Research Methods in Engineering OENG1120

Week 3: Effective paper reading

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RMIT UNIVERSITY

What is academic “literature”?

- Literature embodies the current body of knowledge
  - everything we know right up to now in a particular subject
- **Not all information/literature is equal!**
  - Library
  - Books
  - Newspapers
  - Journals (more reliable
  - Conference proceedings
  - Technical Reports
  - Internet
- **Always use peer-reviewed, scholarly sources!**

Video: What's a Scholarly Source?

Watch this video on the RMIT YouTube channel:

https://www.youtube.com/watch?v=WDvo7WgjTyc&list=PL58B2ECFB395955F9&index=14

What is academic “literature”?

- Scholarly Literature can be broken into:
  - Conference Papers
    (Speculative, untested, wild ideas, value unknown – happening right now)
  - Journal Articles
    (Accepted, tested, peer reviewed - about 1 year old before published)
  - Scientific Book Chapters and Books, Graduate Text Books
    (Well established, proven, of known value – about 5 years old)
  - Undergraduate University Text Books
    (Highly mature, essential grounding for most people in the field)
- Always use peer-reviewed, scholarly sources!

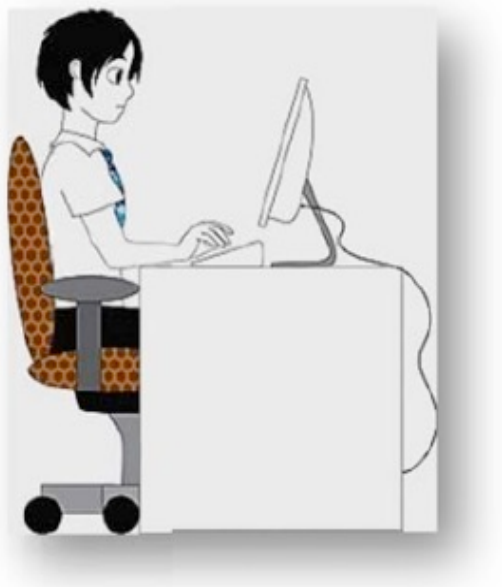
Evaluating information… literature … or in general ☺

- How would you evaluate the information from your information sources? Use the *CRAAP test*
- **Currency** – the timeliness of the information
- **Relevance** – the importance of the information for your needs
- **Authority** – the source of the information
- **Accuracy** – the reliability, truthfulness and accuracy of the information
- **Purpose** – the reason the information exists


THAT MOMENT WHEN YOUR TEACHER MENTIONS
THE RESEARCH PAPER
memegenerator.net

How to Read a Scientific Paper

- One of the most important skills a young scientist needs to learn is how to read (an write) scientific papers
- To understand theses critical skills I created two articles to introduce students to the practices and conventions of scientific articles
- Although scientific paper seem short but they are quite dense and it takes a bit of time and effort to read one!
- Here are some tips to help you get used to the format and make sense of the paper



Produced by Mary Williams for the American Society of Plant Biologists (www.aspb.org).

What is a scientific paper

- Scientific papers
  - Go straight to the source
  - Present data and interpretations
    - Scientist report the results of their research by writing and publishing scientific paper which are written in a very formal style
    - One of the objective is to make the data available from a set of studies as the others can learn from them and build on them to address new questions

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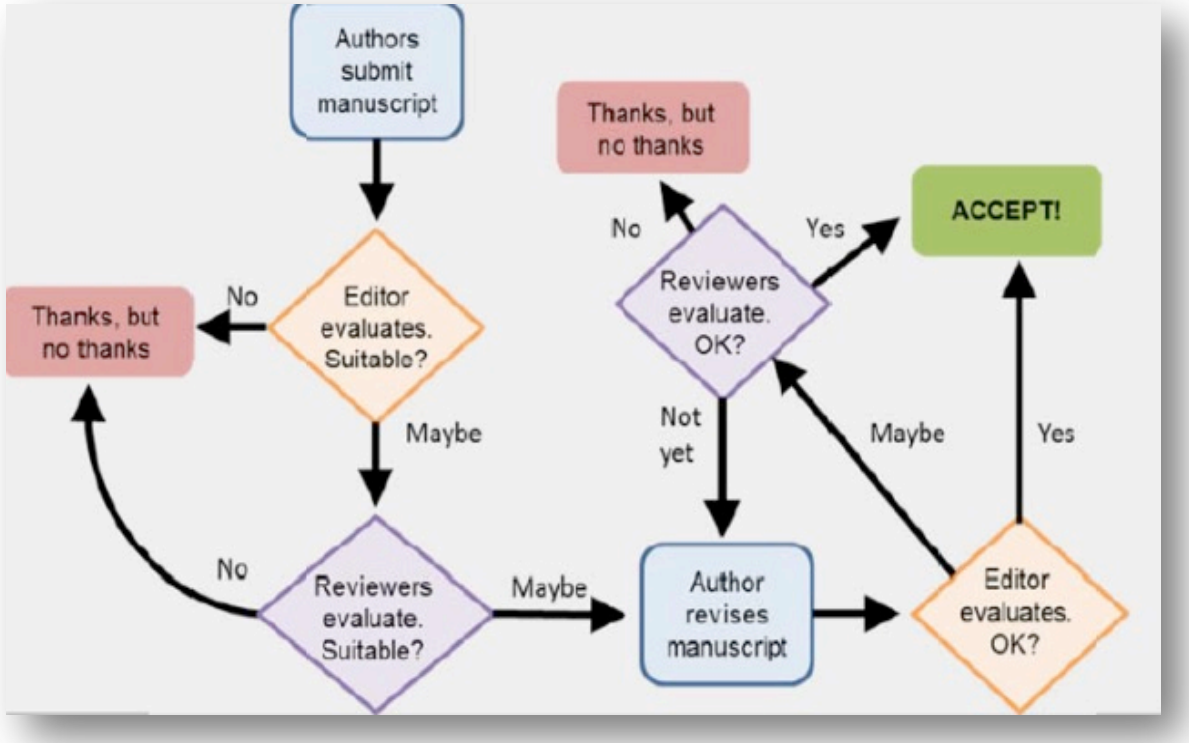
A Scientific paper

Society needs scientific literature

- Peer review is a tradition in scholarly publication. Prior to publication an article is evaluated by other experts



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Anatomy of a scientific paper

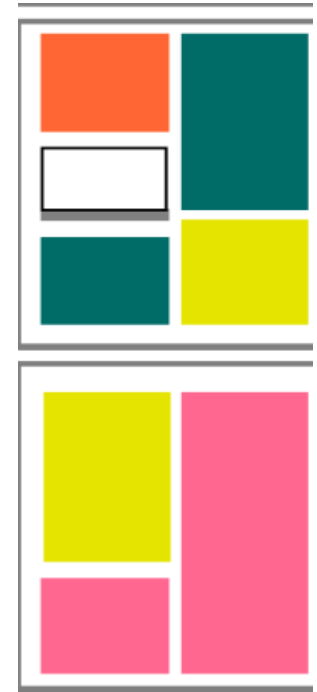
TITLE

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

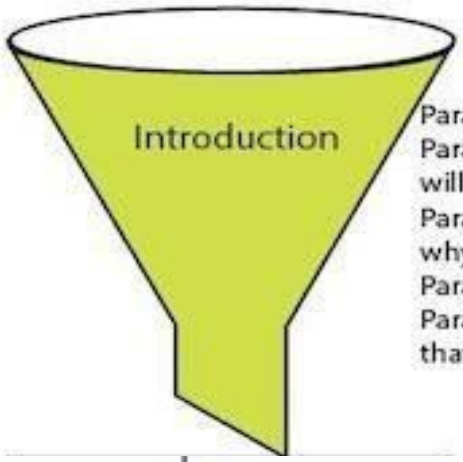
RESULTS: A description of the research conducted and the results obtained
Results are presented as tables, large data sets,and figures which can include graphs, videos, diagrams, and photographs. Some papers include additional supporting data as a supplement



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 to be tested.

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

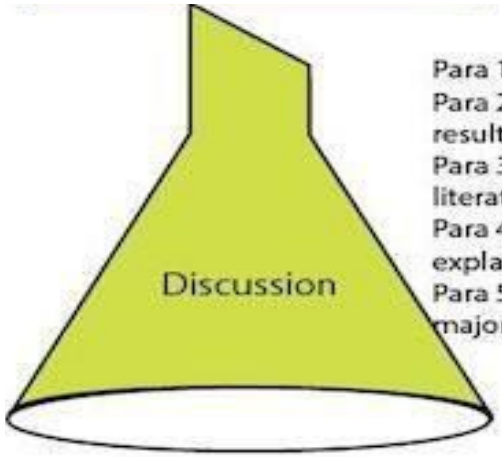
REFERENCES: The list of the articles cited in the paper that provide information on the research topic and the methods used.



Para 1: Overview of the major theme/problematic
Para 2: Introduce important variables which you will consider.
Para 3: Introduce group of organisms and explain why they are useful for studying this system
Para 4: Identify the problem
Para 5: Clearly state the aim and/or hypotheses that are to be tested

Include detailed information necessary on the study site and/or organism here.
Study design
Analyses

Flows directly from the methods. Make sure all aims/hypotheses (intro Para 5) are met
All results must have study design and analyses in the methods



Para 1: Provide a highlight of the results
Para 2: Discuss the literature on which your results impact
Para 3: Discuss other results is relation to existing literature
Para 4: Discuss any caveats to your results and explain how to develop further hypotheses
Para 5: Provide the novel insight in relation to the major theme given in Para 1 of the introduction

How to read a scientific paper

Read the Tile

Should indicate the topic of the research, including the name of the subject organism

Read the Abstract

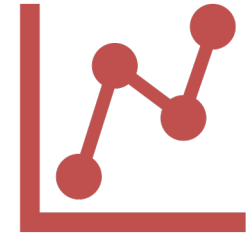
Should summarize the question being addressed, the approach taken and the major findings and their significance.

Read the Conclusion

How to read a scientific paper

Read the Methods

Provides more information about the experiments and statistical methods, including citations to other papers that describe standard methods



Read the Results and Discussion

Describes the experiments carried out and the data obtained and summarise the findings of the research and explores the implications of the results. Be sure to examine the figures and tables as you read through the text

How to read a scientific paper

Read Introduction

Provide the necessary background information to help you understand the goals of the study and why the study is important and inetersting

Look at the References

Can lead you to additional information that may help you understand the paper

Often these references can be found through a hyperlink in the online article

Produced by Mary Williams for the American Society of Plant Biologists (www.aspb.org).

Understanding numerical data

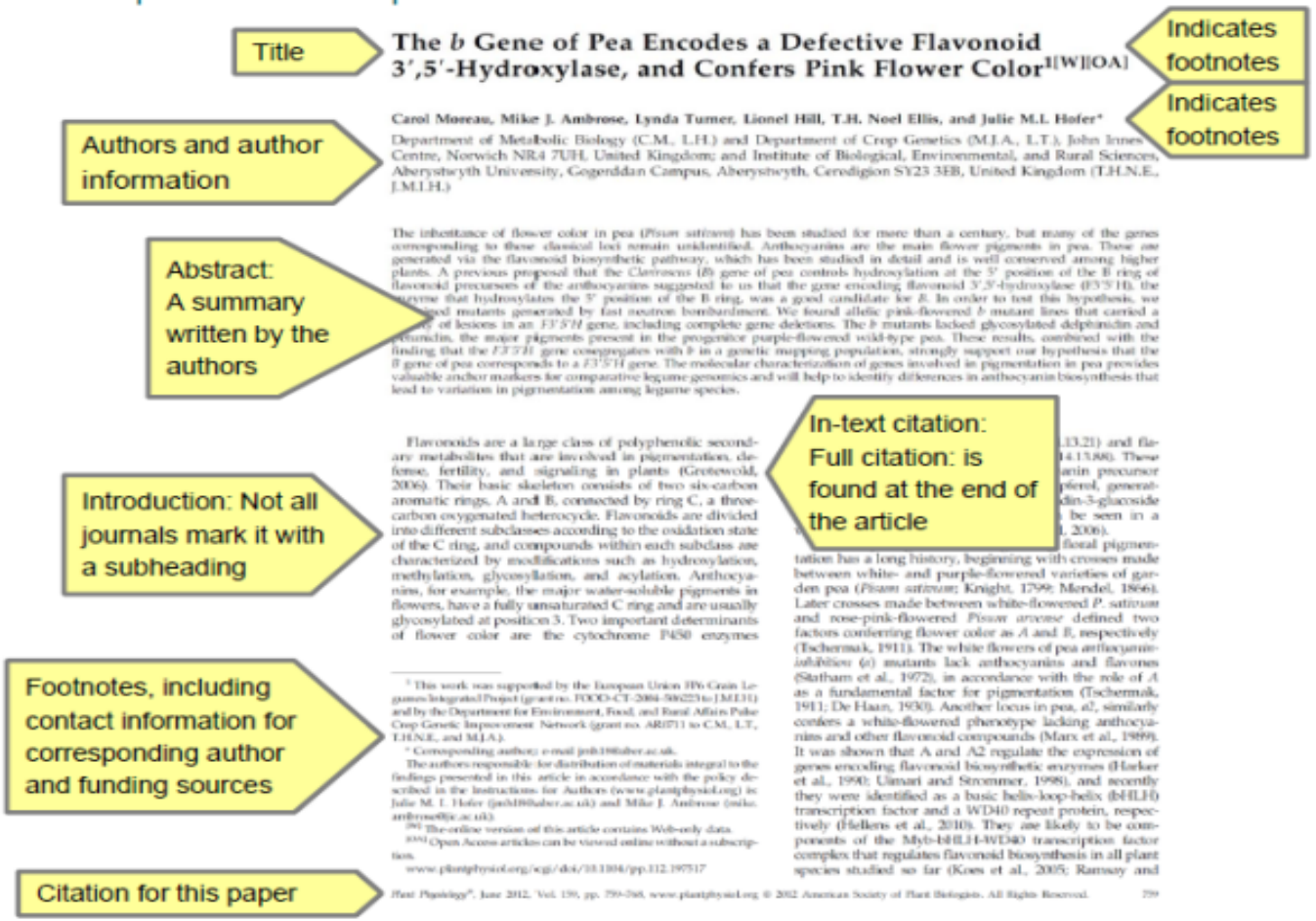
Numerical data are very powerful but can be easily misunderstood or misrepresented

When measurements are collected from independent samples, the values can be used to determine the average value and also how much variation there is in the sample population

Produced by Mary Williams for the American Society of Plant Biologists (www.aspb.org).

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.



Title

The *b* Gene of Pea Encodes a Defective Flavonoid 3′,5′-Hydroxylase, and Confers Pink Flower Color[1][W][OA]

Indicates footnotes

Indicates footnotes

Authors and author information

Carol Moreau, Mike J. Ambrose, Lynda Turner, Lionel Hill, T.H. Noel Ellis, and Julie M.L. Hofer*

Department of Metabolic Biology (C.M., L.H.) and Department of Crop Genetics (M.J.A., L.T.), John Innes Centre, Norwich NR4 7UH, United Kingdom; and Institute of Biological, Environmental, and Rural Sciences, Aberystwyth University, Gogerddan Campus, Aberystwyth, Ceredigion SY23 3EB, United Kingdom (T.H.N.E., J.M.L.H.)

Abstract: A summary written by the authors

The inheritance of flower color in pea (*Pisum sativum*) has been studied for more than a century, but many of the genes corresponding to these classical loci remain unidentified. Anthocyanins are the main flower pigments in pea. These are generated via the flavonoid biosynthetic pathway, which has been studied in detail and is well conserved among higher plants. A previous proposal that the *Clarissoides* (*Cls*) gene of pea controls hydroxylation at the 3′ position of the B ring of flavonoid precursors of the anthocyanins suggested to us that the gene encoding flavonoid 3′,5′-hydroxylase (F3′5′H), the enzyme that hydroxylates the 5′ position of the B ring, was a good candidate for *B*. In order to test this hypothesis, we assayed mutants generated by fast neutron bombardment. We found allelic pink-flowered *b* mutant lines that carried a range of lesions in an *F3′5′H* gene, including complete gene deletions. The *b* mutants lacked glycosylated delphinidin and petunidin, the major pigments present in the progenitor purple-flowered wild-type pea. These results, combined with the finding that the *F3′5′H* gene cosegregates with *B* in a genetic mapping population, strongly support our hypothesis that the *B* gene of pea corresponds to a *F3′5′H* gene. The molecular characterization of genes involved in pigmentation in pea provides valuable anchor markers for comparative legume genomics and will help to identify differences in anthocyanin biosynthesis that lead to variation in pigmentation among legume species.

Introduction: Not all journals mark it with a subheading

Flavonoids are a large class of polyphenolic secondary metabolites that are involved in pigmentation, defense, fertility, and signaling in plants (Grotewold, 2006). Their basic skeleton consists of two six-carbon aromatic rings, A and B, connected by ring C, a three-carbon oxygenated heterocycle. Flavonoids are divided into different subclasses according to the oxidation state of the C ring, and compounds within each subclass are characterized by modifications such as hydroxylation, methylation, glycosylation, and acylation. Anthocyanins, for example, the major water-soluble pigments in flowers, have a fully unsaturated C ring and are usually glycosylated at position 3. Two important determinants of flower color are the cytochrome P450 enzymes

In-text citation: Full citation: is found at the end of the article

floral pigmentation has a long history, beginning with crosses made between white- and purple-flowered varieties of garden pea (*Pisum sativum*; Knight, 1799; Mendel, 1866). Later crosses made between white-flowered *P. sativum* and rose-pink-flowered *Pisum arvense* defined two factors conferring flower color as *A* and *B*, respectively (Tschermak, 1911). The white flowers of pea *anthocyanin-inhibitor* (*a*) mutants lack anthocyanins and flavones (Statham et al., 1972), in accordance with the role of *A* as a fundamental factor for pigmentation (Tschermak, 1911; De Haan, 1930). Another locus in pea, *a2*, similarly confers a white-flowered phenotype lacking anthocyanins and other flavonoid compounds (Marx et al., 1989). It was shown that A and A2 regulate the expression of genes encoding flavonoid biosynthetic enzymes (Harker et al., 1990; Ulmasi and Strommer, 1998), and recently they were identified as a basic helix-loop-helix (bHLH) transcription factor and a WD40 repeat protein, respectively (Hellens et al., 2010). They are likely to be components of the Myb-bHLH-WD40 transcription factor complex that regulates flavonoid biosynthesis in all plant species studied so far (Koes et al., 2005; Ramsay and

Footnotes, including contact information for corresponding author and funding sources

[1] This work was supported by the European Union (Fp6 Grain Legumes Integrated Project (grant no. FOOD-CT-2004-506223 to J.M.L.H.) and by the Department for Environment, Food, and Rural Affairs Pulse Crop Genetic Improvement Network (grant no. AR0711 to C.M., L.T., T.H.N.E., and M.J.A.).

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The authors responsible for distribution of materials integral to the findings presented in this article in accordance with the policy described in the Instructions for Authors (www.plantphysiol.org) is: Julie M. L. Hofer (jmh19@aber.ac.uk) and Mike J. Ambrose (mike.ambrose@jic.ac.uk).

[W] The online version of this article contains Web-only data.

[OA] Open Access articles can be viewed online without a subscription.

www.plantphysiol.org/cgi/doi/10.1104/pp.112.197517

Citation for this paper

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

It's like learning to ride a bike

It takes some practice to learn to read a scientific paper, but with a little effort you should be able to navigate your way around with confidence. This is a guided walk through a recently published article to get you started.

The Title

The title of the paper needs to be factual, informative, and concise. Most journals have a strict character limit; Plant Physiology's limit is 150 characters. You could think of the title as the abstract in a tweet.

Q1. What is the title of this article?

The Authors

Single-author papers are rare, especially in biology. Most papers report the efforts of a team and so have two or more authors. Each author must have made a significant contribution to the research and writing of the paper (for guidelines about authorship, see "*www.plantphysiol.org/site/misc/ifora.xhtml#Authorship*). Minor contributors can be recognized in the Acknowledgments section at the end of the paper. The order in which the authors are listed is important. Typically, the first person listed (the "first author") conducted much of the research and gets the most credit. Sometimes two or more people are given co–first authorship, which is usually indicated in a footnote of the paper. First authors are typically graduate students or postdoctoral researchers carrying out their research in the lab of a more senior scientist, who is typically listed in the last position. If the research involved a collaboration among more than one lab group, the senior authors are typically all listed at the end. In between the first-author position and the senior-author position, others who made significant contributions to the paper are listed.

Some papers list the contributions of each author at the end of the paper. The corresponding author is indicated in the footnotes and is the contact person for the paper; usually the first or last author is the corresponding author. The institutional affiliations of each author are listed in this section

Q2. How many authors does this paper have?
How many institutions and departments represented?
Who is the corresponding author?
Q3. Which organisation provided the funds used to carry out the research, and which author was awarded the funds?

The Abstract

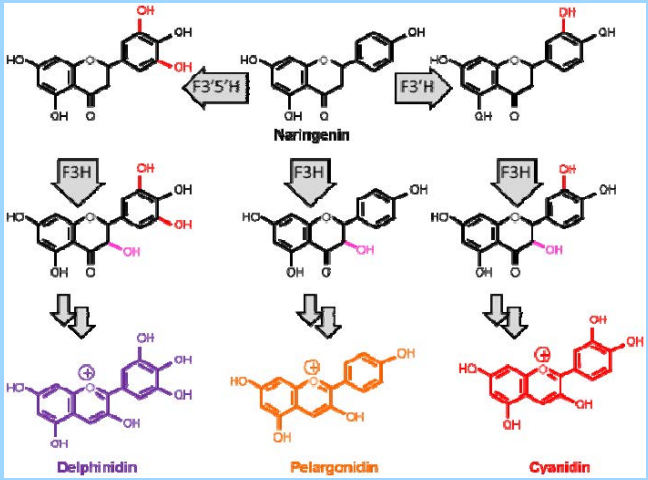
The abstract is a summary of the entire study. The authors highlight the question that they addressed, the methods they used, the hypotheses they tested, and the results of their experiments, and explain what their results mean, all in one paragraph (for Plant Physiology, a paragraph of no more than 250 words).

Q4. After reading the abstract, what do you understand about this paper? What is the experimental organism being studied? In your own words, what question is being addressed in this paper?

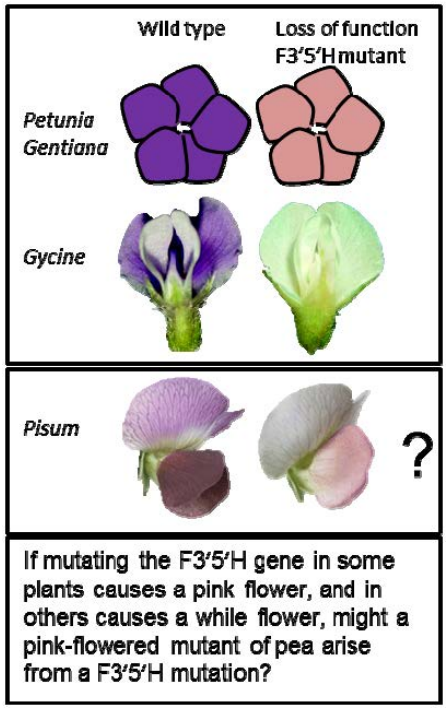
The Introduction

In some journals, including Plant Physiology, the heading "Introduction" is not used, but the introductory information is always the first part of the article after the abstract. The introduction provides the background and justification for the experiment. The introduction describes why the study was carried out and the question being investigated or hypotheses being tested. Statements of facts should be supported with a citation to another published article.

Moreau et al. (2012) introduces the pigment molecules found in flowers called anthocyanins, which are types of a category of chemicals called flavonoids. The article states that the biochemistry and genetics of anthocyanin production have been studied in peas and other plants. The first paper cited in the Introduction is a review article by Grotewold, published in 2006, called "The Genetics and Biochemistry of Floral Pigments," published in the Annual Review of Plant Biology. This review article gathers together a lot of information from many articles. It describes the biochemical pathway for anthocyanin synthesis and the reactions that are catalyzed by the enzymes discussed inMoreau et al. (2012) and so provides important background information. A simplified version of the anthocyanin biosynthetic pathway is shown below.



As shown in the figure above, a colorless precursor, Naringenin, can be hydroxylated at the 3′ position by the enzyme F3′H, or at the 3′ and 5′ positions by the enzyme F3′5′H. These compounds, as well as the unmodified precursor, are subsequently converted into pigments. The presence or absence of the hydroxyl groups affects the color of the pigments. Delphinidin (and related compound petunidin, not shown), are purple and are hydroxylated at both the 3′ and 5′ positions. Moreau et al. (2012) states that the b mutant of pea, which has pink flowers rather than purple flowers, resembles some purple-turned-pink mutants in other plants (Petunia and Gentiana) that resulted from mutations in the F3'5'H gene. However, in Glycine max (soybean) plants mutated in the F3'5'H gene, the flowers are white, not pink like the flowers of the corresponding mutants of Petunia and Gentiana. Moreau et al. (2012) wonder if the b mutant of pea, which has pink flowers, might arise from a loss-of-function mutation in the F3'5'H gene. Another possibility is that pea, which is alegume related to soybean, might produce white flowers when the F3'5'H gene is mutated. To help clear up this apparent discrepancy, the authors decided to investigate the b mutant in pea. They set out to determine which gene is mutated in the b mutant and to address the role of the mutated gene on flower pigment synthesis.



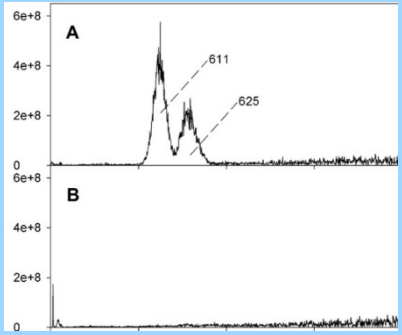
Q5. How many references are cited in the Introduction? How many of them would you want to look up to fully understand the study?
Q6. Do the authors clearly state what questions they addressed in this study?

The Results

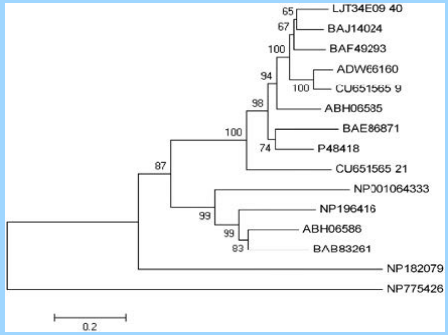
In the article by Moreau et al. (2012), the results are presented in four figures.
Figure 1 shows photographs of the experimental and control organisms to demonstrate the phenotypic effect of the b mutation. Figure 1A shows the pigmentation pattern of a wild-type pea. Figure 1B shows a flower from a b mutant of pea that is less pigmented, and Figure 1C shows an unstable b mutant in which the gene is active in some parts of the petal (the darker parts) and inactive in others (the lighter parts).

Q7. How straightforward was it to understand the data presented in the figures?
Q8. What information do the figure legends provide?
Q9. Where do you find information about the experimental methods used?
Q10. What information is presented in the Supplemental Materials? Why do you think some information is put in this supplementary section?

Figure 2 shows a chromatographic separation of pigments extracted from wild-type (A) and b mutant (B) petals. This instrument detects chemicals based on their size and chemical properties. The peaks labeled 611 and 635 represent delphinidin and petunidin, which are present in the wild-type sample and absent in Glycine (soybean) the b mutant sample. (Panels C and D, and supplemental Figure 1, show additional assays that identify the pigment profiles of wild-type and mutant petals).



Using a gene cloning method, the authors isolated the F3'5'H gene from wild-type peas based on homology to the gene from related plants. The sequence of the pea protein was compared to those of other plants. The sequence alignments are shown in Supplemental Figure 2, and a phylogenic representation is shown in Figure 3.



The Discussion
This section summarizes the finding of this study and interprets how the new information integrates with previous knowledge.

Here is the key finding of Moreau et al. (2012): “In this paper, we have presented genetic and biochemical evidence to show that b mutants lack a functional F3′5′H gene that results in a rose-pink flower color due to the presence of cyanidin- and peonidin-based anthocyanins.” The first part of the discussion analyzes the type of mutations the authors identified in the b mutants, including the nature of the unstable b mutant shown in Figure 1C.
The next part compares the F3′5′H genes in legumes. An interesting observation the
authors make is that although the pea gene is most closely related to the gene from Medicago truncatula, this plant makes yellow flowers!
This observation points to the complexity of the biochemical pathway of anthocyanins, as well as the possibility that a single amino acid mutation in the Medicago gene might make the enzyme it encodes non-functional (something interesting to follow up on!).
The last part of the discussion talks about flower color in soybean, starting with a discussion of the F3H gene and mutations of it. The third-to-last paragraph of the discussion observes, “However, it is not clear why a w1 encoding a defective F3′5′H gene would condition white flower color in soybean, when the pea b mutant and other F3′5′H mutants derived from purple-flowered wild-type plants have pink flowers.” The authors point out that although the soybean study showed that the w1 mutation lies very close to the F3′5′H gene, its identity has not been proven to be the F3′5′H, leaving open the possibility that the w1 mutation is in a different gene. If w1 is not a mutation of the F3′5′H gene, then we no longer have the puzzling issue of different phenotypesfor F3′5′H mutations in different species (something interesting to follow up on!). Thus, by characterizing the F3′5′H gene in pea, these authors have contributed some clarity to a set of puzzling observations and provided a new hypothesis to follow up on.

Q11. In your own words, how does the discussion section differ from the results section?
Q12. Find the places in the discussion that specifically refer to the results and the data presented in the supplemental materials. Is each result discussed similarly, or are different types of data discussed differently?
Q13. What information is conveyed by the final paragraph of the Discussion?

The Materials and Methods
In this section, the authors describe the sources of the biological materials they used and the conditions of their growth and the experimental procedures that they followed. Additional information about their methods, including the sequence of the DNA primers they used for sequencing, can be found in the Supplemental Materials section of the paper.

Q14. In what way is the font of this section different from the remainder of the paper? Why do you think this information is presented differently?

The Acknowledgments
People who helped out with photography and plant care and technical assistance are given thanks here.

Q15. Where do you find guidelines that specify what kinds of contributions are necessary for authorship versus those that are recognized in this section?

For more information about the format and style of a scientific paper, you might find the "Instructions for Authors" guidelines interesting. Every journal provides specific guidelines about the content and format of the papers it will publish, and reading the instructions for authors will help to familiarize you with this format. The complete Instructions for Authors for Plant Physiology is found at http://www.plantphysiol.org/site/misc/ifora.xhtml

The References
This section lists articles that were cited in the text. Some journals list them in alphabetic order, and others list them in the order in which they appear in the text.

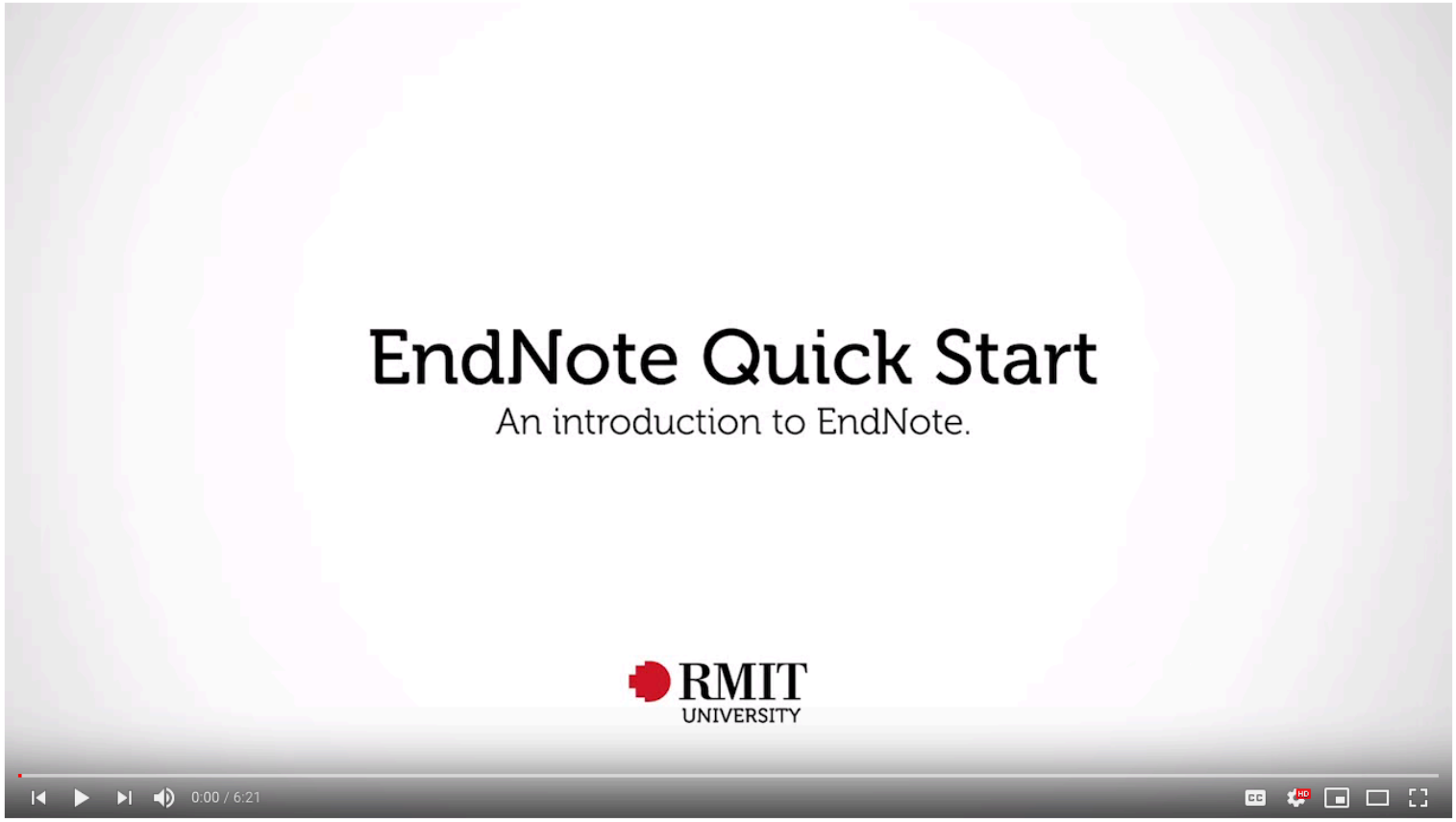
Q16. How many references are listed? How many include one or more of the authors who contributed to this paper?
Q17. What kinds of articles are listed in the references section, and what kinds of sources are not included?
Q18. How would you go about finding these references? How does reading the HTML online version of the article facilitate accessing references?

Written by Mary E. Williams (2013) for the American Society of Plant Biologists. www.aspb.org

EndNote referencing software

- Allows you to create, store and manage references
- Exports references from databases (e.g. Google Scholar), into EndNote library
- Interfaces with MSWord to insert in-text references and compile lists in a chosen style, Harvard of other
- On all RMIT computers and free personal download
- Can sync reference library to cloud
- Can store annotated pdfs (and other filetypes) in same place as references
- More info: http://www1.rmit.edu.au/library/endnote

Video: EndNote Quick Start



https://www.youtube.com/watch?v=97MFHufFd90&list=PL58B2ECFB395955F9&index=11

CAUTION! When using EndNote to insert references to a text document, always check the references for consistency and correctness.

Also, don't make any *manual* changes to the in-text and bibliography references until the VERY end (every time the EndNote program is engaged it auto updates the document and erases all manual formatting and changes)

Questions and Thank You

RMIT UNIVERSITY