Course N^0= 7: Technical Rules for Writing Scientific Articles

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1. Titles

1.1 What to Capitalize in a Title

Understanding what to capitalize in a title is important to make sure that your titles and headlines look correct.

First, it is important to note that there are four main title capitalization styles : **Chicago style, APA style, MLA style, and AP style**. Each of these capitalization styles has slightly different rules for which words are capitalized and each of these styles can be written using title case capitalization or sentence case capitalization.

1.1.1 Title Case Capitalization :

Title case is the most common form of title and headline capitalization and is found in all four major title capitalization styles. Title case is also commonly used for book titlesand other works.

In general, the following capitalization rules apply across the four styles in title case :

Capitalize the first word in the title

Capitalize the last word in the title

Capitalize the important words in the title

Important words in that last bullet generally refer to :

Adjectives (small, large, etc.)

Adverbs (quickly, finally, etc.)

Nouns (laboratory, plant, book)

Pronouns (they, she, he)

Subordinating conjunctions (when fewer than 5 letters , ex : as, if, once, that…)

Verbs (read, concentrate, create)

Title case is the most common title capitalization for book titles, headlines, articles titles, etc. When multiple letters in a title need to be capitalized, use title case capitalization.

1.1.2 Words Not Capitalized in Title Case

While the above words are generally capitalized in titles regardless of style, there are some words that are generally not capitalized when using title case. These will depend on the specific style you choose. These include short words and conjunctions:

Articles (a, an, the)

Coordinating Conjunctions (and, but, for)

Short (fewer than 4 letters, ex : to, as ….)

Prepositions (at, by, to, etc.)

1.1.3 Sentence Case?

The other major type of title capitalization standard is sentence case. Sentence case simply means you capitalize the first letter of a sentence, proper nouns, and nothing else as opposed to capitalizing almost every first letter in title case. It is the same across all of the four styles.

1.2 Title Capitalization Rules by Style

1.2.1 Chicago Manual of Style Capitalization Rules

Chicago Style is one of the most used and respected headline capitalization methods used in journalism. The rules are fairly standard for title case:

- Capitalize the first and the last word.
- Capitalize nouns, pronouns, adjectives, verbs (including phrasal verbs such as "end up"), adverbs, and subordinate conjunctions.
- Lowercase articles (a, an, the), coordinating conjunctions, and prepositions (regardless of length).
- Lowercase the second word after a hyphenated prefix (e.g., Mid-, Anti-, Super-, etc.) in compound modifiers (e.g., Mid-year, Anti-inflammatory, etc.).
- Lowercase the 'to' in an infinitive (e.g., I Want to Execute the Experiment).

1.2.2 APA Style Capitalization Rules

Making sure you have the right capitalization for APA headings is crucial for scholarly articles. The following rules apply to APA headline capitalization and title capitalization:

- Capitalize the first word of the title/heading and of any subtitle/subheading
- Capitalize all major words (nouns, verbs including phrasal verbs, adjectives, adverbs, and pronouns) in the title/heading, including the second part of hyphenated major words (e.g., Self-Report not Self-report)
- Capitalize all words of four letters or more.
- Lowercase the second word after a hyphenated prefix (e.g., Mid-, Anti-, Super-, etc.) in compound modifiers (e.g., Mid-year, Anti-inflammatory, etc.).

1.2.3 MLA Style Capitalization Rules

Making sure you have the right capitalization for MLA headings is crucial for scholarly articles. The following rules apply to MLA headings:

- Capitalize the first word of the title/heading and of any subtitle/subheading.
- Capitalize all major words (nouns, verbs including phrasal verbs, adjectives, adverbs, and pronouns) in the title/heading, including the second part of hyphenated major words (e.g., Self-Report not Self-report).
- Do not capitalize articles, prepositions (regardless of length), and coordinating conjunctions.
- Lowercase the second word after a hyphenated prefix (e.g., Mid-, Anti-, Super-, etc.) in compound modifiers (e.g., Mid-year, Anti-inflammatory, etc.).
- Do not capitalize 'to' in an infinitive (e.g., I Want to Execute the Experiment).

1.2.4 AP Style Capitalization Rules

AP style capitalization is mainly used by writers for the Associated Press but is also used widely throughout journalism. The capitalization rules are as follows:

- Capitalize the first and the last word.
- Capitalize nouns, pronouns, adjectives, verbs (including phrasal verbs), adverbs, and subordinate conjunctions.
- Lowercase articles (a, an, the), coordinating conjunctions, and prepositions.
- Lowercase the second word in a compound modifier (e.g., Mid-year or On-site).
- Capitalize words with four or more letters (including conjunctions and prepositions).
- Capitalize the 'to' in an infinitive (e.g., I Want to Execute the Experiment).

1.2.5 Bluebook Capitalization Rules

Bluebook style capitalization is mainly used by lawyers. The capitalization rules are as follows:

- Capitalize the first and the last word.
- Capitalize nouns, pronouns, adjectives, verbs (including phrasal verbs), adverbs, and subordinate conjunctions.
- Lowercase articles (a, an, the), coordinating conjunctions, and prepositions of four letters or fewer.
- Lowercase "to" in the infinitive.

1.2.6 AMA Capitalization Rules

AMA style capitalization is mainly used in the scientific community. The capitalization rules are as follows:

- Capitalize the first and the last word of titles and subtitles.
- Capitalize nouns, pronouns, adjectives, verbs (including phrasal verbs), adverbs, and subordinate conjunctions (major words).
- Lowercase articles (a, an, the), coordinating conjunctions, and prepositions of four letters or fewer.
- Lowercase "to" in the infinitive.
- Lowercase the second word in a hyphenated compound when it is a prefix or suffix (e.g., "Anti-itch","World-wide") or part of a single word.
- Capitalize the second word in a hyphenated compound if both words are equal and not suffices or prefixes (e.g., "Cost-Benefit")
- Capitalize the first non-Greek letter after a lowercase Greek letter (e.g., "ω-Bromohexanoic")
- Lowercase the first non-Greek letter after a capital Greek letter (e.g., "Δ-9-tetrahydrocannabinol")
- Capitalize the genus but not the species epithet

1.2.7 NY Times Style Capitalization Rules

NY Times style capitalization is mainly used by writers for the NY Times but is also used widely throughout journalism. The capitalization rules are as follows:

- Capitalize major words, e.g. nouns, pronouns, verbs.
- Capitalize the first and the last word.
- Capitalize nouns, pronouns, adjectives, verbs (including phrasal verbs such as), adverbs, and subordinate conjunctions.
- Lowercase articles (a, an, the), coordinating conjunctions, and prepositions.

1.2.8 Wikipedia Style Capitalization Rules

Wikipedia editors must follow certain capitalization rules for any posts to Wikipedia. The capitalization rules are as follows:

- Capitalize major words, e.g. nouns, pronouns, verbs.
- Capitalize the first and the last word.
- Capitalize nouns, pronouns, adjectives, verbs, adverbs, and subordinate conjunctions.
- Lowercase indefinite and definite articles (a, an, the), coordinating conjunctions, and prepositions.
- Capitalize prepositions that contain five letters or more, ex : behind, in front of….
- Lowercase the word "to" in infinitives.

2. Abbreviations

Abbreviations are shortened forms of words and phrases and are a common occurrence in research manuscripts as they can help make highly complex technical writing more concise and easier to read. However, they can also cause a lot of confusion, and make communication unclear if they are not used with caution. Consider these sentences:

One of the most important skills for proofreading a manuscript is ATD. Poor ATD can result in embarrassing factual errors like not defining abbreviations at first mention.

Confused what we are talking about? Don't yet start looking up what **ATD** stands for. Here, we have used it to mean **"attention to detail."** For all you knew, when you first read, it could have meant "advanced technology demonstration," "achieving the dream," or something else that does not quite make sense in the context of the sentence.

Here's another example, this time, from the abstract of an actual manuscript:

We developed a program that included SST for students and CMT for teachers.

Either the abbreviations in this sentence are very common in the author's specialized field or the author has coined them himself/herself. Because the author is so familiar with them, he/she may not have realized that the target readers, some of whom may not be from the same discipline, may not understand them. Ideally, the author should have written the sentence as follows for the first time in the article:

We developed a program that included social skills training (SST) for students and classroom-management training (CMT) for teachers.

In this article, we will provide some tips on the use of abbreviations. Make sure you pay attention to these best practices when using abbreviations in your research writing.

2.1 Define abbreviations at first mention:

Abbreviations should be defined at first mention in each of the following sections in your paper: title, abstract, text, each figure/table legend. Abbreviations work well when you want to reduce the number of words to use. But an abbreviation that is well known in one field may not be common in another.

Example: *We analyzed the results of the computational fluid dynamics (CFD) simulations to determine fluid flow and to detect cavitation in centrifugal pumps.*

In the above example, the term CFD is fairly common in mechanical/civil engineering fields, but might not be clear to an interdisciplinary audience. As a best practice, once you have finished writing the entire manuscript, use the "Find" or equivalent function of your word processor to locate abbreviations and check if they are defined.

2.2 Always consult the target journal's guidelines on abbreviation usage:

- Depending on their focus and target audience, many journals (either broad focus or narrow focus) provide a list of abbreviations that can be used without definition. For example, DNA and ANOVA are fairly common abbreviations that most journals will allow. However, while a mechanical engineering journal might allow the use of CFD without definition, it may not allow the use of FWHM (full-width-at-half-maximum).
- Some journals ask that abbreviations be introduced only if the term is used 3 or more times in the text.
- Some journals discourage the use of any abbreviations in the title and the abstract.
- Terms like CFD are so common and unambiguous that they need not be defined.

2.3 Make sure you use abbreviations that are standard in your field:

In the biological sciences, we often use shortened forms for elements and measurement units. It should be noted that these shortened forms need not be explicitly defined upon first use, but should always be indicated using the standard format (spelling as well as capitalization).

The following abbreviations should be used without definition in the title, abstract, text, figure legends, and tables:

- DNA (deoxyribonucleic acid)
- cDNA (complementary DNA)
- RNA (ribonucleic acid)
- cRNA (complementary RNA)
- RNase (ribonuclease)
- DNase (deoxyribonuclease)
- rRNA (ribosomal RNA)
- mRNA (messenger RNA)
- tRNA (transfer RNA)
- AMP, ADP, ATP, dAMP, ddATP, and GTP, etc. (for the respective 5′ phosphates of adenosine and other nucleosides) (add 2′-, 3′-, or 5′- when needed for contrast)
- ATPase and dGTPase, etc. (adenosine triphosphatase and deoxyguanosine triphosphatase, etc.)
- mRNA (messenger RNA)
- tRNA (transfer RNA)
- AMP, ADP, ATP, dAMP, ddATP, and GTP, etc. (for the respective 5′ phosphates of adenosine and other nucleosides) (add 2′-, 3′-, or 5′- when needed for contrast)
- ATPase and dGTPase, etc. (adenosine triphosphatase and deoxyguanosine triphosphatase, etc.)
- NAD (nicotinamide adenine dinucleotide)
- NAD^+ (nicotinamide adenine dinucleotide, oxidized)
- NADH (nicotinamide adenine dinucleotide, reduced)

- NADP (nicotinamide adenine dinucleotide phosphate)
- NADPH (nicotinamide adenine dinucleotide phosphate, reduced)
- $NADP^+$ (nicotinamide adenine dinucleotide phosphate, oxidized)
- poly(A) and poly(dT), etc. (polyadenylic acid and polydeoxythymidylic acid, etc.)
- oligo(dT), etc. (oligodeoxythymidylic acid, etc.)
- UV (ultraviolet)
- PFU (plaque-forming units)
- CFU (colony-forming units)
- MIC (minimal inhibitory concentration)
- Tris (tris[hydroxymethyl]aminomethane)
- DEAE (diethylaminoethyl)
- EDTA (ethylenediaminetetraacetic acid)
- EGTA (ethylene glycol-bis[β-aminoethyl ether]-*N*,*N*,*N*′,*N*′-tetraacetic acid)
- HEPES (*N*-2-hydroxyethylpiperazine-*N*′-2-ethanesulfonic acid)
- PCR (polymerase chain reaction)
- AIDS (acquired immunodeficiency syndrome)

The following abbreviations should be used without definition in tables:

- amt (amount)
- approx (approximately)
  - avg (average)
  - concn (concentration)
  - diam (diameter)
  - expt (experiment)
  - exptl (experimental)
  - ht (height)
  - mo (month)
  - mol wt (molecular weight)
  - no. (number)
  - prepn (preparation)
  - SD (standard deviation)
  - SE (standard error)
  - SEM (standard error of the mean)
  - sp act (specific activity)
  - sp gr (specific gravity)
  - temp (temperature)
  - vol (volume)
  - vs (versus)
  - wk (week)
  - wt (weight)
  - yr (year)

2.4 Preferred styles for using abbreviations:

When using abbreviations, it is useful to remember that just because an abbreviation is written in capitals does not mean that the capitalization must be retained when the

abbreviation is set out in full. Capitalization is generally reserved only for given names or proper nouns.

Example: FFT is fast **F**ourier transform—"Fourier" is a given name of a person, so it is capitalized, but the other terms can be retained in lowercase lettering.

Some terms are usually indicated by uppercase as well as lowercase letters. Such terms are provided by most journals under an accepted list of terms that need not be defined. When a manuscript also contains other abbreviations that are defined with the same letters, the lowercase format is preferred for the well-known terms, as the competing terms are generally represented by uppercase letters.

Examples: Alternating current (AC/ac), direct current (DC/dc), root mean square (RMS/rms), rotations/revolutions per minute (RPM/rpm).

These terms are acceptable in both uppercase as well as lowercase lettering.

However, when there are other competing terms in the same manuscript, the priority of using uppercase lettering goes to the less common term [digital communication (DC) uses uppercase lettering and direct current (dc) uses lowercase letters].

2.5 Use of Latin abbreviations:

Scientific writing often uses a few Latin abbreviations, such as "e.g."= **for example**, "i.e."= **provides a precise definition or explanation of a preceding statement or term,** and "et al."= **means "and others," indicates a list of people (usually authors).** All of these are used in lowercase and the usage of period should be as per convention. Missing or misplacing a period is akin to misspelling for these abbreviations. Now let's take a deeper look at these:

- The abbreviation "e.g." and "i.e." are always followed by a comma in American English (no comma is required in British English). When used inline, they are either spelled out or offset by commas. However, it is always appropriate to avoid mixing styles. In the examples below, both inline and parenthesized versions are presented in American English convention.

Examples:

1. Some studies **(**e.g., Jenkins & Morgan, 2010**)** have supported this conclusion. Others—**for example**, Chang (2004)—disagreed.

   - Some studies, e.g., Jenkins & Morgan (2010), have supported this conclusion. Others, **e.g.,** Chang (2004), disagreed.

2. Two types of defects **(**i.e., cracks and bends**)** were investigated for each alloy.

   - Two types of defects, i.e., cracks and bends, were investigated for each alloy.

- One of the trickiest abbreviations used in scientific writing is "et al." as it is often misspelled or used incorrectly. This term stands for *et alii*, meaning "and others". This abbreviation is used only to shorten lists of names, such as those in in-text citations or references, and can be used anywhere in the text so long as it is preceded by a name. Any punctuation before or after this term is determined by

the formatting style alone. In the examples below, a name precedes the term and additional punctuation depends on formatting style (APA is used here).

Examples:

1. Bjeg **et al.** (2016) show that the aspect ratio of the room determines whether the airflow is two- or three-dimensional.

2. Previous reports (Bjeg **et al.,** 2016) indicate that the aspect ratio of a room determines whether the airflow is two- or three-dimensional.

3. Reporting Numerical Data

Standard metric units are used for reporting length, weight, and volume. For these units and for molarity, use the prefixes m for 10^{-3}, μ for 10^{-6}, n for 10^{-9}, and p for 10^{-12}. Likewise, use the prefix k for 10^{3}. Avoid compound prefixes such as mμ or μμ. Parts per million (ppm) may be used when that is the common measure for the science in that field. Units of temperature are presented as follows: 37°C or 324 K.

When fractions are used to express such units as enzymatic activities, it is preferable to use whole units, such as "g" or "min," in the denominator instead of fractional or multiple units, such as μg or 10 min. For example, "pmol/min" is preferable to "nmol/10 min," and "μmol/g" is preferable to "nmol/μg." It is also preferable that an unambiguous form, such as exponential notation, be used; for example, "μmol g^{-1} min^{-1}" is preferable to "μmol/g/min." Always report numerical data in the applicable SI units (Système International d'Unités).

4. Statistics

If biological variation within a treatment (coefficient of variation, the standard deviation divided by the mean) is small (less than 10%) and the difference among treatment means is large (greater than 3 standard deviations), it is not necessary to report statistics. If the data do not meet these criteria, however, the authors must include an appropriate statistical analysis (e.g., Student's *t* test, analysis of variance, or Tukey's test, etc.). Statistics should represent the variation among biological units (e.g., replicate incubations) and not just the variation due to method of analysis.

Phylogenetic trees based on nucleotide or amino acid sequence alignments must be supported by appropriate statistical analyses of tree stability (e.g., bootstrap analysis), and nonsupported branches (e.g., bootstrap coefficients below 50%) should be collapsed. A copy of the alignment should be available for examination by the editor or the reviewers upon request.

5. Equations

In mathematical equations, indicate the order of operations clearly by enclosing operations in parentheses, brackets, and braces, in that order: $(a + b) \times c$ or $a + (b \times c)$, $100 \times \{[(a/b) \times c] + d\}$ or $100 \times \{a/[(b \times c) + d]\}$. Italicize variables and constants (but not numerals), and use roman type for designations: E_0, E_h, M_r, K_m, K_s, $a + 2b = 1.2$ mM, Ca^{2+} $V_{max} = \exp(1.5x + y)$, $BOD = 2.7x^2$.

6. Isotopically Labeled Compounds

For simple molecules, isotopic labeling is indicated in the chemical formula (e.g., $^{14}CO_2$, $^{3}H_2O$, and $H_2{}^{35}SO_4$). Brackets are not used when the isotopic symbol is attached to the name of a compound that in its natural state does not contain the element (e.g., ^{32}S-ATP) or to a word that is not a specific chemical name (e.g., ^{131}I-labeled protein, ^{14}C-amino acids, and ^{3}H-ligands).

For specific chemicals, the symbol for the isotope introduced is placed in brackets directly preceding the part of the name that describes the labeled entity. Note that configuration symbols and modifiers precede the isotopic symbol. The following examples illustrate correct usage.

- [^{14}C]urea
- L-[*methyl*-^{14}C]methionine
- [2,3-^{3}H]serine
- [α-^{14}C]lysine
- [γ-^{32}P]ATP
- UDP-[U-^{14}C]glucose
- *E. coli* [^{32}P]DNA
- fructose 1,6-[1-^{32}P]bisphosphate

7. Verb Tense

For clarity you use the **past** tense to narrate particular events in the past, including the procedures, observations, and data of the study that you are reporting.

Be aware that it may be necessary to vary the tense in a single sentence.

For example, it is correct to say

"White (30) **demonstrated** that XYZ cells **grow** at pH 6.8,"

"Figure 2 **shows** that ABC cells **failed** to grow at room temperature,"

"Air **was** removed from the chamber and the mice **died**, which **proves** that mice **require** air."

In reporting statistics and calculations, it is correct to say

"The values for the ABC cells **are** statistically significant, indicating that the drug **inhibited**. . . ."

When you write an experimental report, or draft a thesis chapter, you need to choose which tense, or tenses, to use.

This flyer provides advice intended to help you become more conscious of what the choice of verb tense involves, and to become better able to notice the tense choices that writers in your particular field have made.

From your chosen tense, your reader receives two kinds of information. One concerns time: it is about ‘when’ (past, present or future). The other relates to whether an event or process is open or closed.

The examples below illustrate the distinction between ‘open’ and ‘closed’ events: How long were you at Melbourne Uni? Simple past / closed event: the other person has already graduated.

How long have you been at Melbourne Uni?

Present perfect / open event: the other person is still engaged on his / her course.

7.1 What do tenses do?

Verb tenses present a relationship between

- the present moment (now), and,
- another moment or period in time (which may be long or short).

These moments or periods may be in the past, present or future.

Tenses manage time by placing them within particular relationships or ‘time frameworks’.

As a generalisation: in various types of scientific writing, some time frameworks are more commonly used than others. Their frequency varies from one section of a paper or report to another, and they can also vary between one scientific discipline and another. The next section gives some advice about the various tenses.

7.2 Abstract

This usually refers to your unpublished results and uses **the past tense**.

7.3 Introduction

Your introduction needs to include background information which is generally accepted as fact in a discipline. You also need to explain why the research you are reporting is important. It is usually presented in **the present tense**.

Example: Genomics **provides** crucial information for rational drug design.

You will need to refer to existing research relevant to your work, and you can indicate your opinion of the research you are writing about by careful tense selection.

For example, when you use **the present tense** you are indicating to the reader that you believe that the research findings are still true and relevant, even though the original research may have been conducted some time ago.

Example:

Many of the lakes and wetlands in the region **are** located in craters or valleys blocked by early Pliocene lava flows (Ollier & Joyce, 1964).

Present perfect tense to report research

If you use **present perfect tense** in your introduction when you refer to previous research, you communicate 'recency' or 'currency'. Currency may be **positive** (asserting that previous studies have established a firm research foundation) or **negative** (asserting that not enough relevant or valid work has yet been done). Positive and negative currency can even be asserted in the same sentence, as in the example below (which uses the passive voice):

Example:

A great deal of research **has been conducted** on the basic techniques of nuclear transfer, but few experiments **have been carried out** to discover the most appropriate age of the cytoplasm to support nuclear transfer most effectively.

This suggests that you believe that more experiments are necessary. The existence of a 'research gap' is further emphasised by the phrase: 'but few experiments'.

7.4 Methods

Past tense to describe what was done

In your methods section it is customary to use a form of the **simple past tense** to describe what you did in your study. **Passive voice** is often used.

Examples:

Total phosphorous (TP) and total nitrogen (TN) **were measured** in the laboratory using standard procedures.

The standard protocol **was followed** for the preparation of the media from stock solutions.

The two previous examples are in **the past tense,** but in the passive voice. Have a look at the following examples in the past passive and past active voice.

Past passive

Three 2 litre samples **were taken** at a depth of between 0.1 and 0.5 m at the down-wind end of each wetland.

Past active

Each of the three groups **took** 2 litre samples at a depth of between 0.1 and 0.5m at the down-wind end of each wetland.

Present tense for diagrams and figures

If you use figures or diagrams to help explain what you did, refer to the figure or diagram using the present tense.

Examples:

Table 1 above demonstrates the success of cloning in various animal species.

Figure 2 below shows methylation in mouse 2-cell embryos.

7.5 Results

Past tense for results obtained

In the results section, use the past tense to detail the results you obtained.

Examples:

- ✓ Overall, more than 70% of the insects **collected** were non-phytophagous.
- ✓ Results **indicated** that prolonged exposure to ultra-violet radiation **had** a positive correlation with the development of melanomas.
- ✓ Following activation of NT oocytes with strontium, the cell cycle **resumed** in both groups.

Present tense to refer to figures, tables and graphs

As in the previous sections, use the present tense when you refer to figures, tables and graphs.

Examples:

- ✓ Figure 1 **displays** the comparative variation in the morphology of donor chromatin in both age groups of oocytes.
- ✓ Table 1 below **shows** the stream flows calculated for each stream using Equation 1.

7.6 Discussion

Present tense to explain significance of results

In your discussion section, you will explain the significance of the results. The present tense is normally used for this.

Example:

- ✓ Removal of vegetation for agricultural purposes **appears** to negatively affect the water quality of streams.

Past tense to summarise findings, with present tense to interpret results

Writers may use the past tense to summarise their findings, in combination with the present tense to explain or interpret what the results mean.

Examples:

- ✓ As the maxima and minima **did not correspond** to high and low tides, it is possible that the patterns **observed** may not be the result of mixing of waters with different concentrations.
- ✓ Leaf carbon and phenolic content **did not** differ across sites, **indicating** that the response of secondary plant chemicals such as phenolics to water is complex.

In Example 1, the phrases ‘it is possible that’ and ‘may not be’ are used to indicate that other explanations are possible. This is an example of the use of limiting words to discuss findings in an academically tentative way.

Example 2 is less tentative. If you make a statement such as this, you are completely confident that your results and conclusion are correct.

7.7 Conclusion

A combination of tenses to highlight past research and future directions

In the final section of your thesis or report you summarise the main findings and the major implications of the study, point out any limitations, and offer suggestions for future research. To do these things you may use a combination of tenses.

Example:

- ✓ Although the study **found** evidence of tillage and irrigation within the study area, from the data collected it **was not** possible to determine if the effects of agriculture upstream **cause** (or **caused**) higher levels of total nitrogen downstream. Further studies **are** therefore necessary to determine the effects of agriculture on the health of Stringybark Creek.