Plantae Presents
How to read a scientific paper

Featuring Mary Williams and Michelle Facette

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Tuesday, January 17, 2023

8:00 AM PST | 11:00 AM EST | 4:00 PM GMT | 12:00 AM Beijing

Recording available at:

https://plantae.org/plantaepresents-how-to-read-a-scientific-paper/

American Society of Plant Biologists

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Presents

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Webinar Logistics

Technical issues?

Email **Jayson Padilla at jpadilla@aspb.org** or let us know in the chat/questions box

If you are currently unable to hear any audio, check your internet speed or try dialing in.

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How to read a scientific paper

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Tuesday, January 17, 2023
8:00 AM PST | 11:00 AM EST | 4:00 PM GMT | 12:00 AM Beijing

Speakers:

Dr. Mary Williams, Features Editor @ *The Plant Cell* and *Plant Physiology*

Dr. Michelle Facette, Assistant Professor @ U Mass Amherst

Moderator:

Xiaohui Li, PhD Candidate @ Purdue University West Lafayette

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Plantae Presents
How to read a scientific paper

Featuring Mary Williams and Michelle Facette

Outline for the webinar:

- Speaker introduction, by Xiaohui Li
- How to read a scientific paper, by Dr. Mary Williams
- Case study of the selected paper, by Dr. Michelle Facette
- Q & A
- Concluding remarks and useful links for further study

Attendees:

Please type your questions in the Q&A box 💬 (问答 / Preguntas y respuestas) anytime during the webinar.

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Speaker:
Mary Williams, PhD

- **Features Editor for *The Plant Cell* and *Plant Physiology***
- **Principal Investigator of the NSF-funded LEAPS: RCN: ROOT & SHOOT (Rooting Out Oppression Together and SHaring Our Outcomes Transparently)**

Mary Williams spent the first half of her professional career as a professor at a small liberal arts college (Harvey Mudd College) during which time she was chair of the ASPB Education Committee. In 2009 she joined the staff at ASPB.

She's active on Twitter and Mastodon as @PlantTeaching, and her greatest joy comes from seeing the spark of recognition when she helps someone understand a difficult concept, whether about photosynthesis or the effects of systemic racism.

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How to read a scientific paper

Why are you reading this paper?

Curiosity

As a class assignment

To advance your research

As a peer-reviewer

Mary Williams, PhD

Features Editor, *Plant Physiology* and *The Plant Cell*

@PlantTeaching

https://genomic.social/@PlantTeaching/

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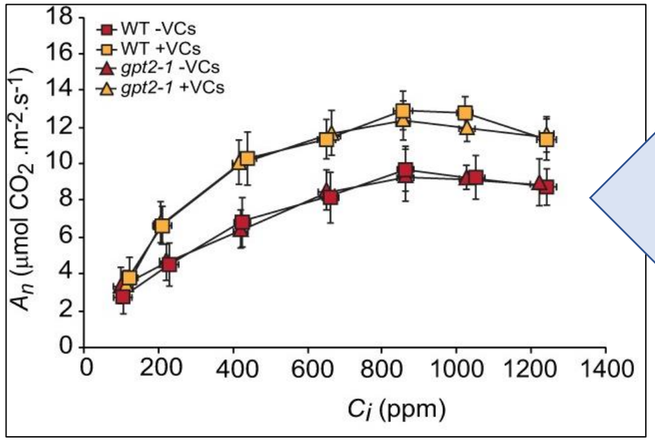
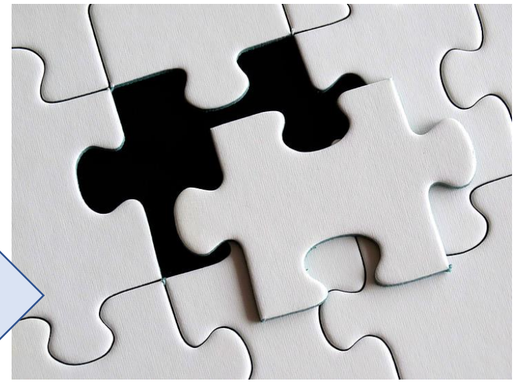
Some of the questions you'll seek to answer when you read a paper

What is the **question**? What new insights and applications come from the work?

What **methods** are used and are they appropriate?



What **results** are presented and how do the authors interpret their data?



Do the **conclusions** fit our current framework of understanding?

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Anatomy of a scientific paper

TITLE

AUTHOR INFORMATION

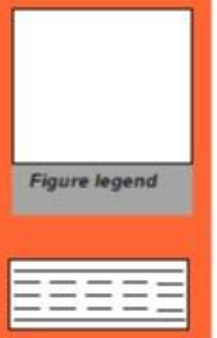
ABSTRACT: A summary of the study and findings, written by the author.

INTRODUCTION: A statement of what is currently known about the study subject that articulates the questions being investigated. It cites other scholarly works, lays the foundations for the study, and sometimes states a hypothesis to be tested.

RESULTS: A description of the research conducted and the results obtained.

Results are presented as tables, large datasets, and figures, which can include graphs, videos, diagrams, and photographs.

Some papers include additional supporting data as a supplement.



DISCUSSION: An analysis and interpretation of the data presented that integrates the new information with prior findings, states the implications of the work, and sometimes generates new hypotheses tobe tested.

METHODS: A description of how the studies were conducted, with sufficient detail so that others can repeat them exactly.

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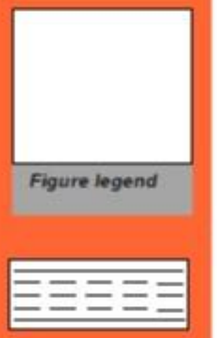

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How I read most papers

1. Title
2. Abstract
3. Intro (skim)
4. Summary figure (if available)
5. Results – focus on figures
6. Discussion – referring back to figures

7. Only occasionally do I read the methods
8. I don't "read" the list of references, but use it as a source for additional background information
9. Sometimes I look at supplemental data to get more information about the results or methods

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Some of the questions you'll seek to answer when you read a paper

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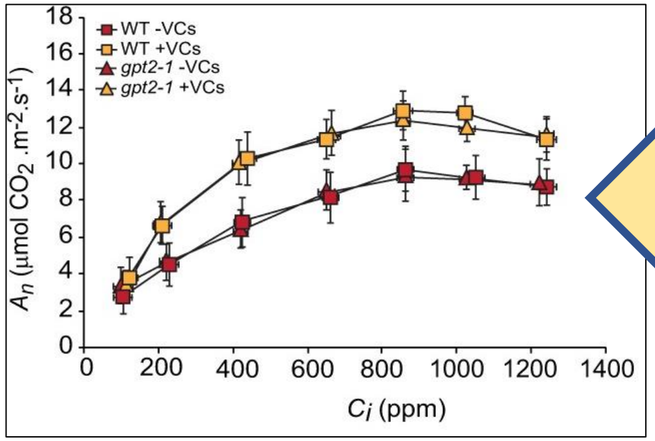
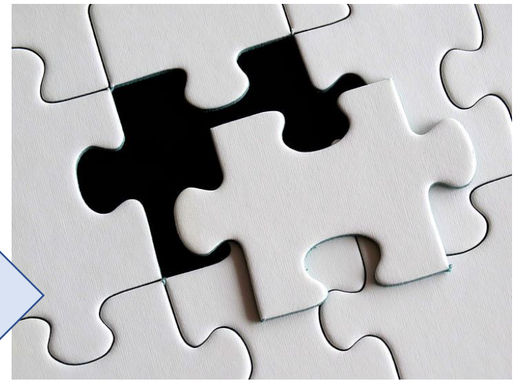


What **results** are presented and how do the authors **interpret** their data?



Do the conclusions fit our current framework of understanding?

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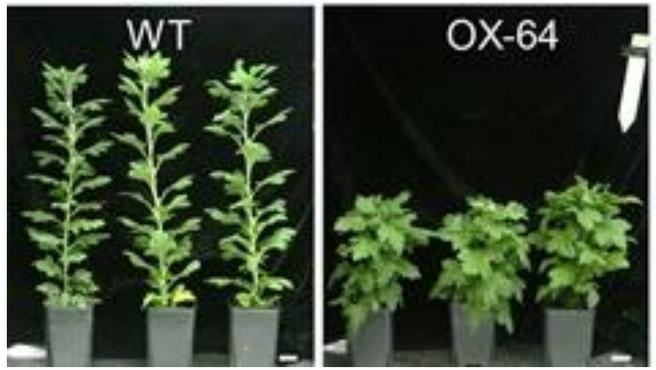
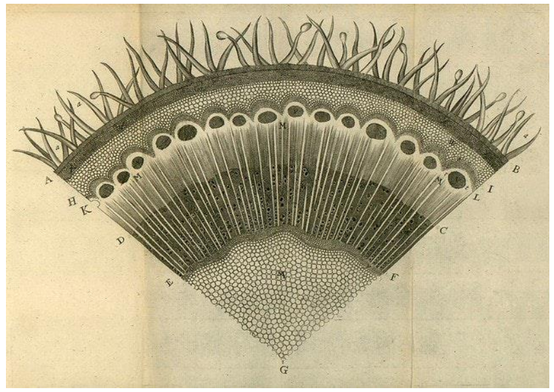
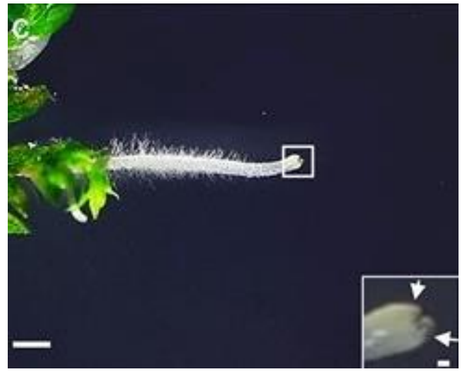
Study the data: Qualitative, quantitative, summary, and supplemental data

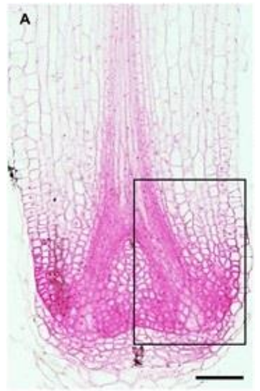
Qualitative data: Usually photographs (formerly drawings). Plants, tissues, cells, colonies

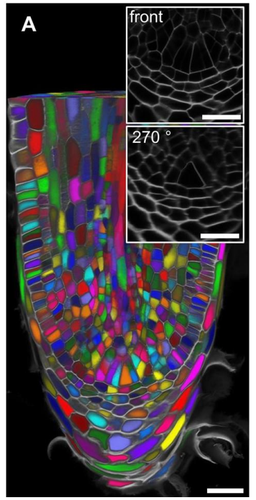


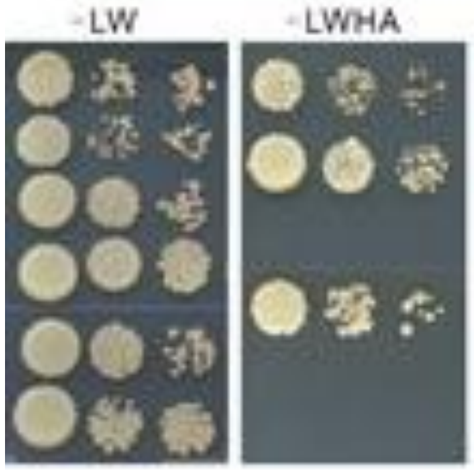


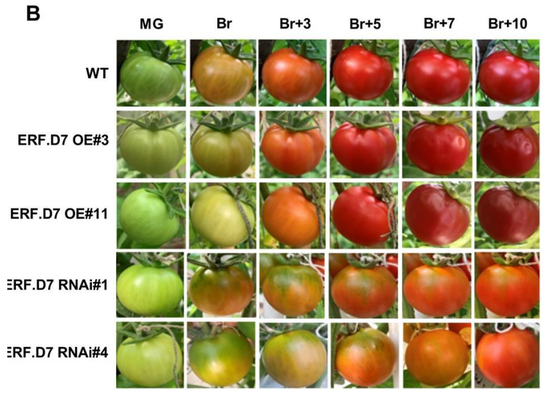
Nehemiah Grew's Anatomy of Plants (1680)

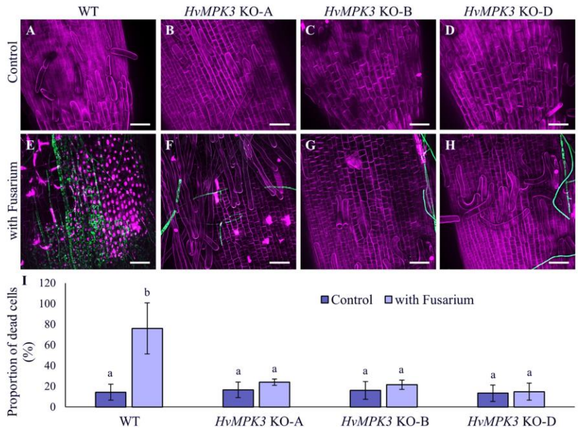












Often qualitative data can be quantified

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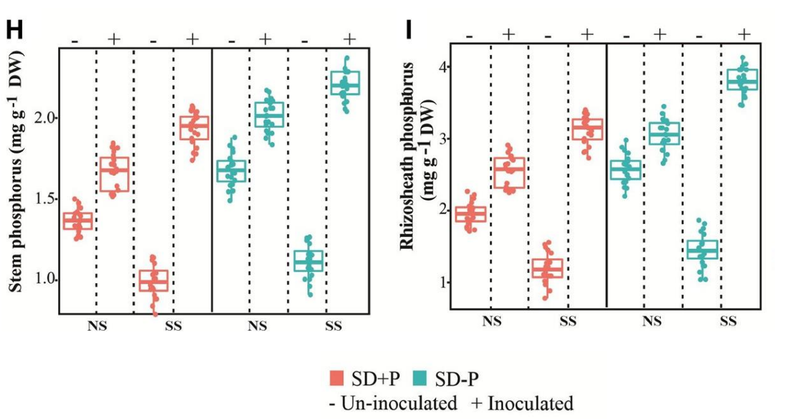
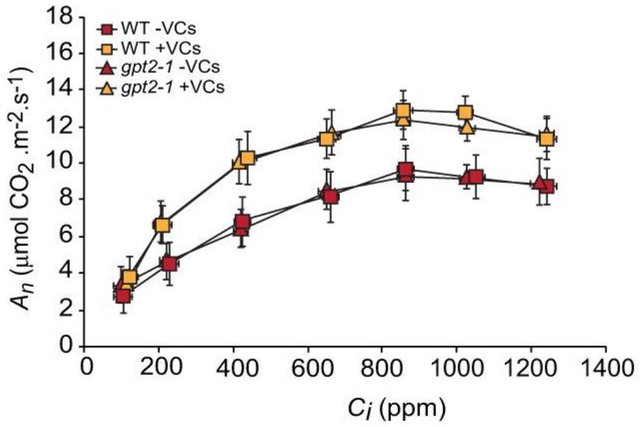
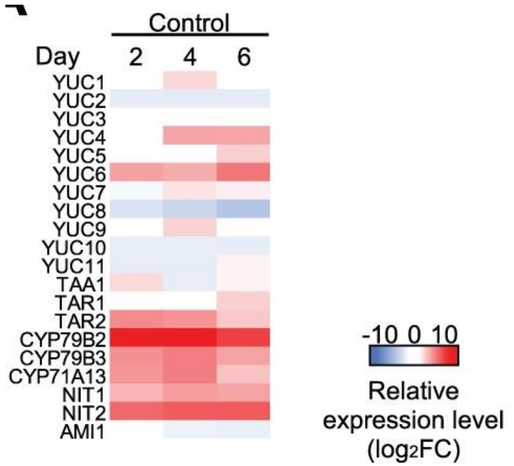
Study the data: Qualitative, quantitative, summary, and supplemental data

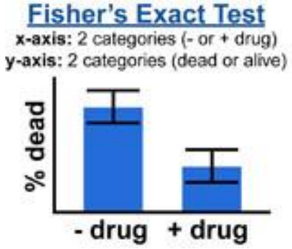
Quantitative data: Measurements, counts, dose-response curves, transcript abundance, etc.

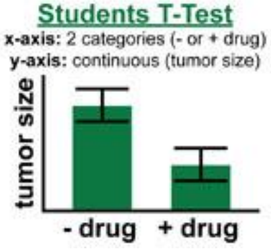


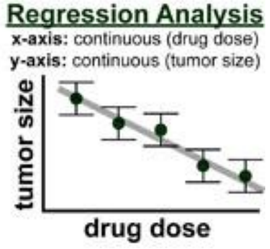


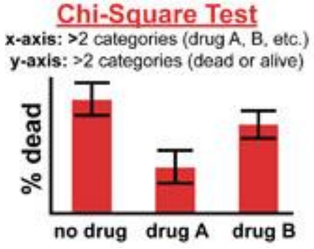


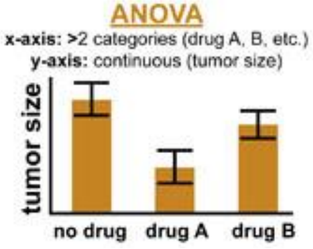
Data are presented so that you can examine the experimental results and see if you agree with how they are interpreted.

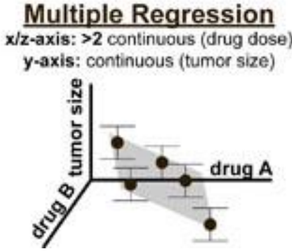












Check the statistical tests too.

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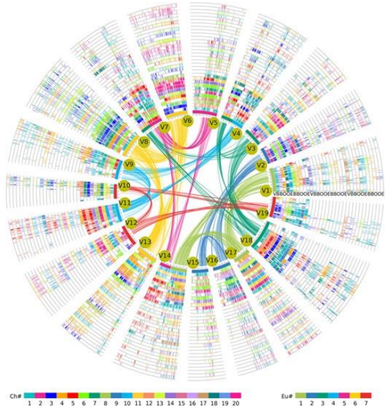
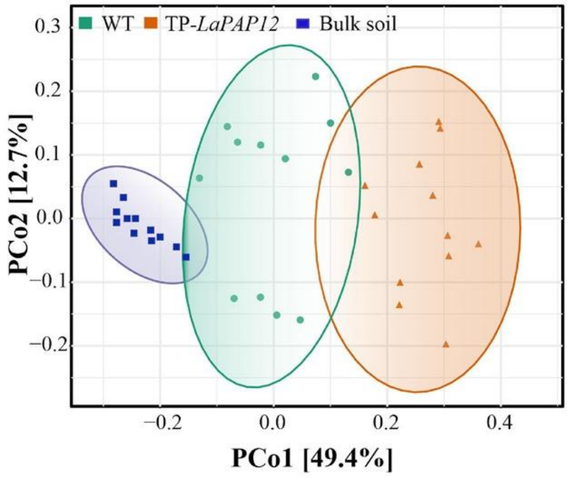
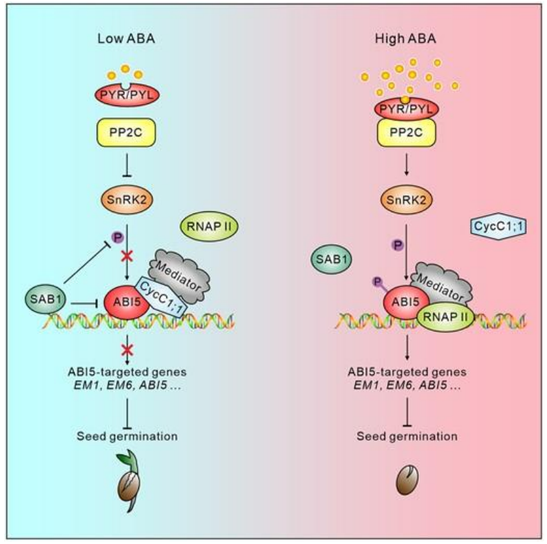
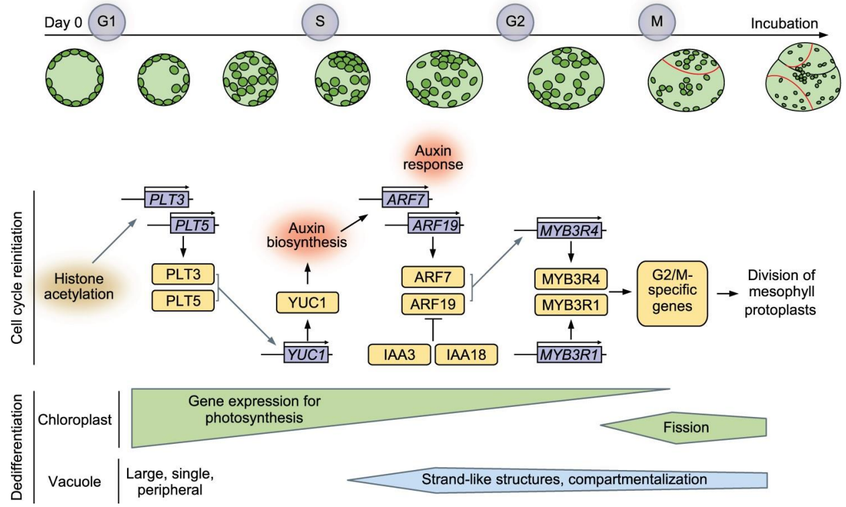
Study the data: Qualitative, quantitative, summary, and supplemental data

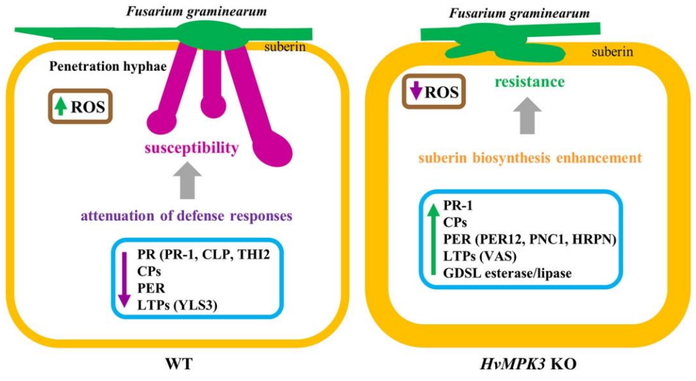
Summary figures and data, summary models:











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Study the data: Qualitative, quantitative, summary, and supplemental data

Supplemental figures and data:

Supplemental data

The following materials are available in the online version of this article.

Supplemental Figure S1. Toxicity of secreted proteins and other compounds from *Botrytis* rely on protein activity.

Supplemental Figure S2. Transient expression control of candidates from *Botrytis*.

Supplemental Figure S3. Expression control of truncated Hip1 derivatives and cysteine mutants.

Supplemental Figure S4. Protein expression and structure prediction of Hip1.

Supplemental Figure S5. Hip1 toxicity is unaltered when fused to GFP but dependence on the presence of a SP.

Supplemental Figure S6. Virus-induced gene silencing of BAK1 and SOBIR1 in *N. benthamiana*.

Supplemental Figure S7. Analysis of *Botrytis hip1* overexpression strains.

Supplemental Figure S8. Secondary lesion formation by *Botrytis*.

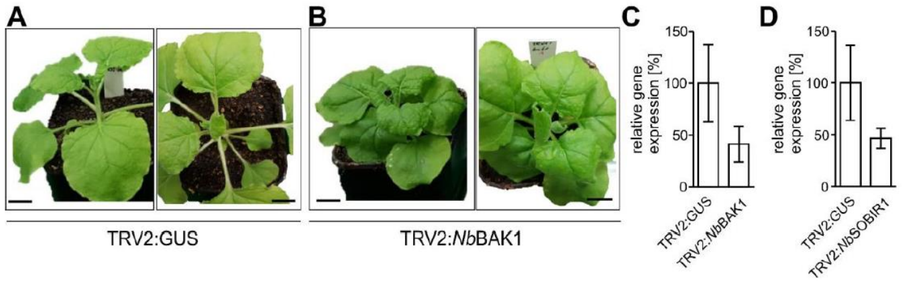
Supplemental Table S1. List of tested candidate genes.

Supplemental Table S2. Alignment of Hip1 homologs.

Supplemental Table S3. Primers used in this study.

8 figures

3 tables



Supplemental Figure S6. Virus induced gene silencing of BAK1 and SOBIR1 in *N. benthamiana*.
(A) Control plants in comparison to BAK1 silencing (B) 20 days' post TRV1/TRV2 infiltration. RT-qPCR of BAK1 (C) and SOBIR1 (D) silenced plants. The control (TRV2:GUS) was set to hundred percent and the experiment carried out three times (n=3). Bar graph shows the mean of three biological replicates with the standard error. The images were digitally extracted for better comparison. Scale bars = 2 cm.

Supplemental table S1. List of tested candidate genes.

Candidate	Gene Accession	Function [PFAM output/assigned]	Fold change [in vitro vs infection]	Size [kDa]
C1	Bcin01g06010	*Glycosyl hydrolases family 16*	-2.1	40
C2	Bcin02g07100	*GDSL-like Lipase / Acylhydrolase family*	12.8	28
C3	Bcin03g05720	*unknown*	30.5	17
C4	Bcin06g06410	*Fungal cellulose binding domain*	165	40
C5	Bcin07g02650	*Cellulase (glycosyl hydrolase family 5)*	215	45
C6	Bcin14g00850	*Glycosyl hydrolases family 28 /* ***BcPG1***	3.1	40
C7	Bcin15g03150	*Pro-kumamolisin, activation domain /* ***Sedolisin***	3.5	60
C8	Bcin01g11160	*Glycosyl hydrolases family 28 /* ***Exopolygalacturonase***	17.1	45
C9	Bcin08g00280	*Serine carboxypeptidase*	12	50
C10	Bcin08g02970	*Pectinesterase /* ***BcPME1***	2.4	38
C11	Bcin09g04790	*Glycosyl hydrolases family 39*	47	52
C12	Bcin11g06400	*unknown*	-2	15

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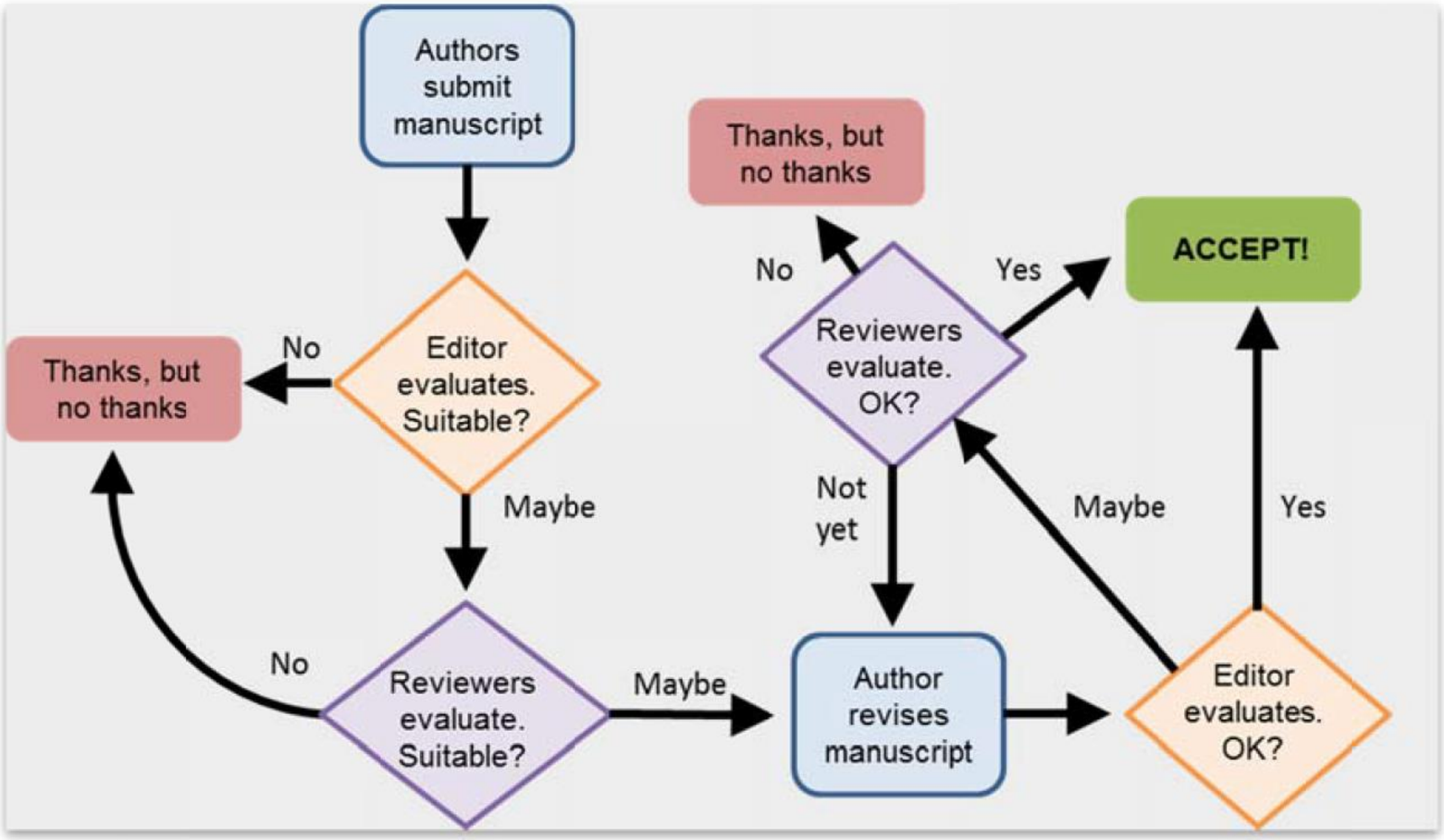
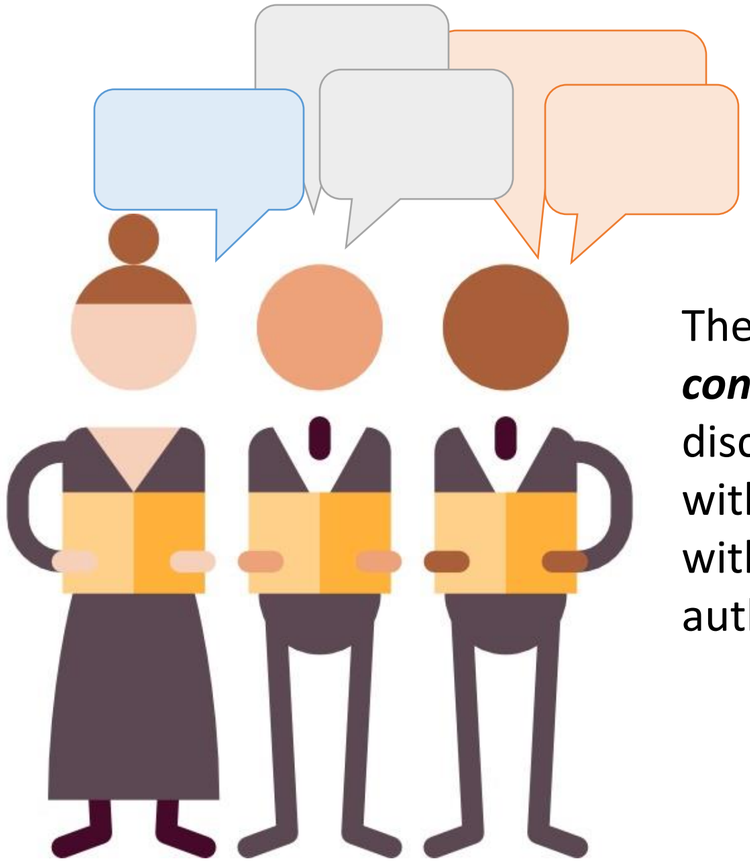
The peer review process (classic and new)



If available, look at the peer reviews or editorial decision letter

Qualified reviewers each evaluate the paper independently



Then, in the ***post-review consultation***, the reviewers discuss their reviews, and work with the editor to write a response with recommendations to the author

REPORT:(The report shows the major requests for revision and author responses. Minor comments for revision and miscellaneous correspondence are not included. The original format may not be reflected in this compilation, but the reviewer comments and author responses are not edited, except to correct minor typographical or spelling errors that could be a source of ambiguity.)

TPC2021-RA-00153 1st Editorial decision – *revision requested* **Mar. 31, 2022**

We have received reviews of your manuscript entitled "S-acylated and Nuclear-Localized SOS3/CBL4 Stabilizes GIGANTEA to Regulate Arabidopsis Flowering Time under Saline Stress." Thank you for submitting your best work to The Plant Cell. The editorial board agrees that the work you describe is substantive, falls within the scope of the journal, and may become acceptable for publication, pending revision and potential re-review.

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The peer review process (classic and new)

bioRxiv
THE PREPRINT SERVER FOR BIOLOGY

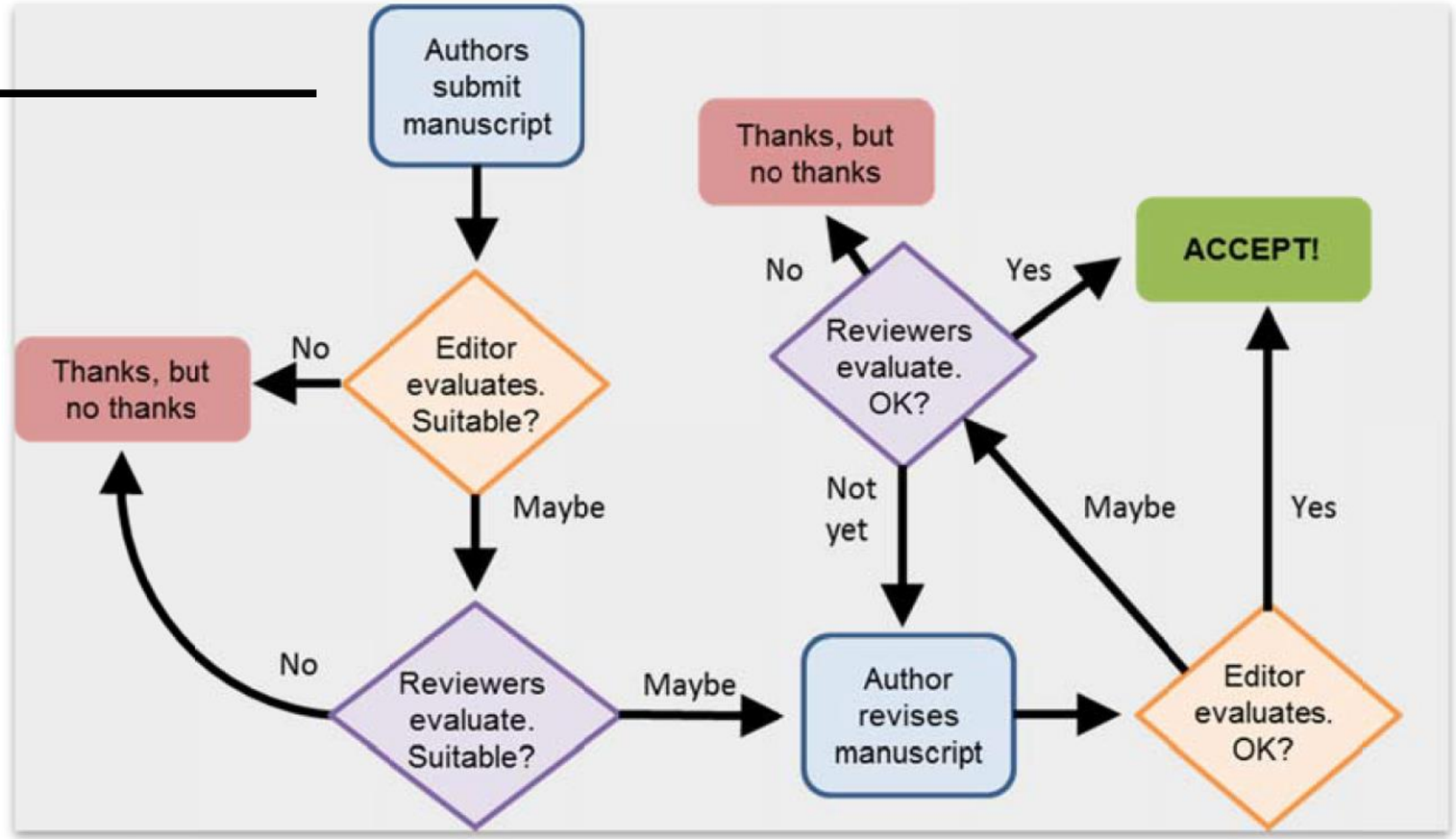
preLights

eLife **“Reviewed preprints”**
https://elifesciences.org/articles/83889

PREREVIEW

Research Square (Springer Nature)

sciety https://sciety.org/groups



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Why you should read scientific papers

Reading papers gives you the opportunity to understand the world. Be open minded, expand your horizons. Read beyond your comfort zone!

Reading papers helps develop your ability to understand and analyze data. Be a detective – are the experiments solid and the data interpreted reasonably, or are important clues overlooked?

Reading papers gives you ideas to enhance your own research. What new methods are available that could help you ask your own questions?

Reading papers as a reviewer lets you help others improve their studies, and ensures that the information that is shared with the public is sound.

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Figure legend

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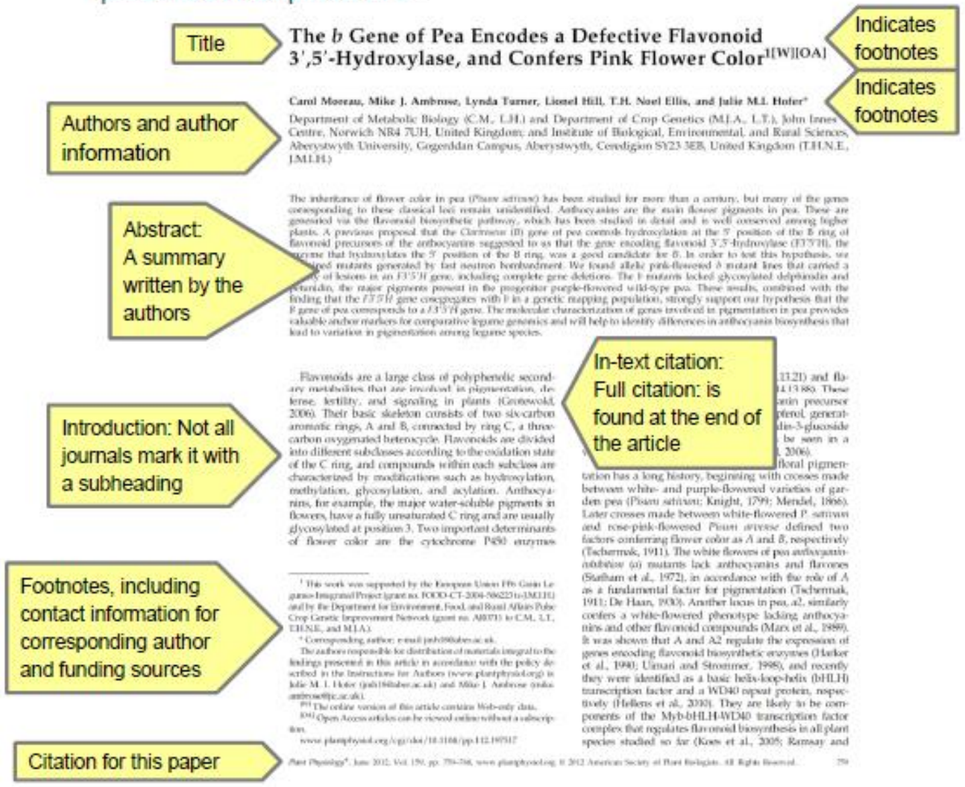
METHODS: A description of how the studies were conducted, with sufficient detail so that others can repeat them exactly.

REFERENCES: The list of the articles cited in the paper that provide information on the research topic and the methods used.

Case study: Reading a Primary Research Article from *Plant Physiology*

This case study examines a recent article published in the journal *Plant Physiology*. The full article is appended to this PDF. Because of space constraints, only the major points from the paper are covered in the case study, and the biochemical pathway is presented in simplified form.



The first page of a typical article from *Plant Physiology*.
(See text for more information about each section)

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Speaker:
Michelle Facette, PhD

Assistant Professor
Department of Biology
University of Massachusetts, Amherst

The Facette lab studies the cellular mechanisms of asymmetric cell division and stomatal function, primarily using maize as a model, and using a combination of microscopy, protein biochemistry and genetics approaches. Before joining the faculty of U Mass in 2018, she was an assistant professor at University of New Mexico for two years. Previously, she did her PhD work at Stanford University studying plant cell walls, and her postdoc work at UCSD focused on asymmetric cell division. She is active on Twitter as @facette_lab.

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Be kind to yourself!

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Prepare yourself:

- Get the materials
- Give yourself sufficient time
- Orient yourself (check the figures)
- Take notes
- Its okay to not understand everything the first time through!
- Get help: Google & colleagues

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The Plant Cell, Vol. 32: 3408–3424, November 2020, www.plantcell.org © 2020 ASPB.

BREAKTHROUGH REPORT

Evolutionary Variation in MADS Box Dimerization Affects Floral Development and Protein Abundance in Maize[OPEN]

María Jazmín Abraham-Juárez,[a,b,1] Amanda Schrager-Lavelle,[a,c,1] Jarrett Man,[a] Clinton Whipple,[d] Pubudu Handakumbura,[a,e] Courtney Babbitt,[a] and Madelaine Bartlett[a,2]

https://academic.oup.com/plcell/article/32/11/3408/609939

Part 1: The introduction.

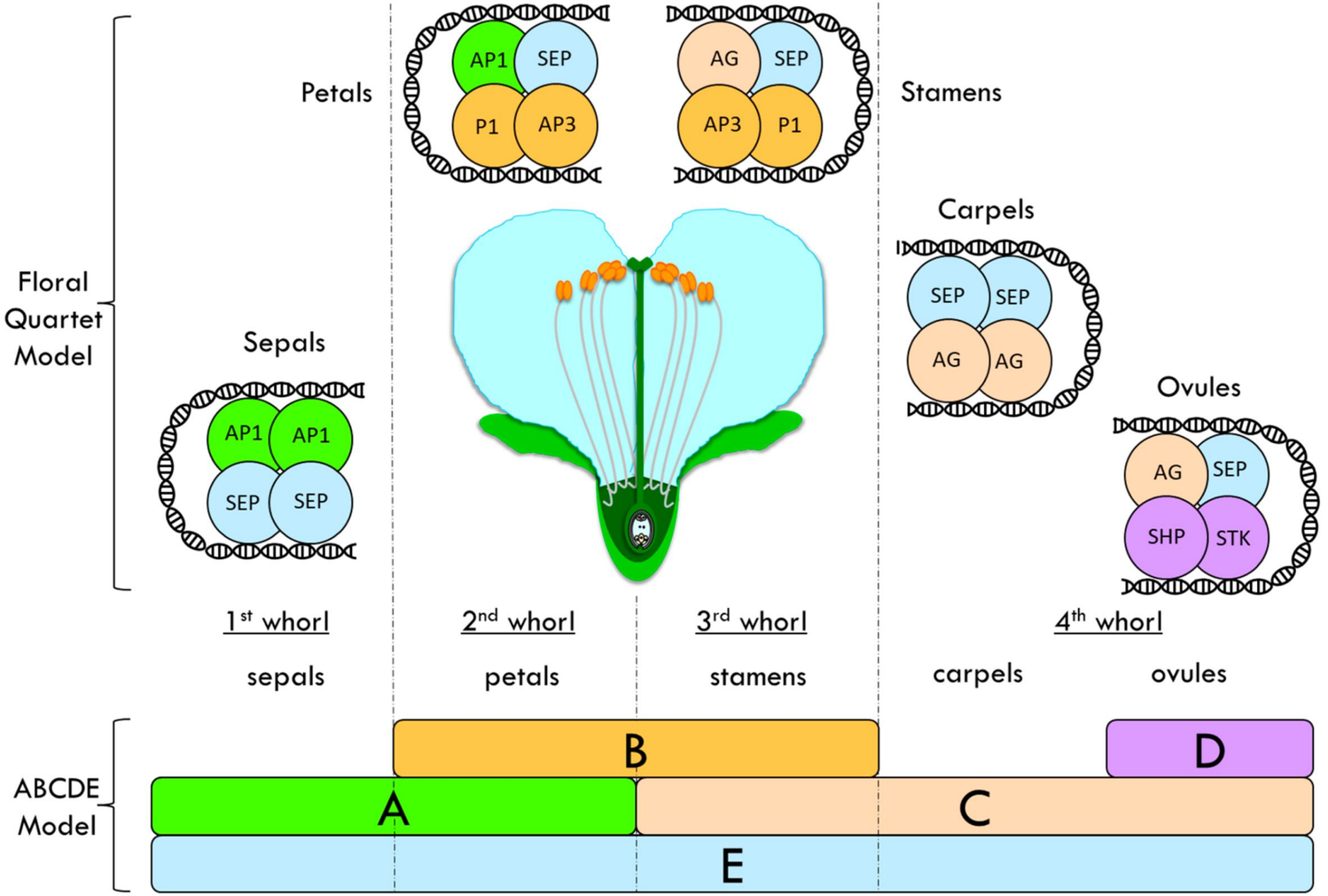
Do I know the background that I need to know to understand this paper?

What is the ABC(DE) model?

This paper is about B family genes.

Pay attention to petals and stamens!

Wait – what do maize flowers look like?!



Vignati, E., Lipska, M., Dunwell, J. M., Caccamo, M., & Simkin, A. J. (2022). Fruit Development in Sweet Cherry. *Plants*, *11*(12), 1531.

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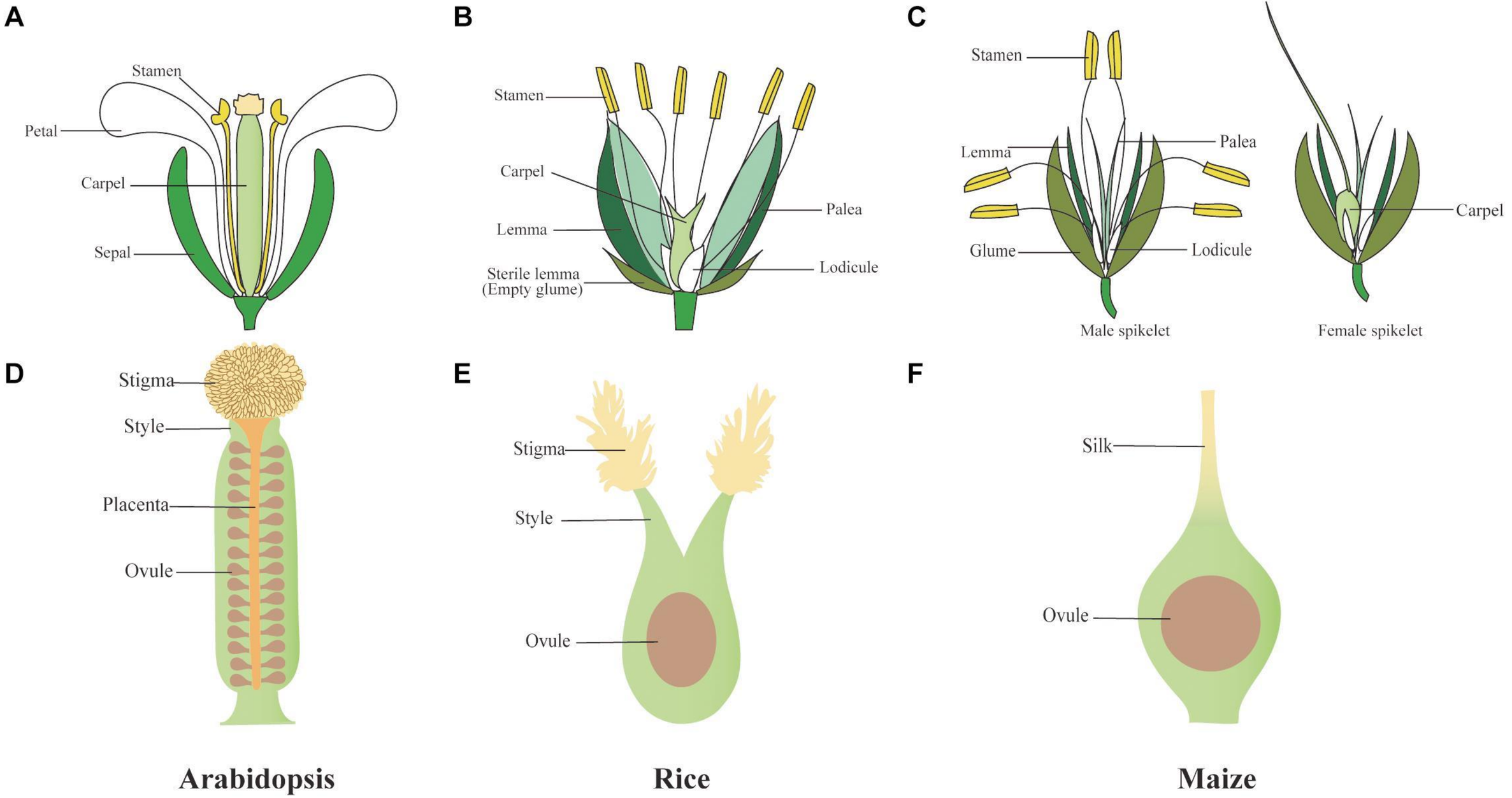

Shen, Chaoqun, et al. "Molecular control of carpel development in the grass family." *Frontiers in Plant Science* 12 (2021): 635500.

How do different flowers have different morphologies?

- How do genes that are conserved across different species lead to different morphologies?
- How do related transcription factor gene families lead to different floral morphologies?
- How do interactions of proteins important for floral development lead to variation in morphology?

- How do variants of the floral B class gene, STERILE TASSEL SILKY EAR (STS1), and its binding partners, affect maize floral development?

Part 2: The results
(aka Figures and Supplemental Data, with methods)

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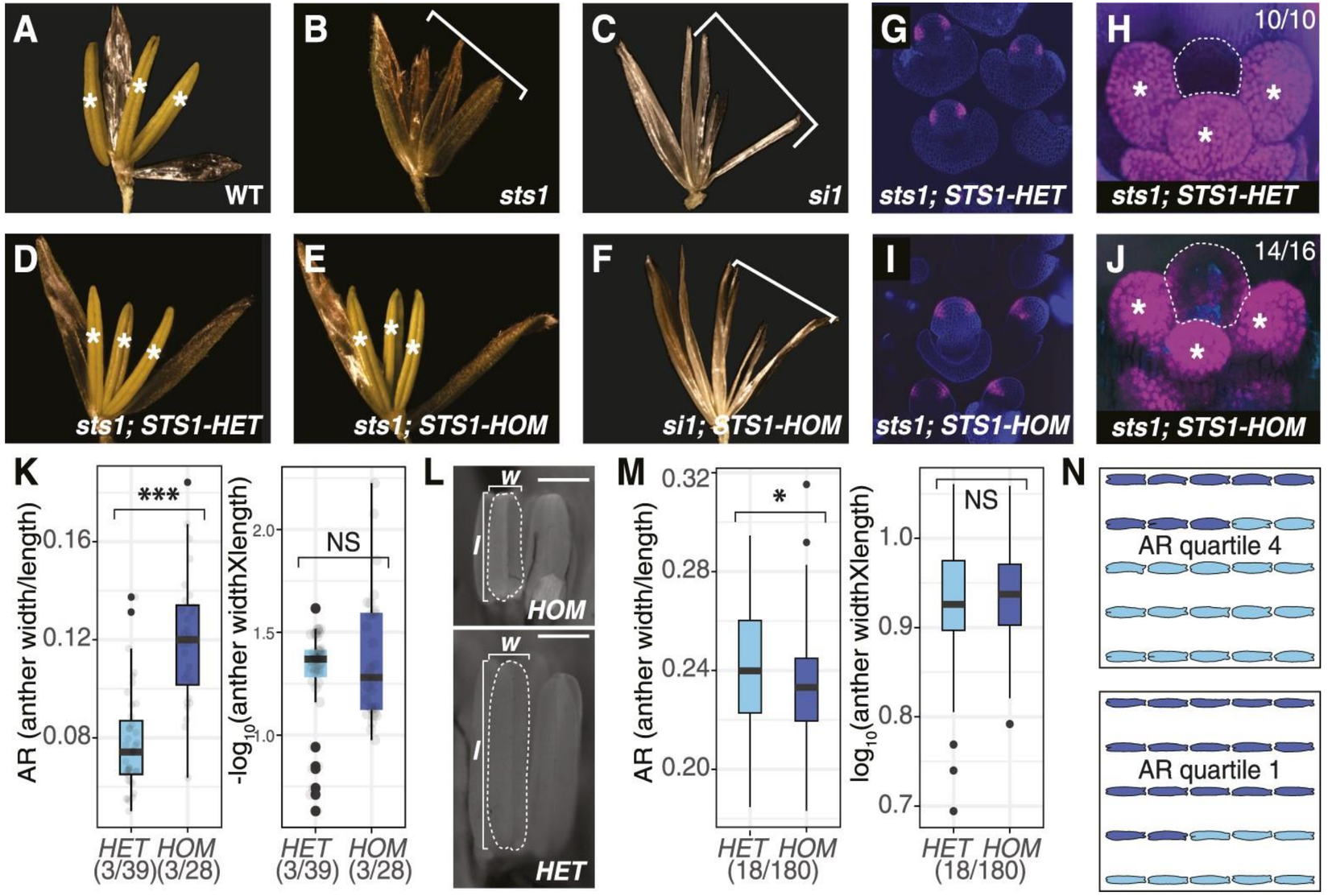
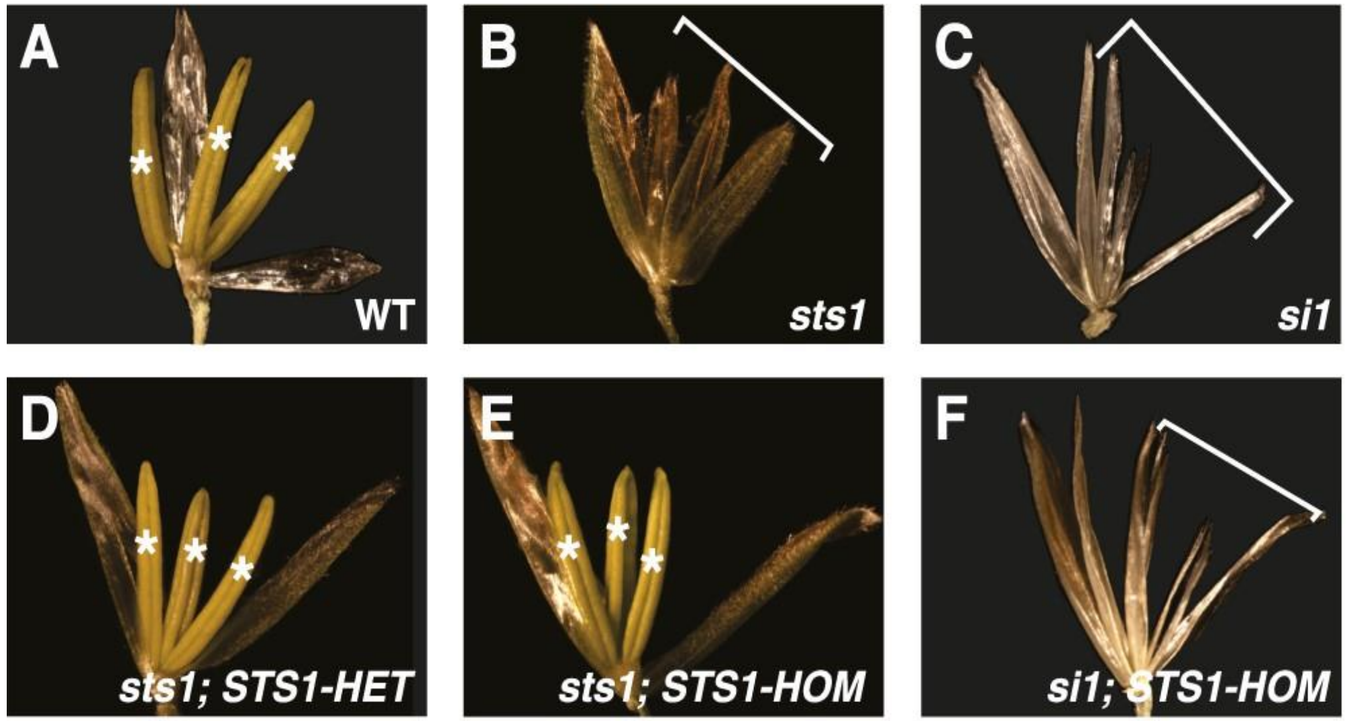


Figure 1. B-Class Dimerization Has Subtle Effects on Floral Development in Maize.

Plant Cell, Volume 32, Issue 11, November 2020, Pages 3408–3424, https://doi.org/10.1105/tpc.20.00300

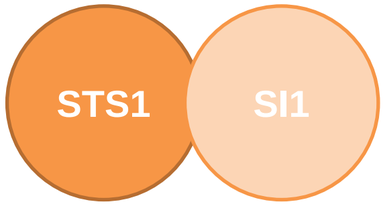


What did they do?

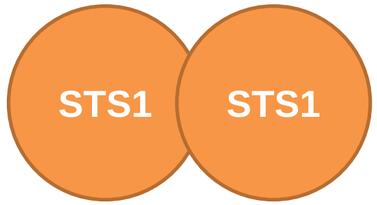
>*sts1* mutants do not have stamens or lodicules (petals)

Made transgenic plants that express different versions of STS1-YFP.

Asked:
Do these STS1 versions both "rescue" the mutant phenotype?
Do they look the same?



"normal" version
heterodimerizes
rescues



mutated version
homodimerizes
also rescues!

Draw pictures/diagrams to help you!

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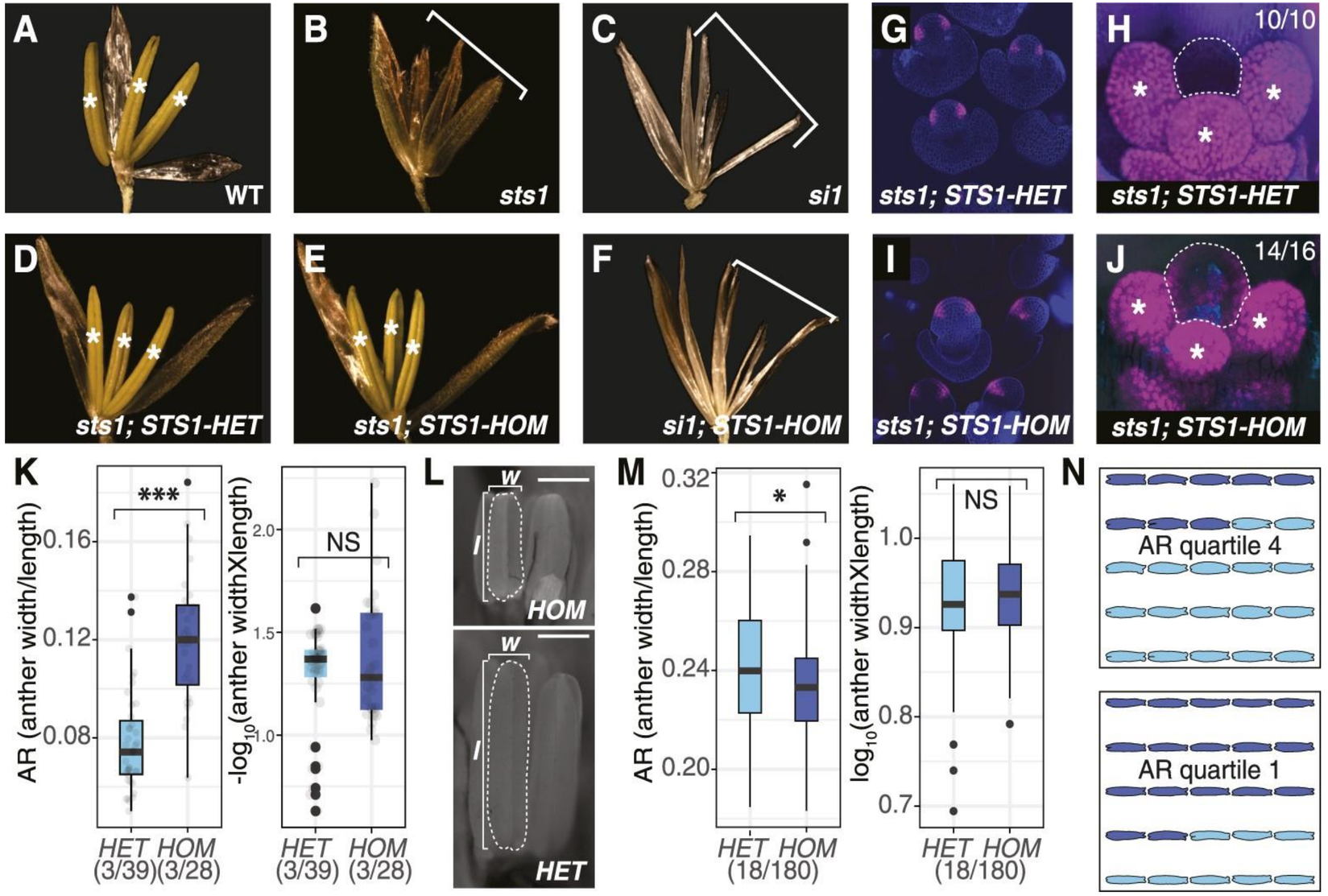

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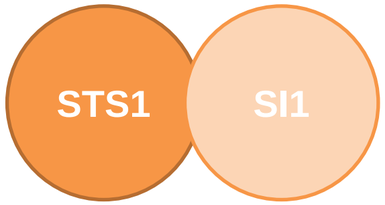
Figure 1 conclusions:

The B class gene STS1 is important for anther development.

STS1 can partner with and function with SI1, another B class gene, or itself, and make relatively normal flowers

BUT those flowers show some variation in morphology (anther size).
and the expression domains are slightly different.



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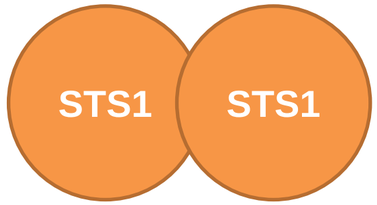

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also rescues!

How do different flowers have different morphologies?

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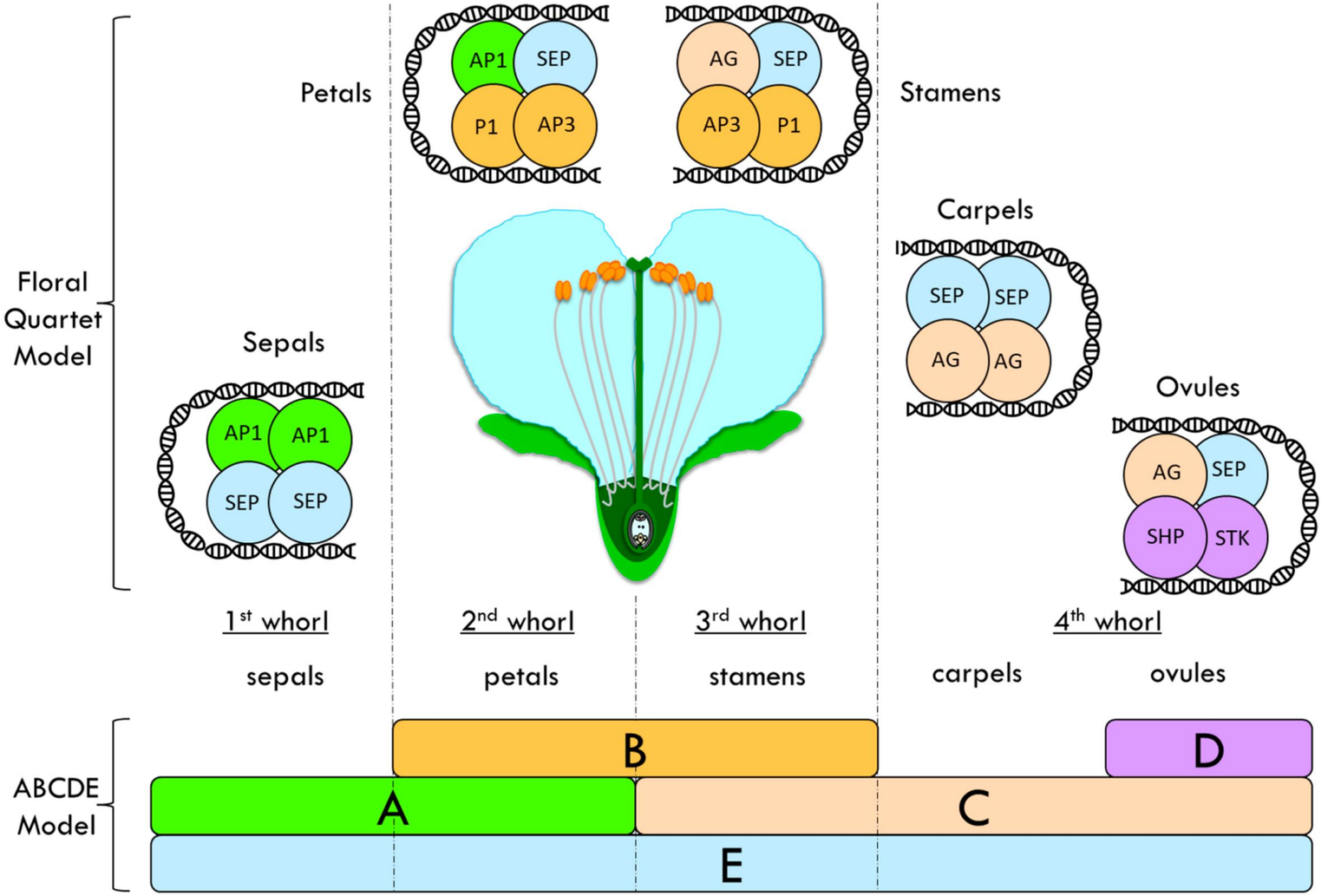

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What is the next question?

STS1 is a transcription factor. Do the genes expressed in flowers change when STS1 homo- or hetero-dimerizes?

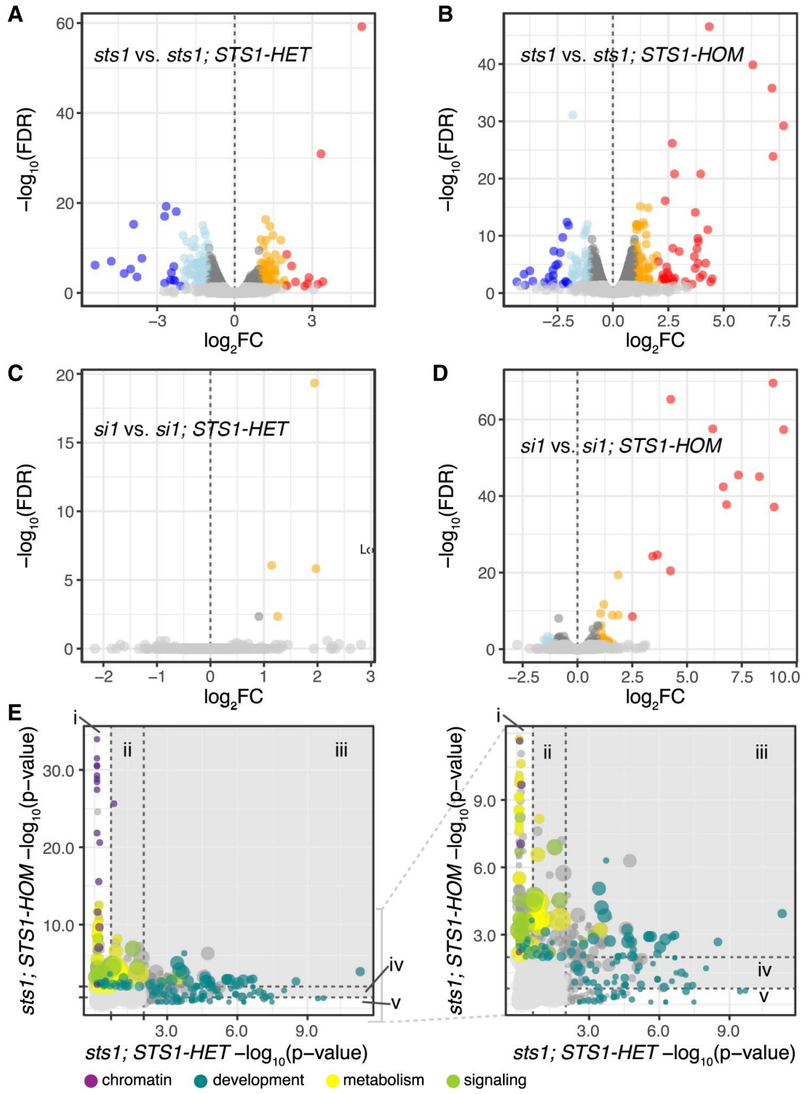

Figure 2. B-Class Dimerization Remodels Transcription in Developing Tassel Flowers.

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What do you do when there is an unfamiliar graph?

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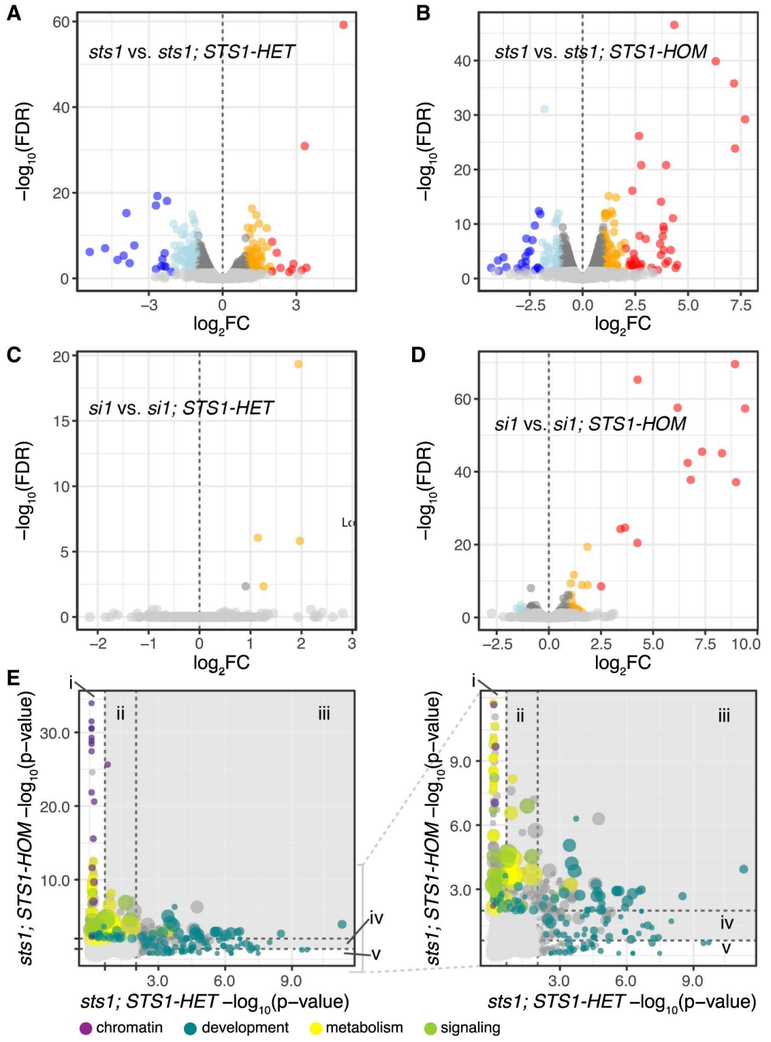

Check the text and the legend.
These are RNA-seq data!

What was the question?
Do the genes expressed in flowers change when STS1 homo- or hetero-dimerizes?

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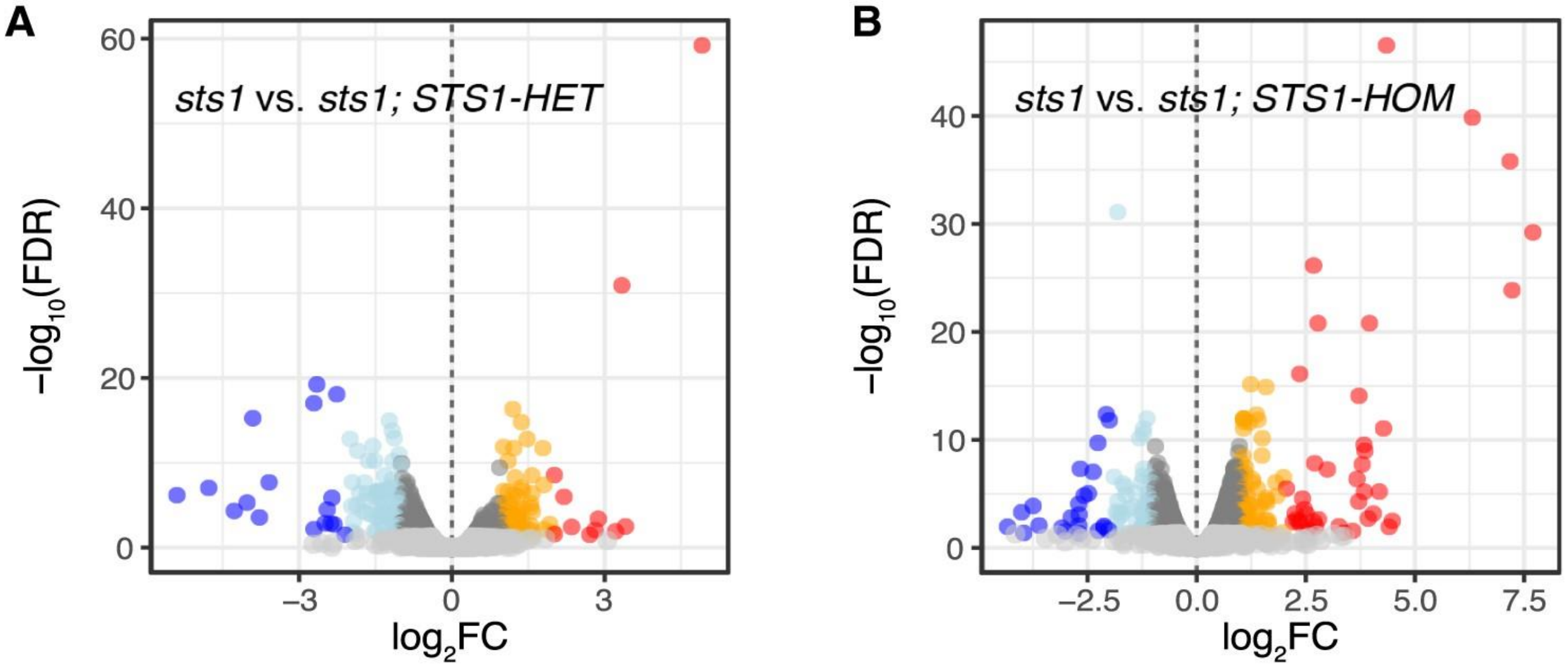

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What do you do when there is an unfamiliar graph?

What is the question being asked?
How does it tie into the “big picture” question?

- **Check the legend/text headings.**
- **Check the axes!**
- **Refer to the methods.**
- **Google is your friend…**
- **Its okay to ask for help! (Be kind to yourself)**

Sometimes you might not “get it” all.
Try at least to figure out what the question is the experiment addresses, and how it relates to the big picture.

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Figure 2 conclusions:

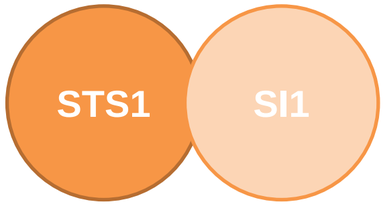
STS1-HOM and STS1-HET result in different genes being expressed.
STS1-HOM seems to have *more* differentially expressed genes.

WAIT!!
What did figure 1 say about STS1-HOM and STS1-HET again?

Figure 1 conclusions:

STS1 can partner with and function with SI1, another B class gene, or itself, and make relatively normal flowers.

BUT those flowers show some variation in morphology



“normal” version
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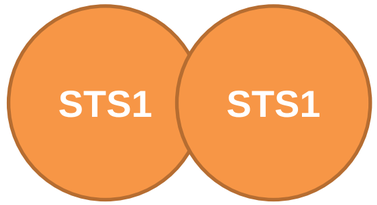

mutated version
homodimerizes
also rescues!

Figure 2 conclusions:

STS1-HOM and STS1-HET result in different genes being expressed.
STS1-HOM seems to have *more* differentially expressed genes.

How are they different??

“Big data” like transcriptomics and proteomics are not always easy to understand from a simple figure. The text can really help here.

In the text:

“These GOterms, specific to STS1-HOM, were almost all related to chromatin assembly and protein modification.”

Nitty gritty details for experts: Check the supplemental data.

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What did we learn so far?

- **STS1 can function as a homodimer (engineered) or a heterodimer (wildtype)**
- **Different dimerization leads to subtly different floral morphologies.**
- **Different dimerization leads to different gene expression.**

What about the protein-protein interactions? How are they different?
Figure 3!

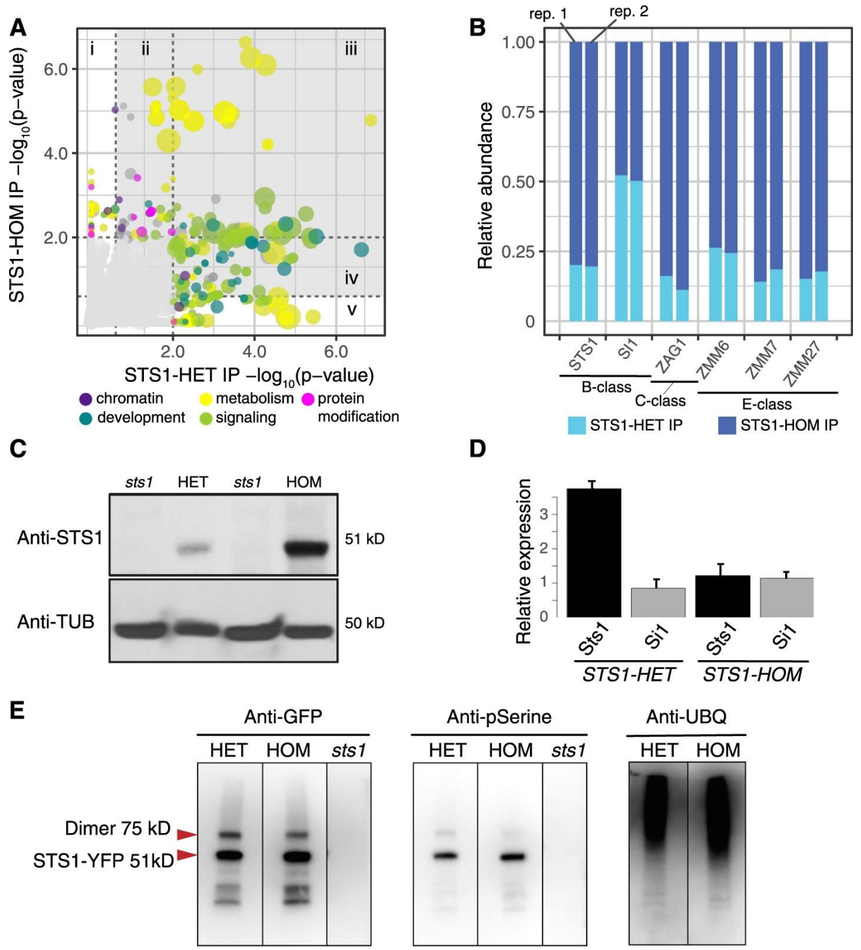

Figure 3. B-Class Dimerization Affects Protein Abundance and Protein Complex Assembly in Developing Tassels.

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Conclusions from Figure 3:

- **STS1-HET and STS1-HOM have overlapping, but also distinct, binding partners.**
- **STS1-HOM protein is more abundant, but STS-HET RNA is more abundant**
    - **implies regulation on the protein level**
- **Both STS1-HET and STS1-HOM are ubiquitinated.**

Part 3: The discussion

Integration of the results

-from within the paper

-from across the field

Is there a model?

(Its okay to draw your own!)

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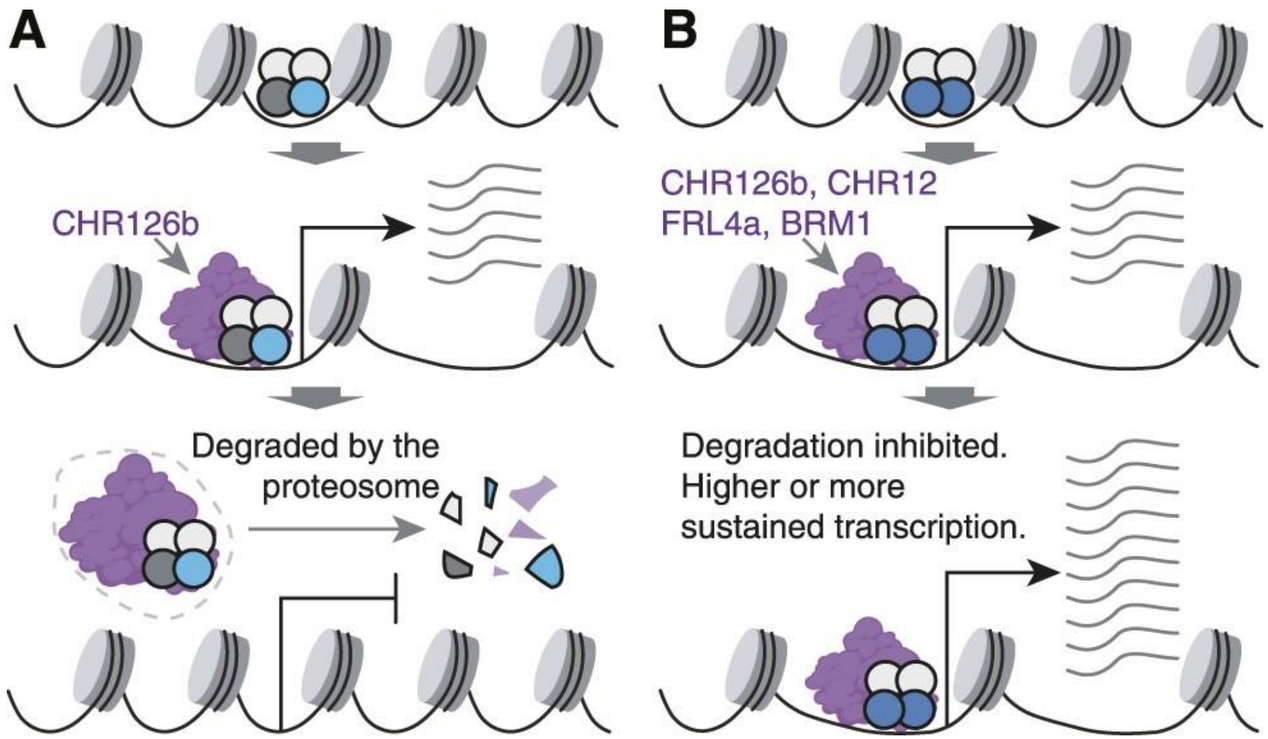

Figure 4. An Activation-Degradation Model for the Consequences of Differential B-Class Dimerization.

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Did the authors answer the questions?
What is outstanding? What do YOU want to know next?
Are there any techniques you are still confused by?

Are there any holes?
Are all the assumptions correct?
Could the data be interpreted another way? (Check those methods!)

Check:

In a nutshell (in the Plant Cell): good for next steps!
Are there reviews available?
What is in supplemental data you may have missed?
Check Google Scholar – what have the authors done next? Who has cited this?

Do you want to re-read the earlier figures, now you “know” the story?
Talk about it with colleagues!

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Be kind to yourself!

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Moderator: Xiaohui Li

PhD Candidate
Department of Botany and Plant Pathology
Center for Plant Biology
Purdue University, West Lafayette

Xiaohui Li is a cell biologist who occasionally do some coding. He is currently studying the mechanism and regulation of the exocytosis process in plant cells, using a combination of quantitative cell biology, chemical genetics and computational biology approaches. Beyond that, he has broad interests in plant biology, including cell dynamics, evolution and host-microbe interactions. Xiaohui is now serving as a Plantae Fellow and can be reached on Twitter as @Xiao_hui_Li.

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Q&A

Attendees:

Please type your questions in the Q&A box 💬 (问答 / Preguntas y respuestas).

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Useful links

How to Read a Scientific Paper? By Mary Williams

https://blog.aspb.org/how-to-read-a-scientific-paper-and-case-study-reading-a-plant-physiology-article/

https://blog.aspb.org/wp-content/uploads/2016/08/HowtoReadScientificPaper.pdf

Navigating a Scientific Paper, By ASPB Plantae Fellows Rose McNelly and Shiqi Zhang

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