collaboration between the RIVM (National Institute for Public Health) and the University of Utrecht since 2010 and offers 'animal testing alternatives' modules as part of postgraduate training for professionals. NKCA also advises teachers on the animal-free testing models available for secondary schools, and recommends animal-testing alternatives as a potential subject for student projects.

10.34 The New England Anti-Vivisection Society (NEAVS)

<http://www.neavs.org/>

US-based animal advocacy organization, whose mission is to end the use of animals in research, testing and science education and replace it with scientifically superior and humane non-animal alternatives. NEAVS advocates for all animals in laboratories and classrooms through education, public outreach, legislation, policy change, and legal action. The organisation is closely affiliated with the American Fund for Alternatives to Animal Research (AFAAR).

10.35 PETA (People for the Ethical Treatment of Animals)

<http://www.peta.org>

PETA continues its campaigns as one of the world's leading animal rights organisations. A previous Lush prizewinner and nominee, PETA's most recent victories include engagement with government officials in both China and India to end animal testing and promote the use of alternatives, as well as direct funding of

researchers in China to provide training in non-animal methods. PETA's International Science Consortium Ltd. (PISC), promotes and funds nonanimal research methods, bringing scientific and technical expertise as well as extensive knowledge of the international regulatory environment to the development of testing protocols.

10.36 Physicians Committee for Responsible Medicine (PCRM)

<http://www.pcrm.org/>

The PCRM promotes alternatives to animal research and campaigns for the use of non-animal methods in medical education. They provide a wealth of scientific educational materials, information on courses and career opportunities and internships. The PCRM also campaigns on a broader scope for higher standards of ethical research and the benefits of preventative medicine.

10.37 Platforms and Funds for Alternatives to Animal Experimentation, Live Kleveland

<http://oslovet.norecopa.no/platform/report/ecopaplatforms.pdf>

A report from The Norwegian Reference Centre for Laboratory Animal Science & Alternatives, Norwegian School of Veterinary Science, Oslo, Norway 2005.

10.38 The Portuguese Society for Humane Education (SPEdH)

<http://www.spedh.com/>

SPEdH was founded in 2006 in Lisbon and campaigns for humane treatment of animals in all aspects of training and education.. SpedH recently hosted the second International Conference Of Alternatives to Animal Experimentation (ICAAE)

<http://www.icaae.com/>

10.39 Juliana von Went Fund for Research Without Animal Experiments

<http://www.jvws.org/>

The Juliana von Wendt Fund, founded in 1971, is a Finnish charity, which supports humane methods of scientific and medical research. The Fund awards yearly grants to Finnish researchers developing and applying non-animal methodology in a wide range of fields including toxicity testing, cancer research, surgery, antibody production, computer assisted drug modelling, tissue culture techniques, higher education etc. Methods replacing exceptionally harmful use of animals are prioritised, as well as projects which are most relevant for human or animal welfare. From 1996 onwards the Fund has awarded The Scandinavian Research Prize for Alternatives to Animal Experiments together with the funds of Sweden and Denmark.

10.40 SAFE (Save Animals from Exploitation)

www.safe.org.nz

SAFE are a New Zealand based organisation and previous 2013 'Public Awareness' Lush Prize winner promoting a number of educational materials. They also offer school speaking services to educate and raise awareness on a variety of animal rights and welfare issues, including animal experiments.

10.41 SenzaGen AB

<http://www.senzagen.com/>

SenzaGen AB, based in Lund, Sweden is a privately owned Biotech-company, providing methods for assessment of immunotoxicological properties of chemical

compounds and mixtures. Continuous R&D activities aims to broaden the application domain of provided services, and the company have close connections to immunological and toxicological researchers at Lund University, Sweden. SenzaGen's lead product, the GARD assay for assessment of chemical skin sensitizers, is a peer-reviewed assay that is currently considered for ECVAM validation and prioritized by the Cosmetic Europe Skin Tolerance Task Force.

10.42 SET (Foundation for the Promotion of Alternate and Complementary Methods to Reduce Animal Testing) Germany

<http://www.stiftung-set.de/index.php>

SET based in Germany, offers the opportunity to gain funding for projects which focus broadly across the 3Rs. SET also have an interest in funding training and education initiatives.

10.43 SEURAT-1 (Safety Evaluation Ultimately Replacing Animal Tests)

<http://www.seurat-1.eu/>

SEURAT-1 is an international scale collaborative project funded under the EU Seventh Framework Programme (FP-7). SEURAT recently hosted its second 'Young Scientists Summer School' in collaboration with ESTIV (European Society of Toxicology In Vitro) to discuss replacement of repeat dose toxicity testing in animals.

10.44 Scientists for Global Responsibility (SGR)

<http://www.sgr.org.uk>

SGR are based in the UK and promote ethical awareness in science and technology. They provide an 'ethical careers' section on their website which includes resources to help scientists and engineers gain a deeper understanding of ethical issues in science, design and technology and help them choose an ethical path in this area. Materials include briefings, presentations, articles and other resources, as well as an 'ethical employers' contact list.

10.45 The Swedish Fund for Research Without Animal Experiments

<http://www.forskautandjurforsok.se/index.php>

The Swedish Fund supports alternatives in basic and applied research in various areas, including the development of computer simulation systems, toxicology, and training of laboratory personnel and courses in alternatives. The fund has awarded over 30 million SEK since 1971 and currently awards projects totalling €80,000-160,000 each year.

10.46 The 3R Research Foundation (Switzerland)

<http://www.forschung3r.ch/en/information>

The 3Rs foundation awards annual prizes for research directly impacting on the 3Rs. They have key areas of interest that they emphasise to grant applicants, one of which is alternative methods to acute and chronic toxicity testing.