

Outline

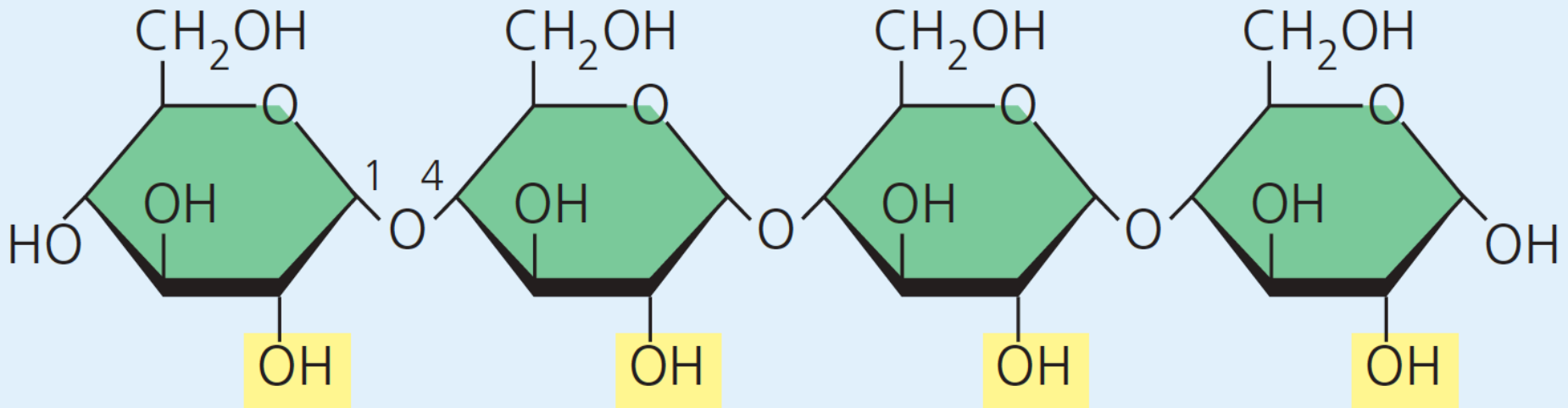
- Resources/methods/tools for studying gene function
 - Induced mutations
 - Site-nonspecific mutations induced by chemical, physical, and insertional mutagen
 - Forward and reverse genetic approaches
 - Site-specific mutation
 - Gene silencing
 - QTL/association mapping
 - Gene expression profiling
 - Multiomics

Final exam

- 10 comprehensive questions (100 points, 65% of the final)
 - Basic terms and knowledge: methods/mutagens used for inducing mutations, gene editing, QTL mapping, association mapping, gene expression profiling, etc.

Biological molecules

- Four large biological molecules
 - Carbohydrates, proteins, polynucleotides, and lipids



Starch: 1-4 linkage of a glucose monomers

Biological molecules

- Small molecules
 - Metabolite refers to small biochemical molecule with molecular weight less than 1000 Da (Wolfender et al. 2015)
 - A primary metabolite is essential to sustain the life of an organism and directly involved in growth, development, and reproduction, such as amino acid
 - A secondary metabolite is not directly involved in growth, development, and reproduction; it is non-essential but may be necessary for survival in a given environment. They are related to defense and signaling mechanism; such as phenolic compounds and terpenoids.

Gene: from DNA to protein

- Transcription

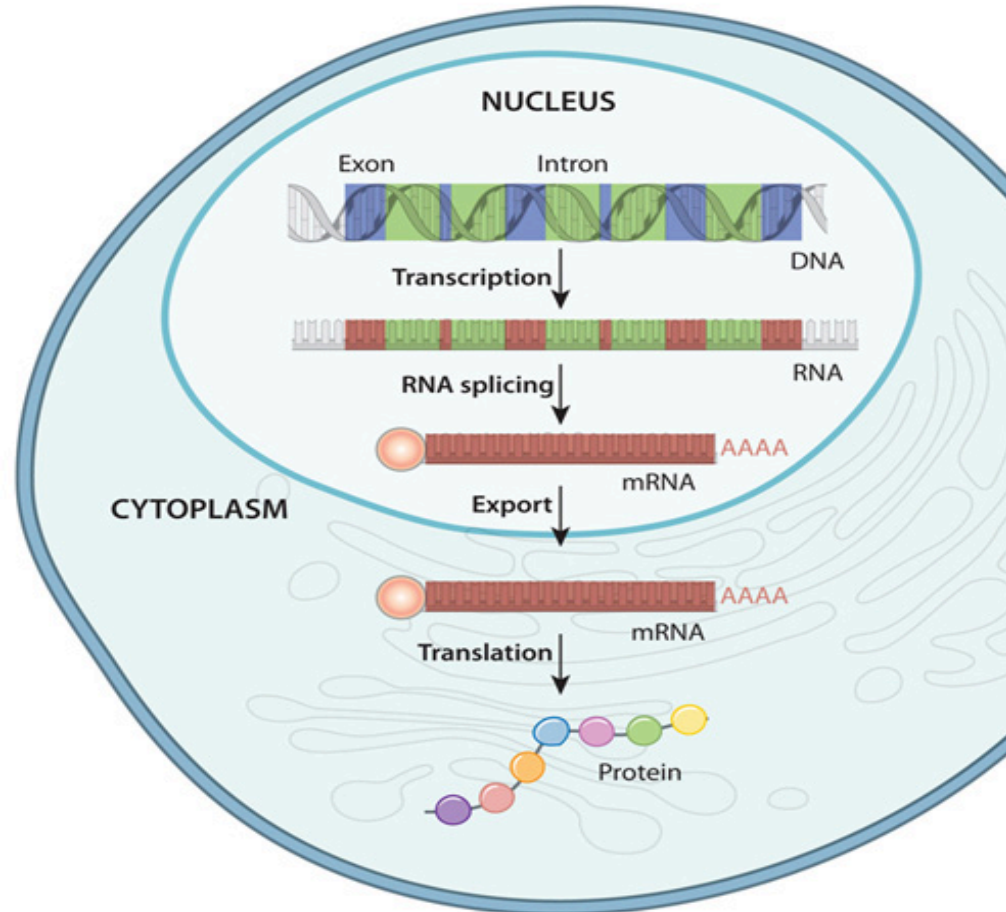
- <https://dnlc.cshl.edu/resources/3d/13-transcription-advanced.html>

- RNA splicing

- <https://dnlc.cshl.edu/resources/3d/rna-splicing.html>

- Translation

- <https://dnlc.cshl.edu/resources/3d/15-translation-basic.html>

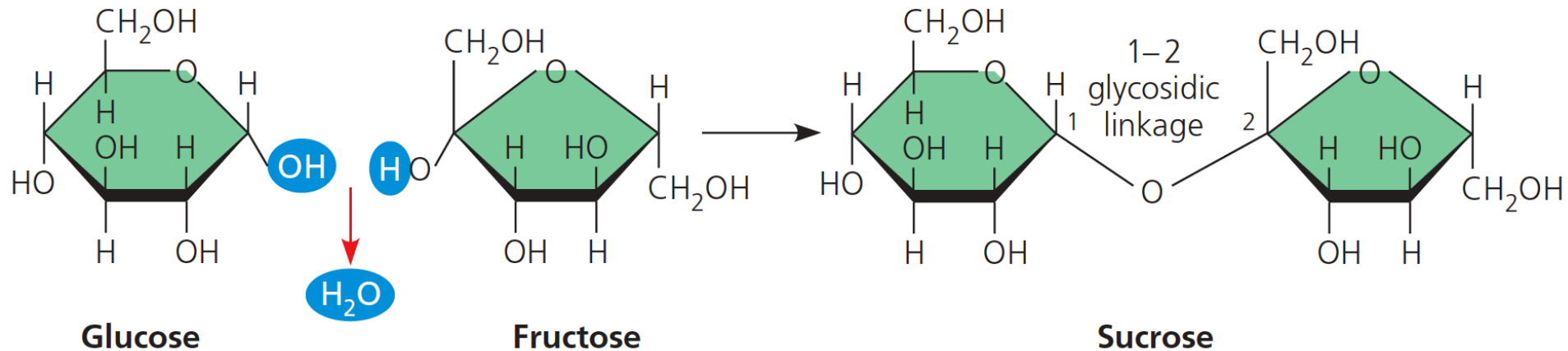


Proteins encoded by genes

- Defense
- Structure proteins
- Storage
- Transport
- Enzymes
 - Enzymes catalyze biochemical reactions
 - <https://pdb101.rcsb.org/learn/videos/how-enzymes-work>

Biochemical reactions

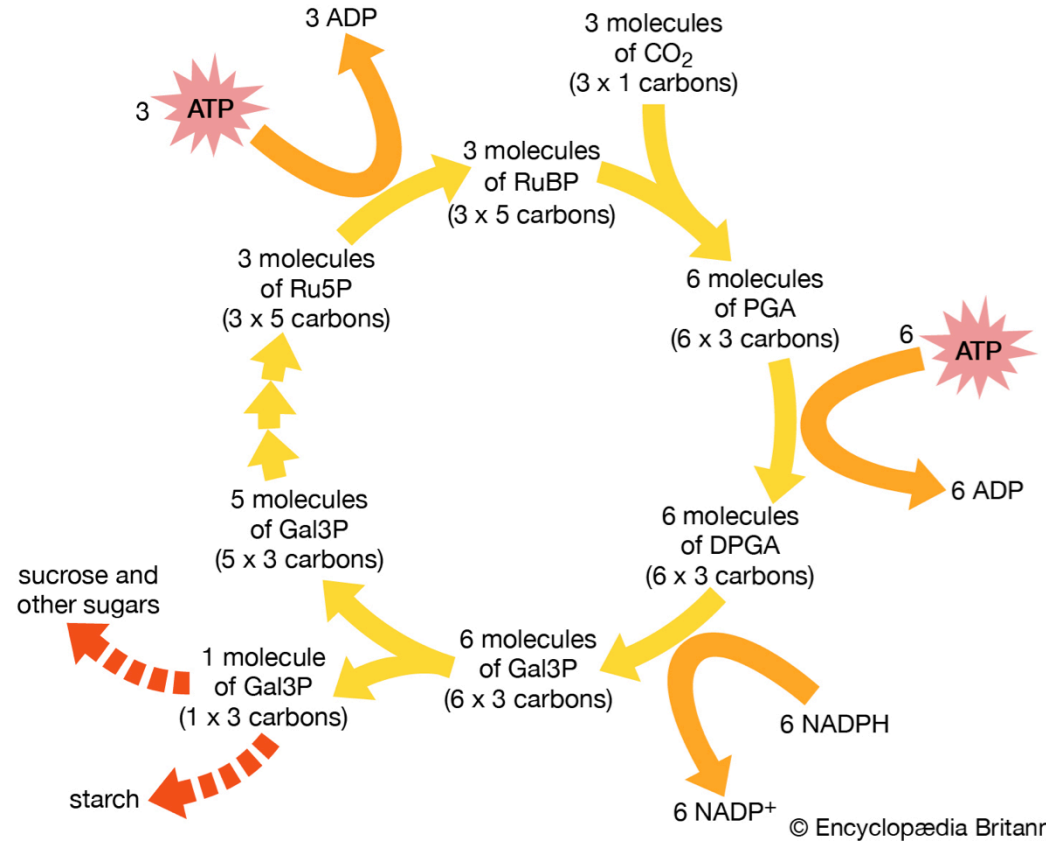
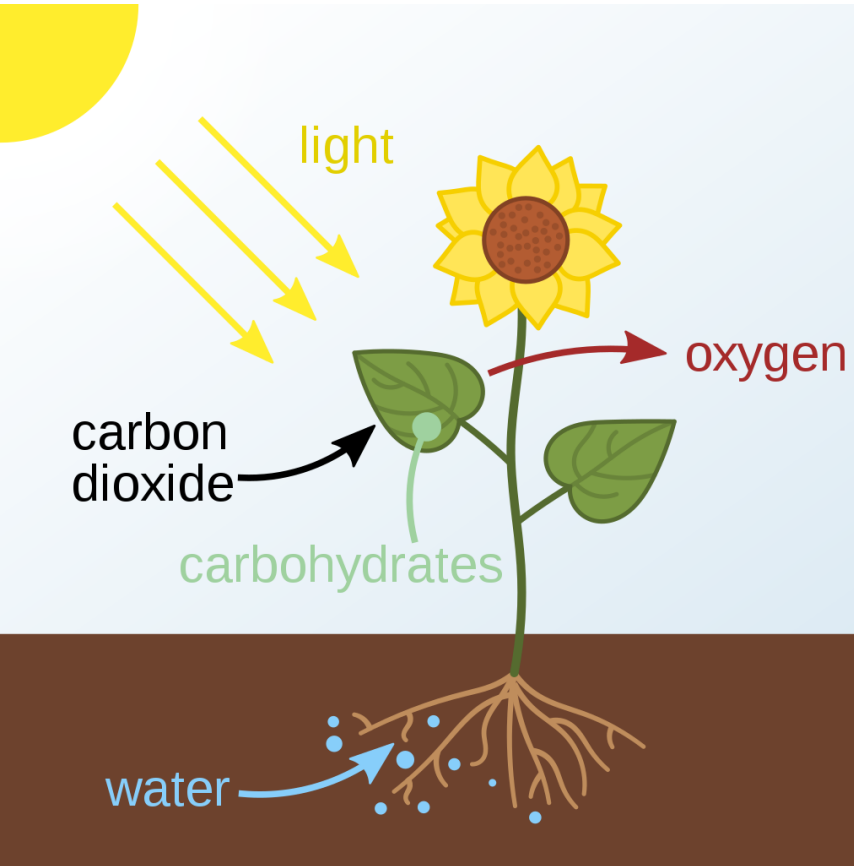
- Chemical reactions make and break chemical bonds, leading to changes of molecules



Biological pathway

- Cell contains thousands of molecules, mostly proteins and small chemical compounds. Groups of molecules work together to perform tasks, e.g., provide energy, respond to the environment, etc.
- A biological pathway is an ordered series of molecular events that leads to creation of a new molecule product or change in a cell

Photosynthesis pathway

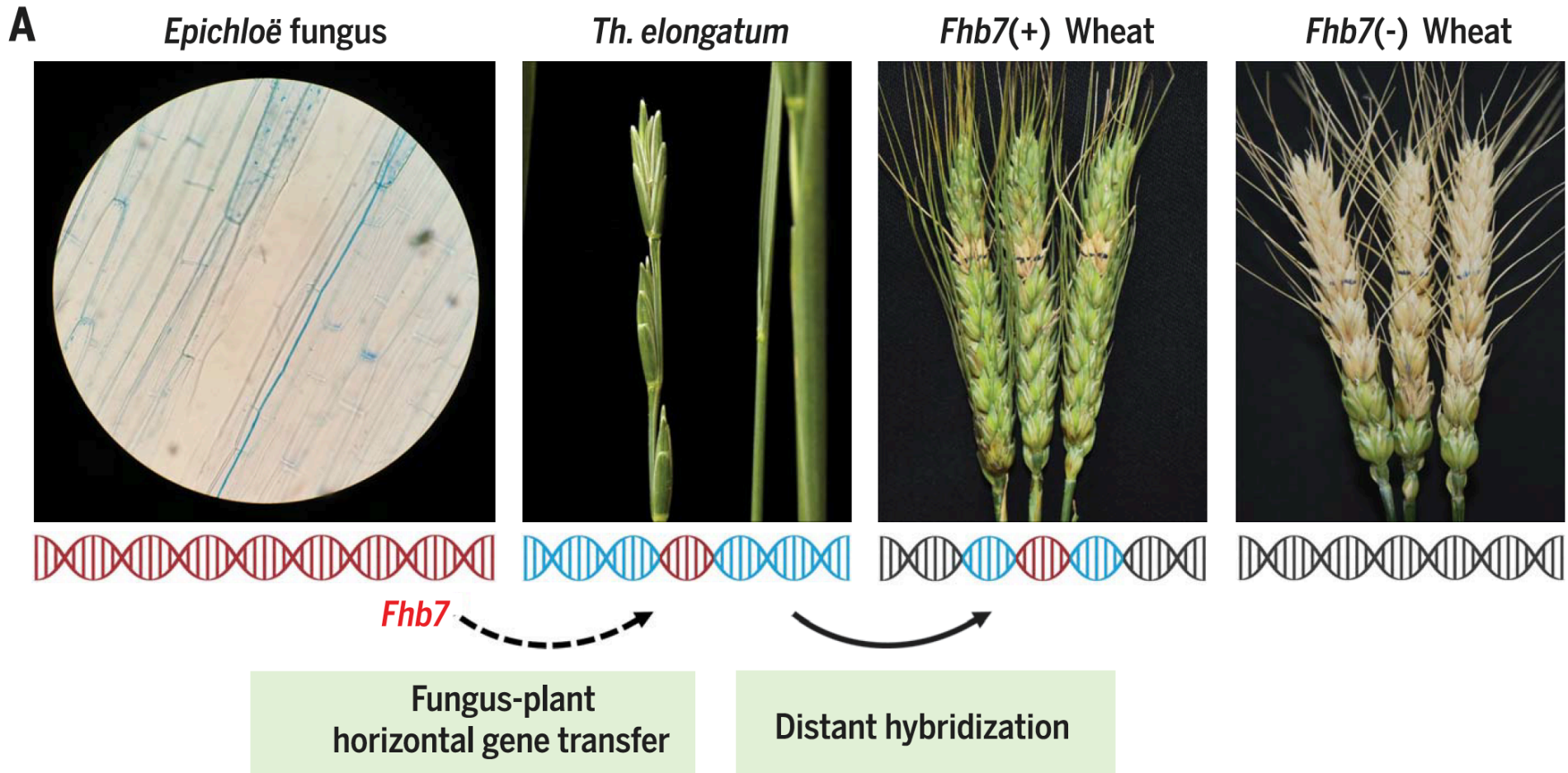


- Biological pathway database

- <https://reactome.org>

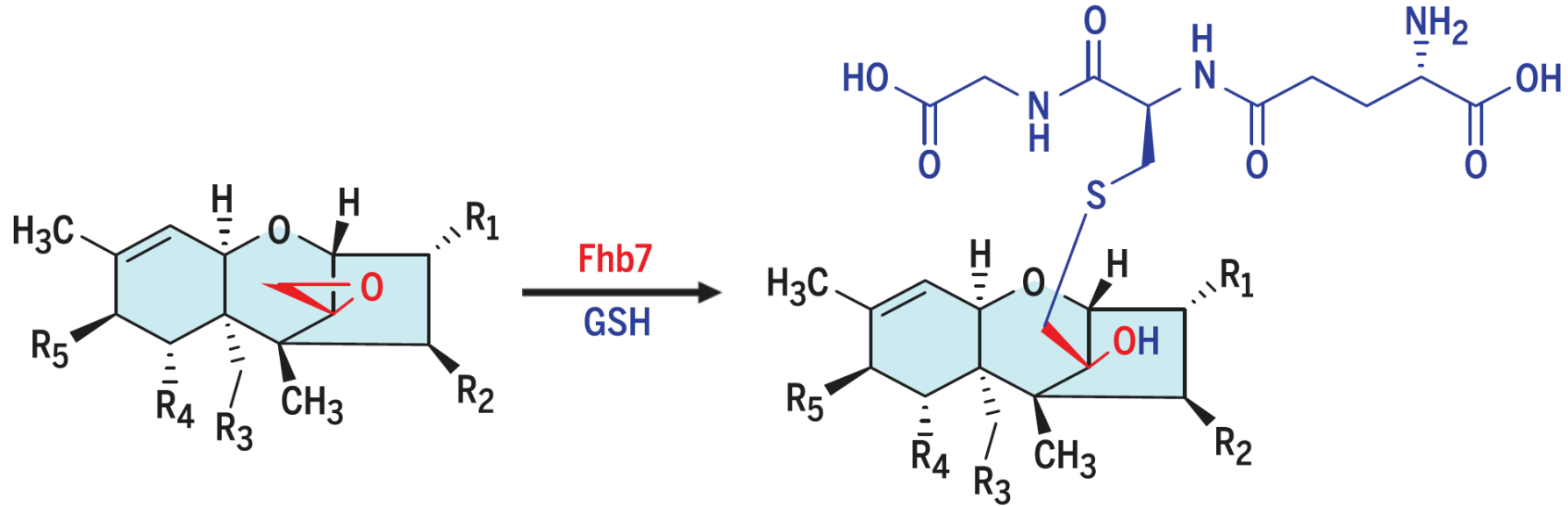
- <https://plantreactome.gramene.org/index.php?lang=en>

Fhb7, a gene related to resistance to Fusarium



Fhb7 encodes a GST that detoxifies Fusarium-produced trichothecenes

B



Wheat genome

- Allopolyploid ($2n=6x=42$, AABBDD), 17-gigabase
- 107,891 protein-coding gene (0.95%)
- Small RNA (0.05%)
- Repeat sequence (84.7%)
 - Retrotransposon
 - Transposon
- Unannotated DNA (14.4%)