Session 2: Future technologies for feral predator control

(CRISPR/CAS9 genome editing and gene drives)

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THE UNIVERSITY of ADELAIDE
SUB CRUCE LUMEN

Genome editing

Juliette Thomas, age 11

CRISPR genome editing

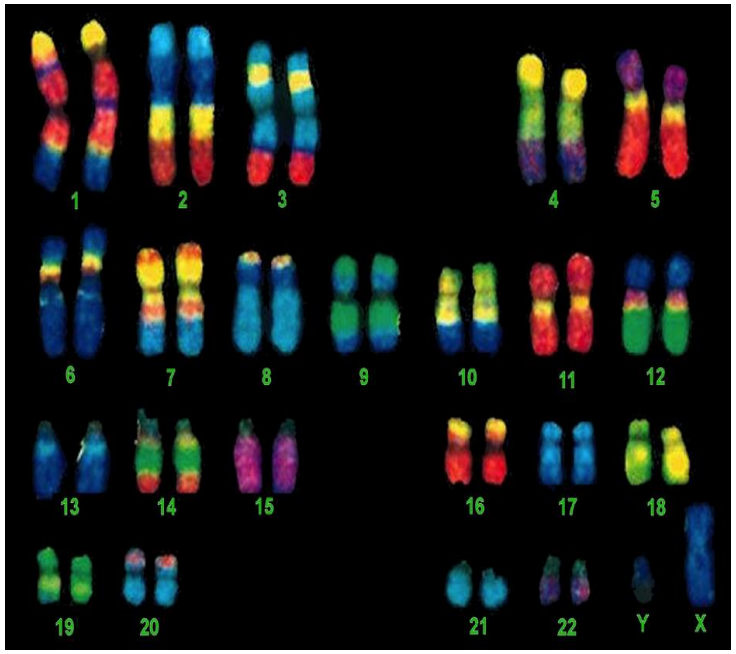
GENOME EDITING: Targeted and precise modification of any organism's genome

A revolution in biology, medicine and agriculture! (>9,000 CRISPR papers since 2012)

How could CRISPR technology be used for control of invasive pest species?

http://en.hdbuzz.net/038

The Genome



Every cell contains the blueprint for life…..3,000,000,000 building blocks → 20,000 genes!

Each gene has a role → alter gene sequence or activity → change phenotype (properties/characteristics) of an individual

Add new genes→ acquire new phenotypes

CRISPR genome editing

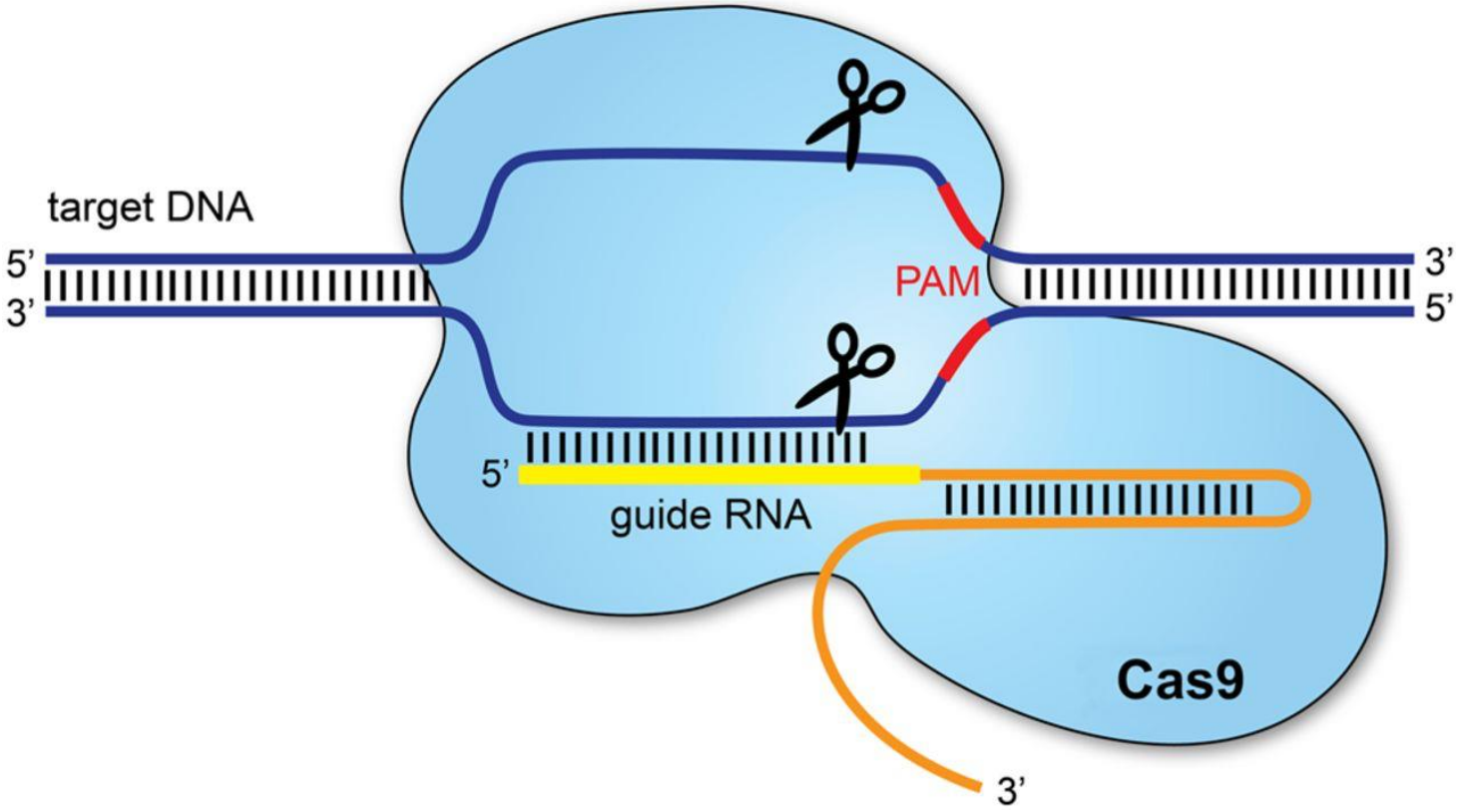
"programmable" molecular scissors

Make a cut/modify virtually any sequence in the genome → inactivate/alter/activate any gene

CRISPR = Clustered Regularly Interspaced Short Palindromic Repeats (from bacteria)

http://en.hdbuzz.net/038

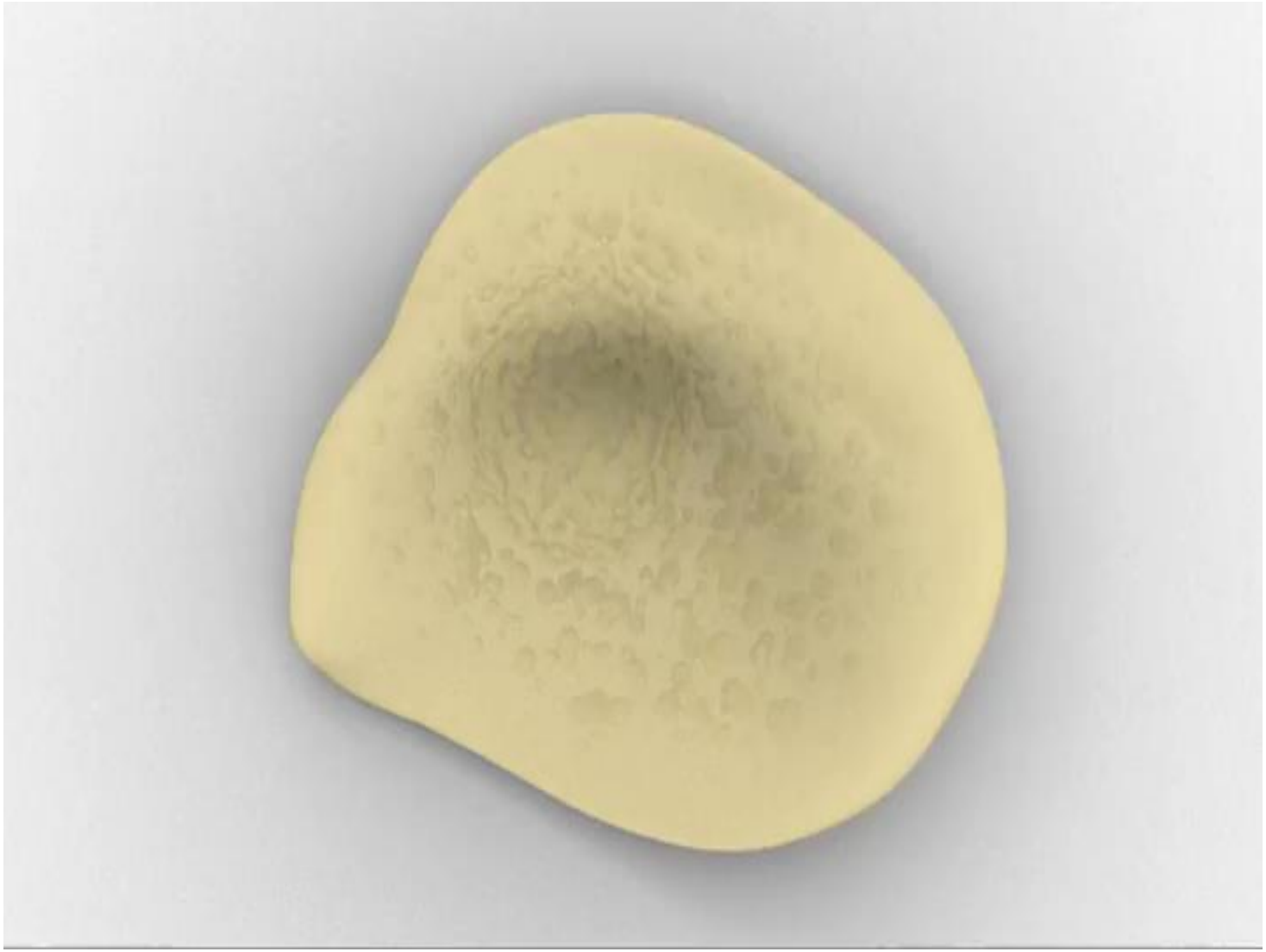
CRISPR/CAS9: Programmable genomic scissors



CAS9 = endonuclease (DNA cutting enzyme)
Guide RNA = provides the "address code" for the cut

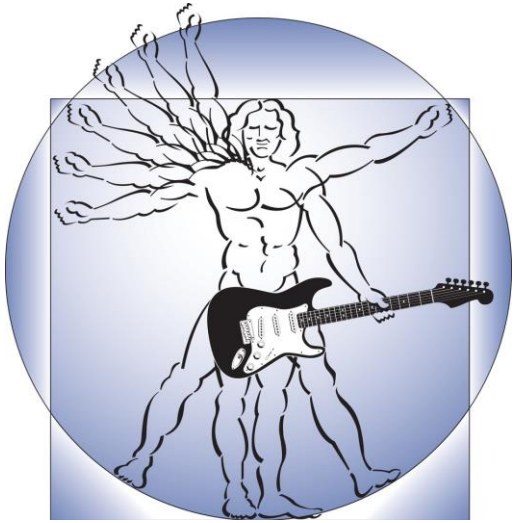
Repair of the DNA cut → change DNA sequence→ altered gene function (or new gene added)

CRISPR in action



http://www.independent.co.uk/news/science/indyplus-video-crispr-technique-8925604.html

Vast array of genomes have been modified by CRISPR/CAS9

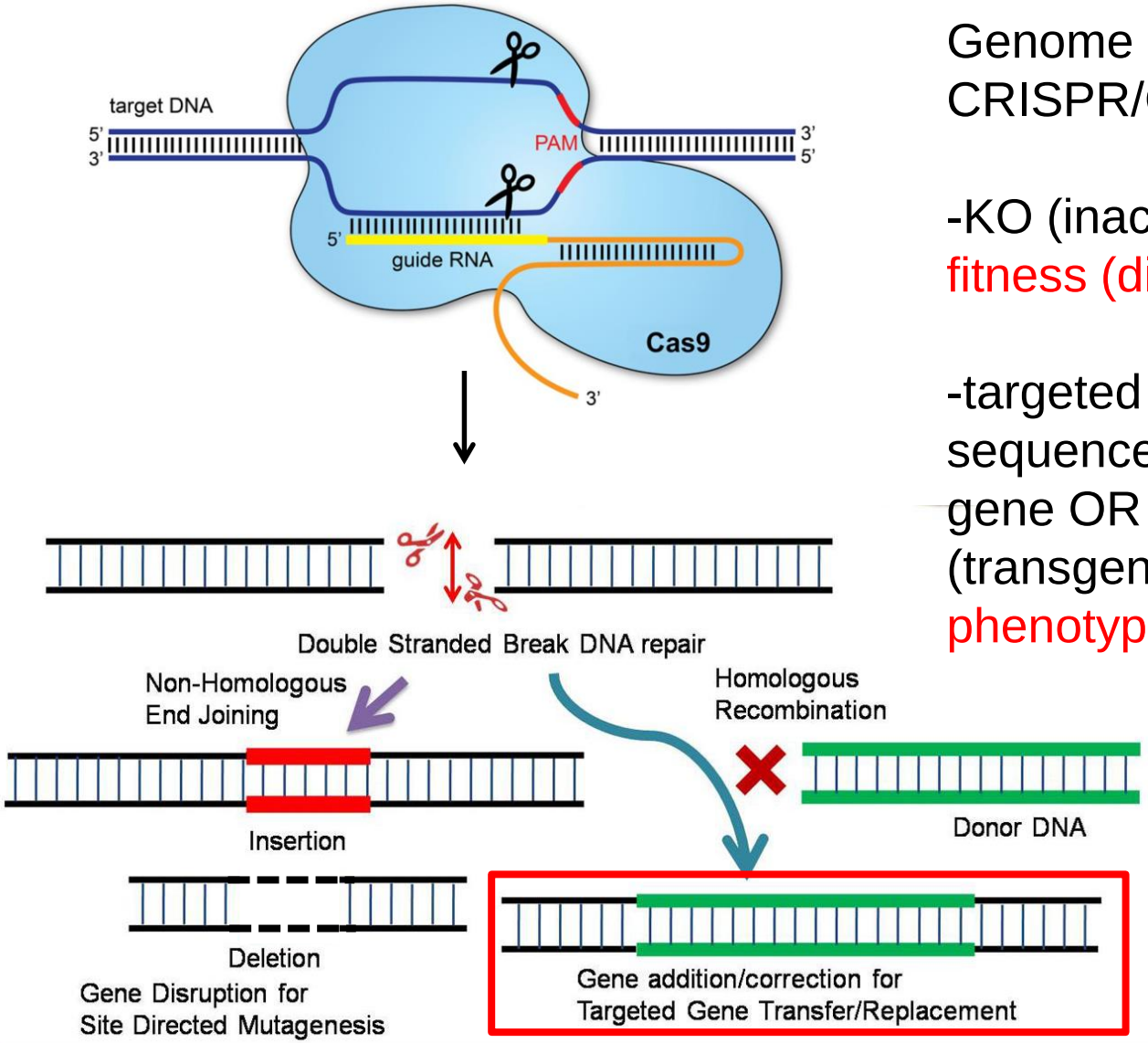


Hundreds of genes targeted in >50 species (including humans) → CRISPR/Cas activity not limited by species or cell type.

#CRISPRCat

Rainbow
Unicorn
Butterfly
Kitten

CRISPR-mediated KO and transgenesis



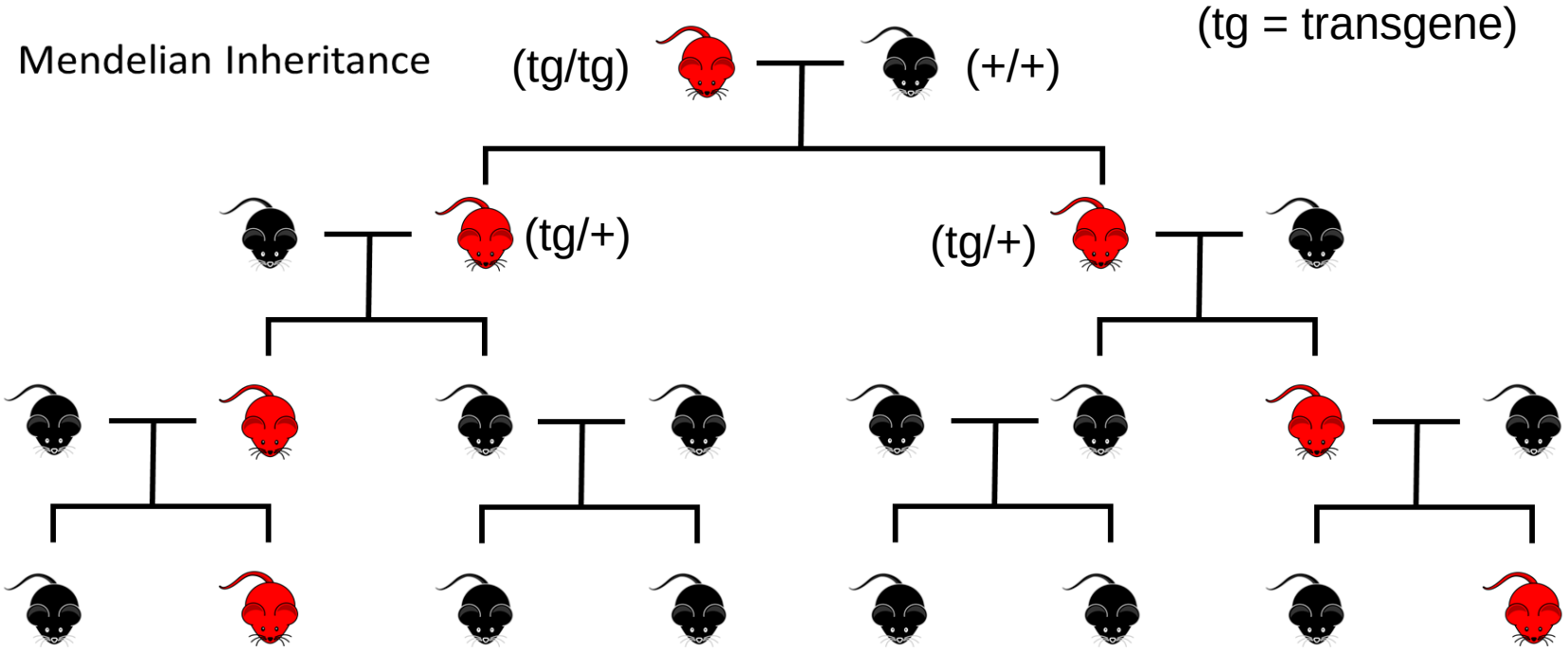
Genome modifications using CRISPR/CAS9 include:

-KO (inactivation) → loss of fitness (disease state)

-targeted insertion of new sequences (modify endogenous gene OR add new gene (transgenesis)) → new phenotype

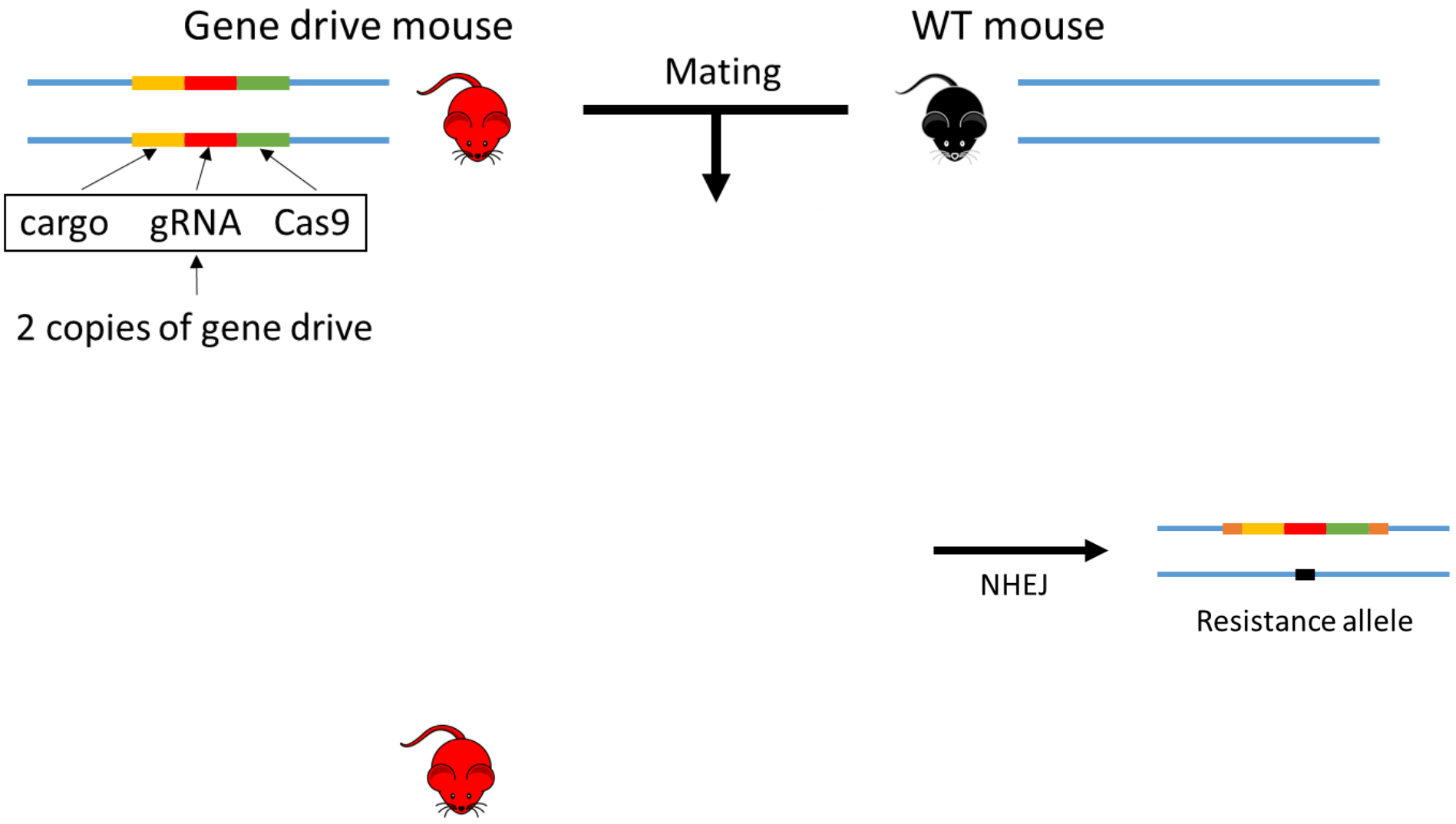
CRISPR Population Modification

Simple genetic modification (tg) does not spread through a pest population



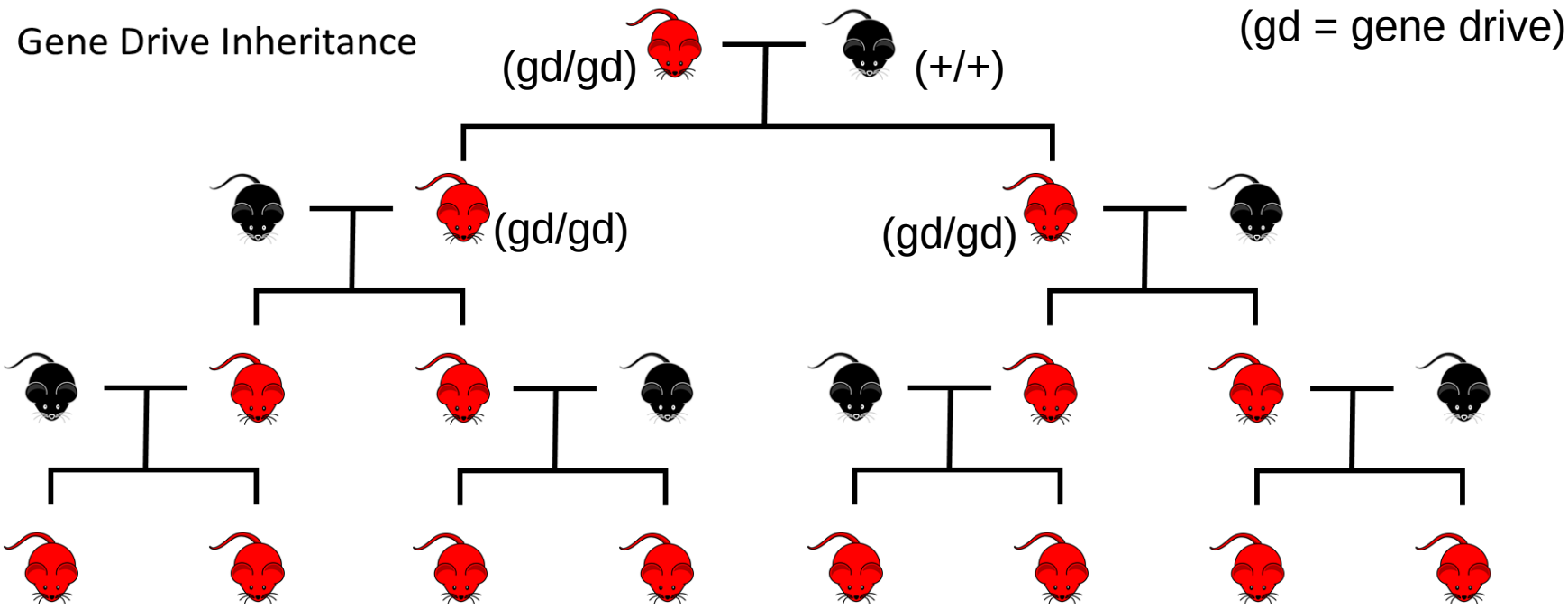
→ gene drives

CRISPR-Cas9 Gene Drive



Gene Drive Population Modification

- Self-replicating genetic construct that promotes its own inheritance
- Potentially spreads through entire population and allows population-level genetic engineering

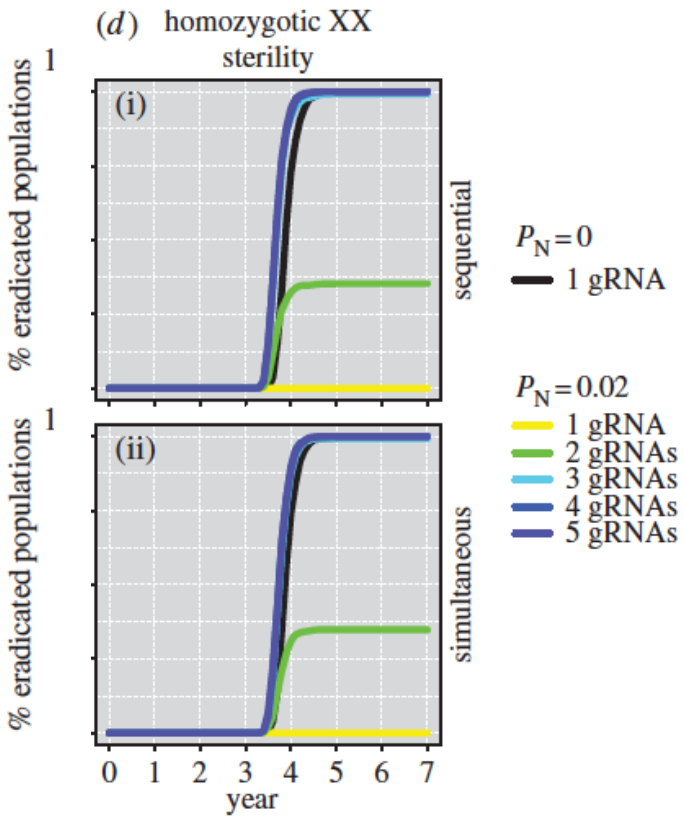


CRISPR gene drives

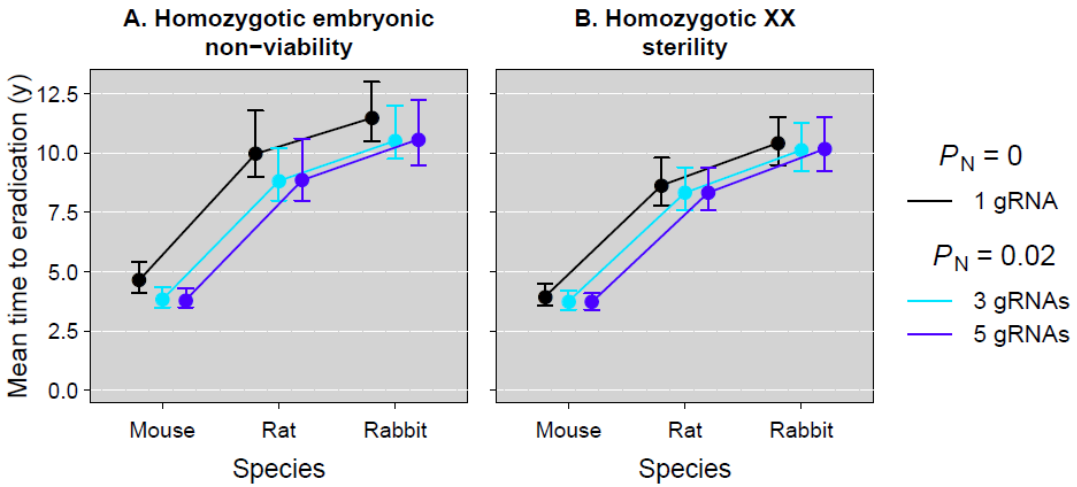
Shown to “work” in fruit flies, mosquitos and yeast

No data for mammals yet (watch this space!)

Best suited to species with short generation times



Island population 50,000,
seed 100 gene drive animals



Prowse et al (2017)

Gene drive issues (these are significant!)

- Gene drive spread to native range
- Species jump
- anti-GM sentiment
- Ethics of species (cat) genetic modification
- appropriate regulation
- “Social license”

GBIRd (Genetic Biocontrol of Invasive Rodents)
http://www.geneticbiocontrol.org

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