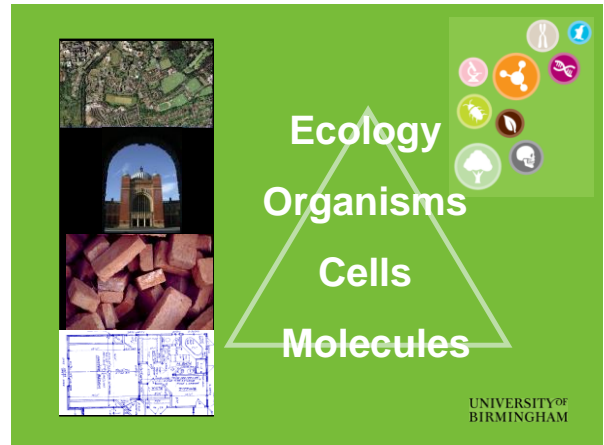


**Plant adaptation to changing environments:  
A role for GM**



Dr Jeremy Pritchard  
@DrJPritchard



**Molecules: Transcription and Translation**



DNA  
mRNA  
Protein

Population growth



Climate change

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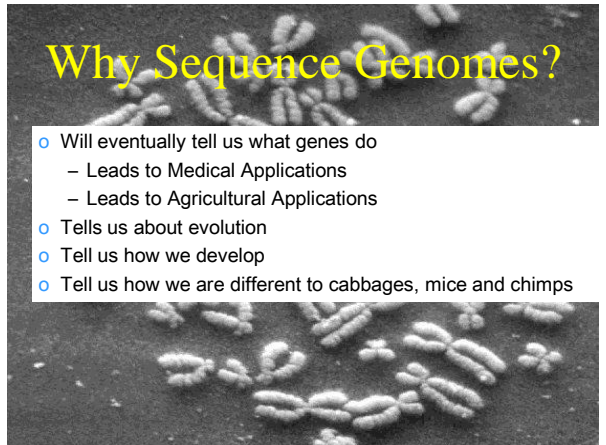
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Conventional breeding has been going on for 10,000 years

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## 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











**Complete Genome Projects: 6887**  
**A** Archaeal: 227 **B** Bacterial: 6349 **E** Eukaryal: 311  
**Finished: 2577** **Permanent Draft: 4310**

**GOLD** Complete Genome Projects: 6887

Accession	Organism	Genome Size (Mb)	Genes	Features	Annotations	References
1	Archaea	1.2	1500	100	10	1
2	Bacteria	2.5	3000	200	20	2
3	Eukarya	10.0	10000	500	50	3
4	Archaea	1.5	1800	120	12	4
5	Bacteria	3.0	3500	250	25	5
6	Eukarya	12.0	12000	600	60	6
7	Archaea	1.8	2200	140	14	7
8	Bacteria	2.8	3200	220	22	8
9	Eukarya	11.0	11000	550	55	9
10	Archaea	1.6	1900	110	11	10
11	Bacteria	2.6	3100	210	21	11
12	Eukarya	13.0	13000	650	65	12
13	Archaea	1.4	1700	90	9	13
14	Bacteria	2.4	2900	190	19	14
15	Eukarya	14.0	14000	700	70	15

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## Applications of GM crops

Improved shelf life		Pathogen resistance – insects or viruses	
Improved nutrition		Production of biofuels	
Stress resistance		Production of useful by-products	
Herbicide resistance		Bioremediation	

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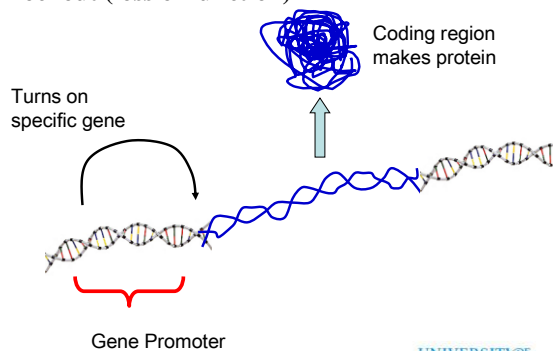
## Examples from my research

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

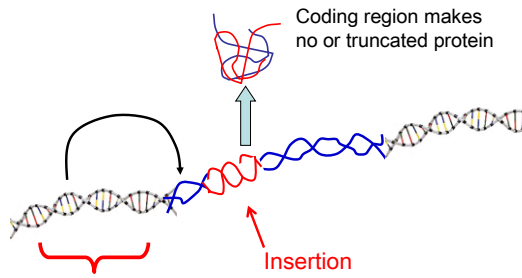
**Must** combine Molecular with Physiology

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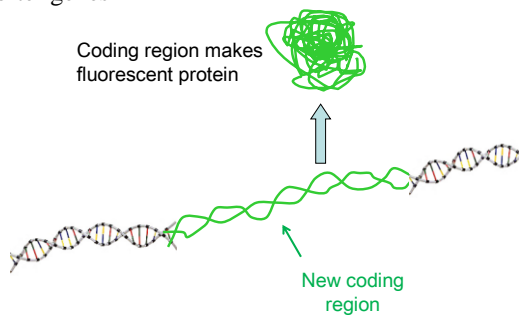
## Knockout (loss of function)



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**Knockout (loss of function)**UNIVERSITY OF  
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Remove coding region

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ctgtcttc:actaaac:caaaacc:caggaaa:aatgatta  
cgtggcagc:actgtac:acgc:ctc:acg:gcg:ggtag:caact  
ttac:gtag:ctatg:attc:taagga:attc:ca:gc:ctac:cggat  
cgtlacag:tgtagga:aaagatt:cttaccag:acag:tcgc:cg  
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ca:cttc:ctc:cc:caac:agat

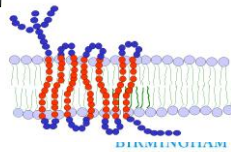
CHx21

### DNA Sequence

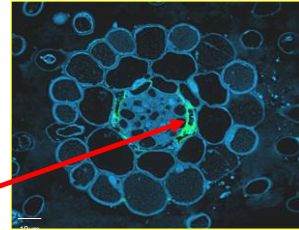
MSSGAPLNVTPNPYDIEESRFGKIVCYDQSLLF  
EKREQKGWESGSTLASSLPFFITQLFVANLSYR  
VLYYLTRPLYLPFFVAQILCGLLFSPSVLGNTRFI  
IAHVFPYRFTMVLETFANLALVYN

Amino acid Sequence

Computer says: it looks like a salt transporter



Immunology- protein is detected in root endodermis

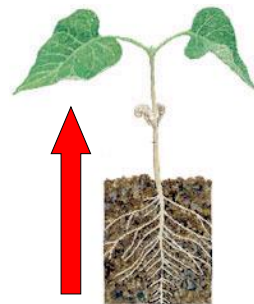
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Is the computer right?

Find out; make knockout mutants

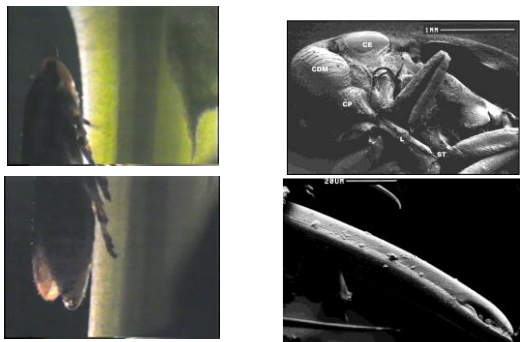
ctgtcttctc	actaaactcc	aaaaccacc	ggaaaaatga	ttagctggca	cgactggc
acgcgtctca	ccgcgcgtgt	accactttac	gtagctatga	tctc	<u>ttagc tgggaatat</u>
atcacgccta	cggatccgta	cagtggtgga	agatattctc	accagaccag	tgcctggga
tcaaacgcgt	cgtcgcgtat	ttcgcgcctc	ctctcctctc	cttcacattc	atctccacca
acgataccta	cgccatgaat				

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

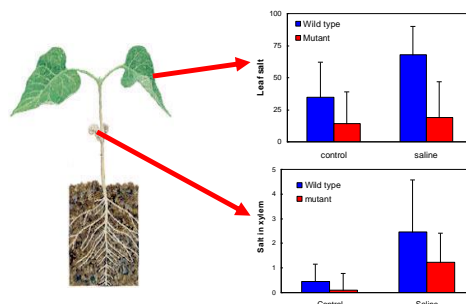
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## Xylem sampling from transpiring plants



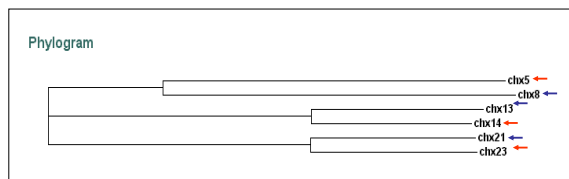
## Leaf salt is lower in mutant xylem and leaf



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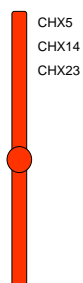
## Bioinformatics

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



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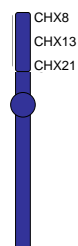
### 1. Duplication



Chromosome 1

### 2. Translocation

### 3. Diversification

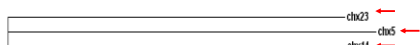


Chromosome 2

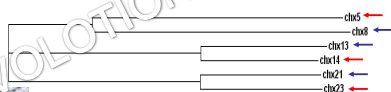
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## Evolution in action

From this.....

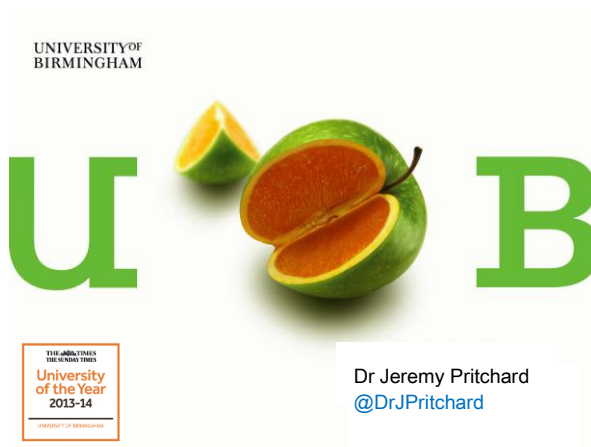


To this.....



.....a better adapted plant

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Slides and other resources are available  
as PowerPoint

Email me: [J.Pritchard@bham.ac.uk](mailto:J.Pritchard@bham.ac.uk)

or go to

<http://www.birmingham.ac.uk/schools/biosciences/outreach>

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