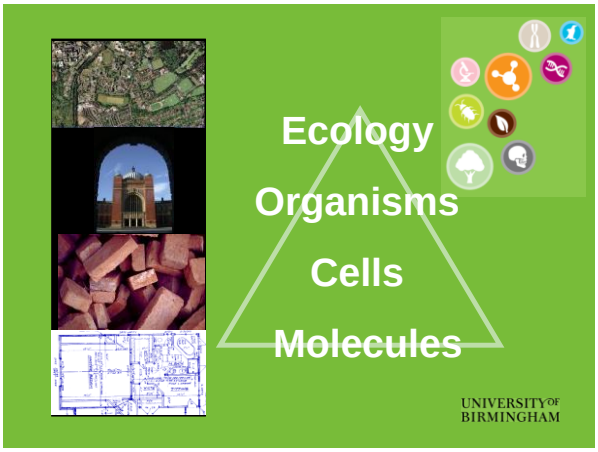
Plant adaptation to changing environments:
A role for GM

Dr Jeremy Pritchard
@DrJPritchard



Molecules: Transcription and Translation

DNA
mRNA
Protein

Population growth

Climate change

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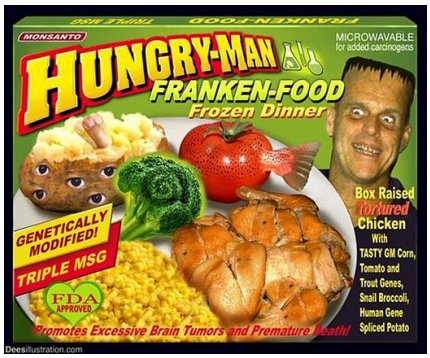
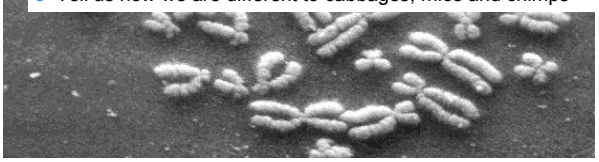
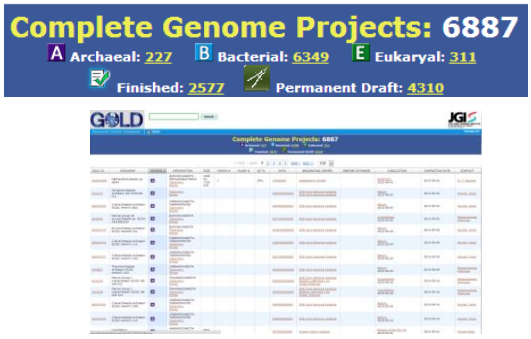


Conventional breeding has been going on for 10,000 years

Why Sequence Genomes?

- Will eventually tell us what genes do
  - Leads to Medical Applications
  - Leads to Agricultural Applications
- Tells us about evolution
- Tell us how we develop
- Tell us how we are different to cabbages, mice and chimps





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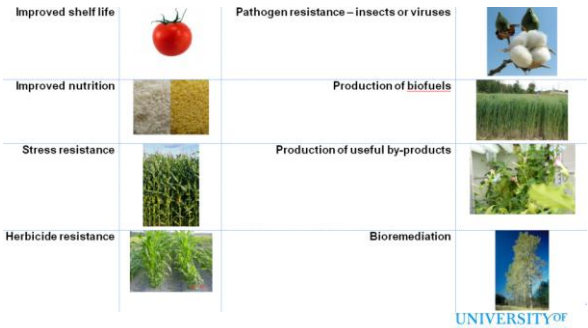
Applications of GM crops



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Examples from my research

- Knockouts — What does a gene do?
- Localisation — Where is it expressed?
- Transcriptomics — How do genes respond?

Must combine Molecular with Physiology

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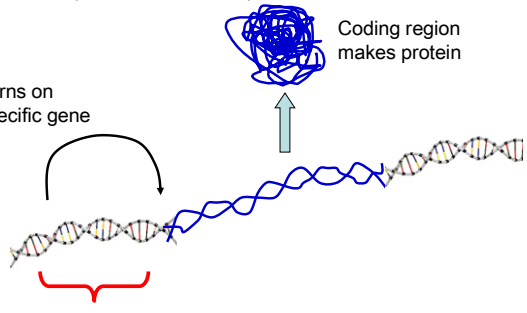
Knockout (loss of function)



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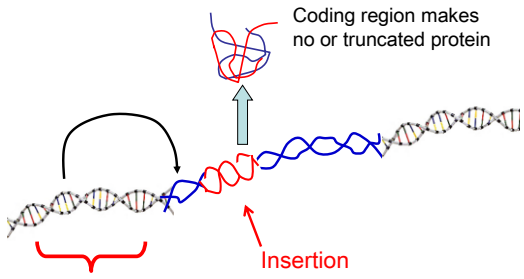
Knockout (loss of function)



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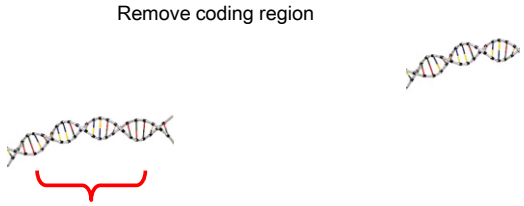
Reporter genes



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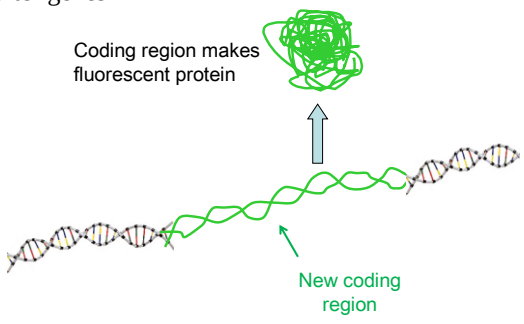
Reporter genes



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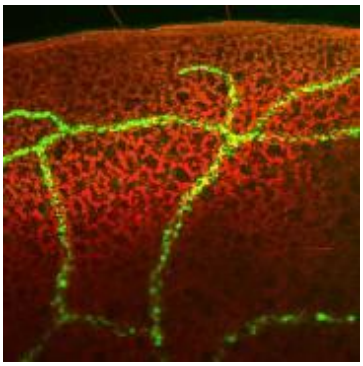
Phloem reporter gene



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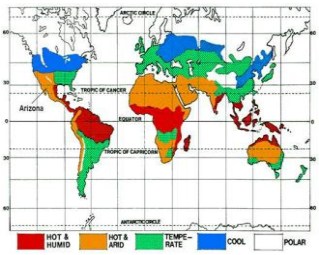
Salinity – the silent flood



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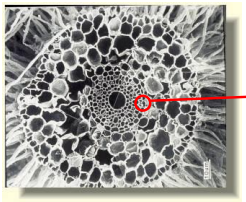
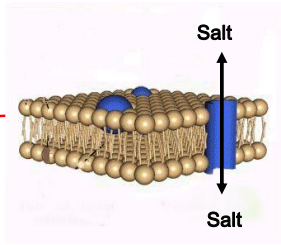
Salt crosses membranes through protein ‘gates’

These gates control salt levels in xylem





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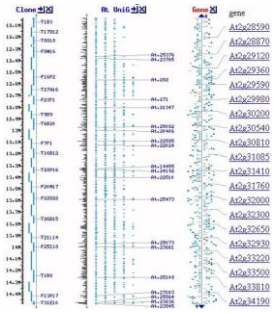

Bioinformatics - *Arabidopsis* – the model plant

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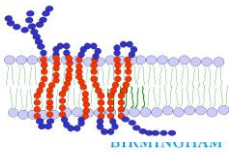
CHx21

DNA Sequence

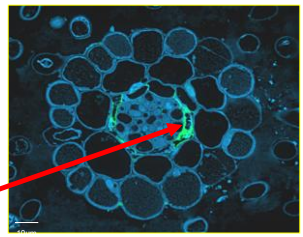
MSSGAPLNVTNPNYDIEESRFGKIVCYDQSLLF
EKREQKGWESGSTLASSLPFFITQLFVANLSYR
VLYYLTRPLYLPPFVAQILCGLLFSPSVLGNTRFI
IAHVFPYRFTMVLETFANLALVYN

Amino acid Sequence

Computer says: it looks like a salt transporter



Immunology- protein is detected in root endodermis



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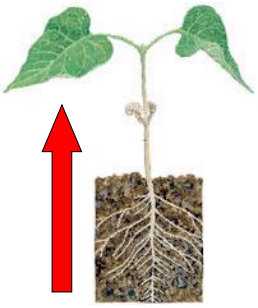
Is the computer right?

Find out; make knockout mutants

```
ctgtcttctc actaaactcc aaaacccacc ggaaaaatga ttacgtggca cgactgtgcc
accgtcctca ccgccgtggt accactttac gtagctatga ttct ttacg tgg aatat
atcacgccta cggatccgta cagtggtgga agatattctc accagaccag tgctcggcca
tcaaccgctt cgtcgctatc ttcgccgtcc ctctcctctc cttccacttc atctcgacca
acgatcctta cgccatgaat
```

Insert extra sequence: This means stop – no protein is made



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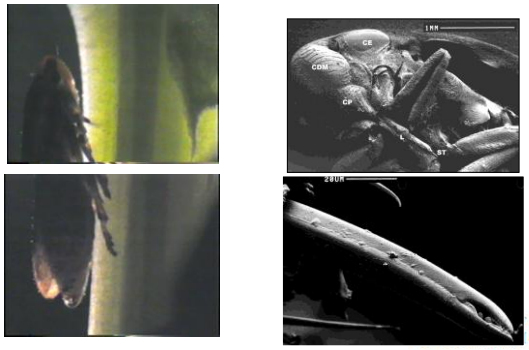
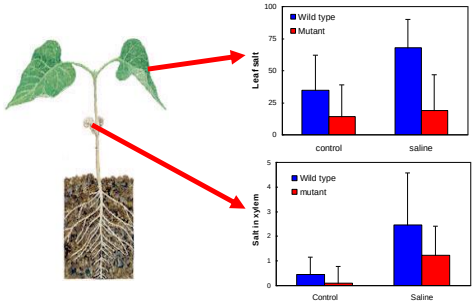
Xylem sampling from transpiring plants



Leaf salt is lower in mutant xylem and leaf



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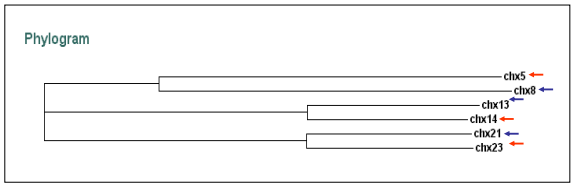
Bioinformatics

- 5 similar sequences to CHX21
- In pairs on chromosome 1 & 2



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1. Duplication
2. Translocation
3. Diversification

Chromosome 1

Chromosome 2

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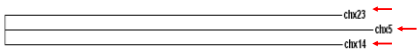
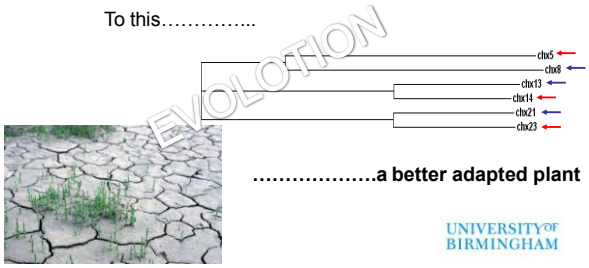
Evolution in action

From this……..



To this……..



…….a better adapted plant

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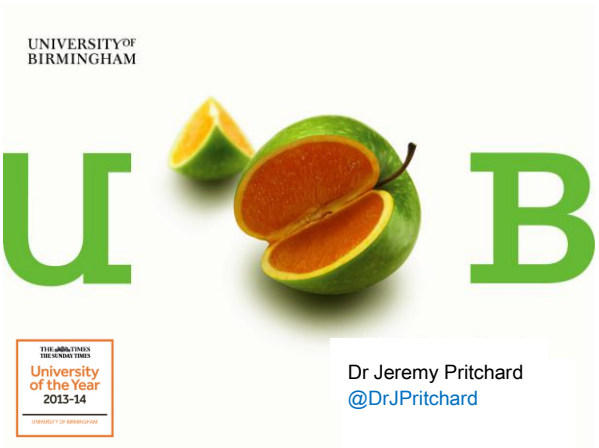

University of the Year 2013-14

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Slides and other resources are available as PowerPoint

Email me: J.Pritchard@bham.ac.uk
or go to
http://www.birmingham.ac.uk/schools/biosciences/outreach

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