4. RESEARCH POSTERS I

40 Points

One of the key objectives of this course is to introduce you to the scientific method as applied in geomorphology. We will accomplish this objective by conducting field and laboratory work that will allow us to test hypotheses relating stream channel geometry, stream hydraulic conditions, and stream bed sediment in the Tomorrow River, Wisconsin, and by communicating our research results to others. To this end, we will create posters to hang on the third floor of the Science Building, B-wing, for everyone to read. Our audience includes students, faculty, and visitors who may not have much (any) background in geomorphology.

YOU SHOULD BE ABLE TO:

- Discuss the importance of communication as part of the scientific method;
- Identify the key components to any form of scientific communication, whether poster, oral presentation or written paper; and,
- Complete a rough draft of your poster introduction, collect information for your study site description, and establish your expectation regarding your hypothesis.

INTRODUCTION

Science is not a collection of "facts;" it is a way of understanding the world. The scientific method is a particular process of discovery that involves the development of testable hypotheses, experimentation, incorporation of experimental results into a larger body of pre-existing research, and ultimately communication of the experimental results to the scientific community. Two important aspects of the scientific method include the repeatability of experiments and the communication of our experimental results.

Repeatability of experiments is important because there are few (if any) research findings of which we are 100% sure. In any scientific experiment, there is always an element of doubt regarding the results – we might be 99.99% sure of something, but not 100% sure. The element of doubt arises from the fact that there is some randomness to the way the world behaves. The element of doubt arises from the fact that there are many things about the world which we do not know or cannot measure, and therefore cannot account for. The element of doubt arises due to inevitable experimental errors (after all, we are human). In the earth sciences, the element of doubt arises when conducting field experiments because we cannot control all the factors that might possibly influence our results. Because of this element of doubt, repeatability is critical to the scientific method; multiple experimenters need to arrive at similar conclusions before the scientific community accepts the experimental results as true.

Communication of our experimental results is important because experiments can be repeated only when we know what other scientists have done or when other scientists know what we have done. As a result, it is critical to explain what we did, how we did it, where we did it, when we did it, how we analyzed our data, why we analyzed our data in that particular way, and what our results tell us about how the world works. Only then can other scientists attempt to repeat our experiment. In addition, science does not occur in a vacuum; it is not about reinventing the wheel. Scientific experiments build on all the

experiments that have come before. Through the process of experimentation, we can learn which techniques or tools or procedures work best for different types of experiments. Thus, as new techniques or tools become available and experiments have clearly shown their advantages over previously used techniques or tools, we want to take advantage of that knowledge in our own experiments. As a result, communication is critical to the continued development of our scientific understanding of the world.

SCIENTIFIC COMMUNICATION

Scientific communications generally take one of three forms: written research papers published in refereed journals, oral presentations of research at professional conferences, and poster presentations of research at professional conferences. Scientific journals are distinguished from "popular" journals by the fact that (1) papers published in scientific journals have undergone a peer review process, and (2) papers published in scientific journals contain citations embedded within the papers and complete reference lists at the end of the papers. The peer review process is important to insure that for a given research question or objective, scientists have followed appropriate methodologies and research design, used appropriate data, and analyzed and interpreted their results in an appropriate manner. The peer review process also helps insure that experimental results are placed in the appropriate context of past research. The inclusion of citations and reference lists gives credit to other researchers investigating similar or related topics, allows scientists to rely on results of other experiments to help further their own projects, and provides support for decisions scientists make during the process of conducting an experiment or interpreting the results of an experiment.

All scientific communications, whether written papers, posters, or oral presentations, include similar types of information – knowledgeable readers will look for this information. The necessary information includes an introduction, possibly a study site description, methodology, results, discussion, conclusion, and reference list. Your final poster needs to contain all of these components, which are explained below.

Introduction

The introduction should alert the reader to what they will find in the rest of the poster. The introduction should clearly state the **objective** of the project and the **importance** of the project. The importance may be related to "pure" science – increasing our knowledge of how the world works in a particular discipline or setting, or simply gaining a better understanding of certain processes. Or, the importance may be related to "applied" science – finding ways to use what we know to improve our ability to make life safer or better for people living in certain situations or environments. The statement of importance addresses the "so what?" or "who cares?" question. Addressing the importance of the project often involves citing past research. For example, scientists may have pointed out shortcomings of a particular research project, provided suggestions for future research based on the results of a particular research project, or they may have identified gaps in our current understanding of the world that need to be filled. Citing these previous works provides support for the importance of your work.

The objective of your research projects is to test some hypotheses relating stream channel geometry and flow conditions. Please **do not** state that the objective is to "get experience doing science." When you address the importance of your project, the importance must relate to your specific hypotheses. Table 4.1 summarizes the grading rubric for the Introduction.

Study Site Description

Not all scientific papers/presentations/posters contain a study site description because the study site is not always relevant to the project. In geomorphology, however, the characteristics of a study site can be crucial to the outcome of a project – the outcome may change depending on where the study is conducted. As a result, most geomorphology papers/posters/ presentations will include a description of the site where the study was conducted.

TABLE 4.1 Grading Rubric for the Introduction

Excellent (9-10 points)	Good (7-8 points)	Satisfactory (5-6 points)	Unsatisfactory (3-4 points)	Failing (0 points)
Research objective defined clearly and concisely	Research objective defined	Research objective defined, but not entirely clear	Research objective unclear	Research objective not defined
Importance stated clearly and concisely	Project importance stated	Project importance stated but not clearly	Project importance contrived	Project importance not stated
Cited literature provides strong support for project importance	Cited literature provides support for project importance	Cited literature provides marginal support for project importance	Cited literature is inappropriate or irrelevant to project importance	No literature is cited
Cites at least three scientific resources	Cites at least two scientific resources	Cites just two scientific resources	Cites just one scientific resource	No literature is cited

The information included in a study site description will vary depending on the objective of the project. Since our research hypotheses address stream channel geometry and stream flow, you should describe any characteristics of the site that could affect either of these characteristics. Relevant information may include:

- A location map
- Description of the river channel:
    - scale drawings of your two transects are **required** as part of the study site description
    - straight or meandering?
    - typical width and depth of the channel, and variability in channel width and depth
    - presence/absence of pools, riffles, hydraulic jumps, eddies, or turbulence
    - presence/absence of boulders or other obstacles to flow such as large woody debris
    - type of sediment on the channel bed (e.g. well/poorly sorted; sandy/gravelly)
    - nature of the channel banks (e.g. presence/absence of undercutting; bank slope; signs of erosion/ deposition; bank stability; presence/absence of vegetation)
    - Photos are very useful for conveying this type of information. I will take photos in the field and you are all encouraged to include some of these photos on your posters.
- Description of the surrounding land
    - vegetation type/density
    - land use
    - topography
- Description of the local soils and the general geologic setting. You may find useful information on web sites maintained by the Wisconsin DNR and the USGS.

Table 4.2 summarizes the grading rubric for the study site description.

TABLE 4.2 Grading Rubric for the Study Site Description

Excellent (9-10 points)	Good (7-8 points)	Satisfactory (5-6 points)	Unsatisfactory (3-4 points)	Failing (0 points)
Description is accurate and concise;	Description is relatively accurate	Description is wordy and unclear;	Description is wordy and unclear;	Description is inaccurate;
includes all relevant characteristics	minor omissions or inaccuracies don't detract significantly from description	includes some inaccuracies or irrelevant information or misses some important characteristics	includes inaccuracies, irrelevant information and misses important characteristics	includes irrelevant information; misses important characteristics
Includes two properly scaled and labeled transect drawings	Includes two scaled transect drawings	Includes two transect drawings; scale not completely accurate	Includes two transect drawings; scaled incorrectly	No transect drawings

Methodology

An accurate description of your methodology is critical for two reasons. First, the methodology affects the validity of the project results. If the methodology is not appropriate for the objectives of the project, it does not matter how meticulous you are at following certain procedures or how fancy your measurement instruments are. If the methodology is basically sound, but you carry it out in an inappropriate way, your data may be compromised. The result is that you end up with data that is either inappropriate or inaccurate.

Second, if other researchers want to replicate your experiment, they need to know how you did the experiment. Replication is critical to the scientific process; if other researchers cannot replicate your results, they will not take your results seriously. You will be replicating experiments done by other scientists, and the only reason you can do this is because these scientists have told you what their methodology was.

Your methodology section should include an accurate description of what you actually did – the procedures you followed and the instruments you used. Be concise when writing your methodology. You need to give *just enough* information for the reader to understand what you did and how you did it. Be sure to include citations from the methods literature you read because citations provide assurance that the methodology you used is appropriate for your project. You should also use citations from the methods literature to point readers to the picky details rather than writing all the picky details yourself. With sufficient citations, a reader can learn all those picky details by reading the literature. Table 4.3 summarizes the grading rubric for the methodology.

TABLE 4.3 Grading Rubric for the Methodology

Excellent (9-10 points)	Good (7-8 points)	Satisfactory (5-6 points)	Unsatisfactory (3-4 points)	Failing (0 points)
Describes methodology clearly and concisely	Describes methodology	Description is unclear and confusing	Description is nearly incomprehensible	Methodology is not described
Methodology is completely appropriate	Methodology is appropriate for objective	Methodology is mostly appropriate for objective	Methodology is only marginally appropriate	Methodology is not appropriate for objective
Readers could easily replicate methodology	Readers could replicate methodology	Readers could likely replicate at least some of the methodology	Very difficult for readers to replicate methodology	Readers could not replicate methodology
Includes more than three relevant citations	Includes three relevant citations	Includes just two citations; not all citations relevant	Includes just one citation; citation not entirely relevant	No citations included

Results

The results section is where you present your data analysis. You can't just say "the data show width and depth are negatively correlated." You need to show the reader how you arrived at that conclusion. You can show your data analysis in the form of tables, charts, or graphs. You can include descriptive statistics, such as means, standard deviations, and correlation coefficients. If you have taken a statistics course, you may want to do a t-test (if appropriate). You need to provide numbers here. The easiest way to test most of your hypotheses is by creating charts or graphs in Excel. After you present your numbers (or charts), you need to explain what the charts show or what the numbers mean. Include only those numbers, charts or graphs that address your hypothesis.

Normally the results of an experiment are compared to the results of other similar experiments described in the scientific literature in the *Discussion* section, not the *Results* section. For your posters, however, I want you to include citations to other research projects in your *Results* section. You should start your *Results* section by stating your expectation regarding your hypothesis – do you expect the hypothesis to be true or false? Your expectation should be based on the results of other research projects. You need to cite a minimum of two other research projects (i.e. you need at least two citations) when you establish your expectation.

After establishing your expectation, you should discuss your results. Then, if your results do not agree with your expectation, you should discuss possible reasons for this. Two reasons why our results might be different include:

- Methodological problems. Our results could be compromised if we did not adequately follow standard procedures for collecting this type of field data. Or, our results could be compromised by the nature of our study site; there may be some characteristic of our study site that precluded us from getting accurate measurements. Or, researchers in a difficult setting for doing field work may have used an entirely different methodology to accommodate their field site.
- Real differences in the relationship between two variables due to unique site characteristics. If you cite results from river research in a steep mountain environment, those results may be different from yours due to differences in slope or channel roughness. If you cite results from a braided river, those results may be different from yours due to inherent differences in braided as opposed to meandering rivers.

You should end the results section with a concluding sentence. Table 4.4 summarizes the grading rubric for the results section.

TABLE 4.4 Grading Rubric for the Results

Excellent (9-10 points)	Good (7-8 points)	Satisfactory (5-6 points)	Unsatisfactory (3-4 points)	Failing (0 points)
Clearly states expectation regarding hypothesis (true/false)	States expectation regarding hypothesis (true/false)	Expectation regarding hypothesis (true/false) not completely clear	Expectation regarding hypothesis (true/false) is unclear	Expectation regarding hypothesis (true/false) not stated
supports expectation by referring to three or more relevant scientific resources	supports expectation by referring to two relevant scientific resources	Supports expectation by referring to one or two scientific resources; one source not entirely relevant	Supports expectation by referring to just one scientific resource; source not entirely relevant	Expectation not supported by references to scientific resources
Analysis is appropriate for the objective and for the data	Analysis is appropriate for the objective and for the data	Analysis is mostly appropriate for objective and data	Analysis is only marginally appropriate for objective and data	Analysis is inappropriate or missing
Correctly interprets results; description is clear and concise	Minor mistakes interpreting results; description is clear	Moderate mistakes interpreting results; description is wordy and somewhat confusing	Major mistakes interpreting results; description is unclear	Interpretations are incorrect
Correctly compares results with results from scientific resources	Compares results with results from scientific resources	Compares results with results from scientific resources	Comparison of results to other scientific resources is unclear	No comparison of results to scientific resources
discusses plausible reasons for expectation not being met (if appropriate)	discusses plausible reasons for expectation not being met (if appropriate)	Reasons for expectation not being met (if appropriate) are unclear	Reasons for expectation not being met (if appropriate) are contrived or inappropriate	No reasons listed for expectations not being met
Conclusion stated clearly and concisely	States conclusion	Conclusion is unclear	Conclusion is unclear	Conclusion is missing

Discussion

The *Discussion* section is where researchers usually compare their project results to the results of other published projects; however, since you should have included this comparison in your *Results* section, do not include it again here. Instead, you should discuss the implications of our field methodology on the accuracy of our measurements and the likelihood that the results of our hypothesis tests are correct. Do not re-summarize the methodology; focus on the advantages or disadvantages of our methodology for testing your hypotheses. There may be other field methods that would be more appropriate for testing your hypotheses. If so, discuss why these methods would be better.

You should also discuss the impact of our study site characteristics on the accuracy of our measurements and the likelihood that the results of our hypothesis tests are correct. Do not describe the study site again – you already did that. Instead, discuss how those characteristics may have impacted your results. It may be that the site characteristics are inappropriate for testing

your hypotheses – if so, state why. Or perhaps the site characteristics resulted in your expectations not being met – if so, state why. Table 4.5 summarizes the grading rubric for the discussion section.

TABLE 4.5 Grading Rubric for the Discussion

Excellent (9-10 points)	Good (7-8 points)	Satisfactory (5-6 points)	Unsatisfactory (3-4 points)	Failing (0 points)
Discussion of advantages and disadvantages of our methodology is clear and compelling	Discusses advantages and disadvantages of our methodology	Discussion of advantages and disadvantages of our methodology is limited or not entirely clear	Discussion of advantages and disadvantages of our methodology is insufficient or irrelevant	No discussion of advantages and disadvantages of our methodology or discussion is unintelligible
Discussion of impact of methodology on study results is thoughtful and coherent	Discusses impact of methodology on study results	Discussion of impact of methodology on study results is limited and misses some important points	Discussion of impact of methodology on study results is misses many important points	No discussion of impact of methodology on study results or discussion misses all the important points
Discussion of impact of site characteristics on study results is thoughtful and compelling	Discusses impact of site characteristics on study results	Discussion of impact of site characteristics on study results is superficial or misses important points	Discussion of impact of site characteristics on study results is irrelevant or misses many important points	Discussion of impact of study site characteristics on study results misses all the important points
Discussion is based on multiple appropriate scientific resources	Discussion is based on multiple, generally appropriate scientific resources	Discussion is based on limited scientific resources; not all of which are relevant	Discussion is based on limited inappropriate resources	Discussion is not based on any scientific resources

Conclusion

In the conclusion you should restate your project objective (i.e. restate your hypotheses) and restate the results of the project. Your conclusion should also restate key points from your discussion that establish the confidence you have in your results. You could also restate the importance of your project and then state how your results contribute to that topic. and where researchers discuss the broader implications of their research.

Conclusions also often contain suggestions for future research. There is no such thing as a "perfect" research project in geomorphology. There will always be room for improvement or for more data. You should provide some suggestions for future researchers who decide to replicate our project so their results will be better than ours. Or, if you think our results are good, what could future researchers do to add to our understanding of relationships between stream hydraulic and geometric characteristics? Table 4.6 summarizes the grading rubric for the conclusion.

Reference List

All scientific papers/posters/presentations contain a reference list. The presence or absence of a reference list is part of what distinguishes a scientific paper/poster/presentation from a popular journal article (e.g. National Geographic). A reference list and a bibliography are not the same thing. A bibliography is a list of resources people can turn to for more information on a particular subject, but these resources may not be cited anywhere in the paper. A reference list is a list of all the sources cited in the paper. Every source cited in your poster must be included in your reference list and every source in your reference list must be cited somewhere in your poster. Format the reference list according to the handout *Geography/ Geoscience Reference List and Citation Guide*. Table 4.7 summarizes the grading rubric for the reference list.

TABLE 4.6 Grading Rubric for the Conclusion

Excellent (9-10 points)	Good (7-8 points)	Satisfactory (5-6 points)	Unsatisfactory (3-4 points)	Failing (0 points)
Conclusion restates objective and results clearly and concisely	Conclusion restates objective and results	Statement of objective and results is somewhat incoherent	Statement of objective and results is confusing and unclear	Conclusion does not restate objective and results
States confidence in results clearly and coherently	States confidence in results	Confidence in results is not clearly stated or is not well reasoned	Confidence in results is poorly reasoned and confusing	Confidence in results is not stated
Provides good, thoughtful suggestions for future research	Provides appropriate suggestions for future research	Provides limited or slightly inappropriate suggestions for future research	Provides no appropriate suggestions for future research	Provides no suggestions for future research

TABLE 4.7 Grading Rubric for the Reference List

Excellent (9-10 points)	Good (7-8 points)	Satisfactory (5-6 points)	Unsatisfactory (3-4 points)	Failing (0 points)
Reference list is complete	Reference list is complete	Reference list is missing one or two sources	Reference list is missing multiple sources	Reference list is missing multiple sources
All references contain all the appropriate information	All references contain all the appropriate information	Some references are incomplete; some needed information is missing	Multiple references are incomplete; much needed information is missing	Most of the references are incomplete
All references are properly formatted	References contain minor formatting errors	List contains multiple formatting errors	List contains multiple minor and some major formatting errors	List contains multiple major formatting errors

PROCEDURE

Complete a rough draft of your introduction

- State your project objective.
- State the importance of your project.
- Find scientific resources to support your statement of importance.

Collect information for your study site description

Our study site is on the Tomorrow River where County DD crosses the river (Figure 4.1). County DD dead-ends into County D just west of our study site. An island is present just upstream from where County DD crosses the Tomorrow River. We will take our first set of measurements upstream from that island. Another island exists downstream of the bridge and we will take our second set of measurements just upstream from that island.

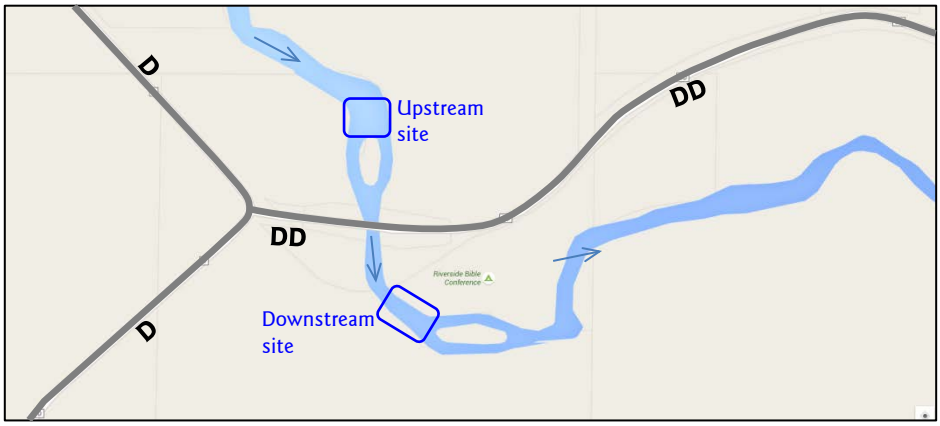
Establish your expectation for your hypothesis

- Each person on a team is responsible for one hypothesis; assign everyone a hypothesis.
- Find scientific resources to support or refute your assigned hypothesis.
- State your expectation.
- Make a list of what the studies found regarding your hypothesis. Note whether the studies used the same methodology we did and note key characteristics of their study site.

Create a team reference list

- Include all sources from everyone on your team. Insure the references are formatted correctly.

FIGURE 4.1 Study Site



GRADING RUBRIC FOR POSTER CONTENT

	Excellent (9-10 points)	Good (7-8 points)	Satisfactory (5-6 points)	Unsatisfactory (3-4 points)	Failing (0 points)
Introduction	Research objective defined clearly and concisely	Research objective defined	Research objective defined, but not entirely clear	Research objective unclear	Research objective not defined
	Project importance stated clearly and concisely	Project importance stated	Project importance stated but not clearly	Project importance contrived	Project importance not stated
	Cited literature provides strong support for project importance	Cited literature provides support for project importance	Cited literature provides marginal support for project importance	Cited literature is inappropriate or irrelevant to project importance	No literature is cited
	Cites at least three scientific resources	Cites at least two scientific resources	Cites just two scientific resources	Cites just one scientific resource	No literature is cited
Site Description	Description is accurate and concise	Description is relatively accurate	Description is wordy and unclear	Description is wordy and unclear	Description is inaccurate
	includes all relevant characteristics	minor omissions or inaccuracies don't detract significantly from description	includes some inaccuracies or irrelevant information, or misses some important characteristics	includes inaccuracies or irrelevant information and misses important characteristics	important characteristics missing; includes irrelevant information
	Includes two properly scaled and labeled transect drawings	Includes two scaled transect drawings	Includes two transect drawings; scale not completely accurate	Includes two transect drawings; scaled incorrectly	No transect drawings
Methodology	Describes methodology clearly and concisely	Describes methodology	Description is unclear and confusing	Description is nearly incomprehensible	Methodology is not described
	Methodology is completely appropriate	Methodology is appropriate	Methodology is mostly appropriate	Methodology is only marginally appropriate	Methodology is not appropriate
	Readers could easily replicate methodology	Readers could replicate methodology	Readers could likely replicate at least some of methodology	Very difficult for readers to replicate methodology	Readers could not replicate methodology
	Includes more than three relevant citations	Includes three relevant citations	Includes just two citations; not all citations relevant	Includes just one citation; citation not entirely relevant	No citations included
Results	Clearly states expectation regarding hypothesis (true/false)	States expectation regarding hypothesis (true/false)	Expectation regarding hypothesis (true/false) not completely clear	Expectation regarding hypothesis (true/false) is unclear	Expectation regarding hypothesis (true/ false) not stated
	supports expectation by referring to three or more relevant scientific resources	supports expectation by referring to two relevant scientific resources	Supports expectation by referring to two scientific sources; one source not entirely relevant	Supports expectation by referring to just one scientific resource; source not entirely relevant	Expectation not supported by references to scientific resources
	Analysis is appropriate for the objective and for the data	Analysis appropriate for the objective and for the data	Analysis is mostly appropriate for objective and data	Analysis is only marginally appropriate for objective and data	Analysis is inappropriate or missing
	Correctly interprets results; description is clear and concise	Minor mistakes interpreting results; description is clear	Moderate mistakes interpreting results; description is wordy or slightly confusing	Major mistakes interpreting results; description is unclear	Interpretations are incorrect
	Correctly compares results to results from scientific sources	Compares results with results from scientific sources	Compares results with results from scientific resources	Comparison of results to scientific sources is unclear	No comparison of results to scientific resources
	Discusses plausible reasons for expectation not being met (if appropriate)	Discusses plausible reasons for expecta-tion not being met (if appropriate)	Reasons for expectation not being met (if appropriate) are unclear	Reasons for expecta-tion not being met (if appropriate) are contrived/inappropriate	No reasons listed for expectations not being met
	Conclusion is clear and concise	States conclusion	Conclusion is unclear	Conclusion is unclear	Conclusion is missing

Discussion	Discussion of advantages and disadvantages of our methodology is clear and compelling	Discusses advantages and disadvantages of our methodology	Discussion of advan-tages/disadvantages of our methodology is limited or not entirely clear	Discussion of advan-tages/disadvantages of our methodology is insufficient or irrelevant	No discussion of advantages/disad-vantages or discussion is unintelligible
	Discussion of impact of methodology on study results is thoughtful and coherent	Discusses impact of methodology on study results	Discussion of impact of methodology on results is limited and misses some important points	Discussion of impact of methodology on results is misses many important points	No discussion of impact of method-ology on results or discussion misses all the important points
	Discussion of impact of site characteristics on results is thoughtful and compelling	Discusses impact of site characteristics on results	Discussion of impact of site characteristics on results is superficial or misses important points	Discussion of impact of site characteristics on results is irrelevant or misses many important points	Discussion of impact of site characteristics on results misses all the important points
	Discussion is based on multiple appropriate scientific resources	Discussion based on multiple, generally appropriate scientific resources	Discussion is based on limited scientific resources; not all of which are relevant	Discussion is based on limited inappropriate resources	Discussion is not based on any scientific resources
Conclusion	Conclusion restates objective and results clearly and concisely	Conclusion restates objective and results	Statement of objective and results is somewhat confusing	Statement of objective and results is incoherent	Conclusion does not restate objective or results
	States confidence in results clearly and coherently	States confidence in results	Confidence in results is not clearly stated or is not well reasoned	Confidence in results is poorly reasoned and confusing	Confidence in results is not stated
	Provides good, thoughtful suggestions for future research	Provides appropriate suggestions for future research	Provides limited or slightly inappropriate suggestions for future research	Provides no appropriate suggestions for future research	Provides no suggestions for future research
Reference List	Reference list is complete	Reference list is complete	Reference list is missing one or two sources	Reference list is missing multiple sources	Reference list is missing multiple sources
	All references contain all the appropriate information	All references contain all the appropriate information	Some references are incomplete; some needed information is missing	Multiple references are incomplete; much information is missing	Most of the references are incomplete
	All references are properly formatted	References contain minor formatting errors	List contains multiple formatting errors	List contains multiple minor and some major formatting errors	List contains multiple major formatting errors