**Grand Challenges In Critical Zone Science Research Paper**

The US Critical Zone Observatories program (<http://criticalzone.org/national/>) has the best characterization of the critical zone (CZ): *The critical zone is Earth's permeable near-surface layer from the tops of the trees to the bottom of the groundwater. It is a living, breathing, constantly evolving boundary layer where rock, soil, water, air, and living organisms interact. These complex interactions regulate the natural habitat and determine the availability of life-sustaining resources, including our food production and water quality.* As the CZ is so expansive it is not surprising that many things that we do impact the CZ, yet also many of the things we rely on (water, food, air) are very heavily influenced by the CZ and its processes.

Due to the importance and large scale, the CZ also is center stage in many of the “Grand Challenges” facing humanity today. Grand Challenges are crucial global threats in the near future that might drastically change the way most of the inhabitants of Earth live and function, or don’t live or function. Such examples include, but are not limited to, shortages of water, declining availability of fossil fuels, coastal inundation, the literal collapse of ecosystems, eutrophication, soil erosion, food production, carbon cycling, global warming, and climate change. You are to produce an original 10 page scholarly paper on one such grand challenge and address one such grand challenge. In addition it is likely the papers will address issue(s) relating to sustainability of CZ resources, environmental (CZ) stability, and/or human quality of life, health and safety. The semester project will develop over the following schedule:

a) clearance of a final topic with the instructor by xxxxx;

 b) a 2-page outline due by xxxxx;

 c) a 2 slides/2 minutes update presentation on xxxxx and,

 d) a 10-15 minute presentation, and a 10-pages, double-spaced, properly-referenced report of the topic on xxxxx.

Note: Each checkpoint is worth 5 points if hit.

Research Paper Points possible = 20 checkpoint points + 54 rubric points = 74 total points.

Paper Presentation Points (rubric separate document) = 26 points.

Grand Challenges assignment = 100 points.

You will be scored using the following rubric:

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| Criteria | Exemplary (6) | Good (4) | Acceptable (2) | Unacceptable (0) |
| Purpose | The writer's central purpose orargument is readily apparent tothe reader. | The writing has a clear purpose or argument, but may sometimes digress from it. | The central purpose or argument is not consistently clearthroughout the paper. | The purpose or argument is generally unclear |
| Content | Balanced presentation of relevant and legitimate information that clearly supports a central purpose or argument and shows a thoughtful, in-depth analysis of a significant topic. Reader gains important insights. | Information provides reasonable support for a central purpose or argument and displays evidence of a basic analysis of a significant topic. Reader gains some insights. | Information supports a central purpose or argument at times. Analysis is basic or general. Reader gains few insights. | Central purpose or argument is not clearly identified. Analysis is vague or not evident. Reader is confused or may be misinformed. |
| Organization | The ideas are arranged logically to support the purpose or argument. They flow smoothly from one to another and are clearly linked to each other.The reader can follow the line of reasoning. | The ideas are arranged logically to support the central purpose or argument. They are usually clearly linked to each other. For the most part, the reader can follow the line of reasoning. | In general, the writing is arranged logically, although occasionally ideas fail to make sense together. The reader is fairly clear about what writer intends. | The writing is not logically organized. Frequently, ideas fail to make sense together. The reader cannot identify a line of reasoning and loses interest. |
| Feel | The writing is compelling. It hooks the reader and sustains interest throughout. | The writing is generally engaging, but has some dry spots. In general, it is focused and keeps the reader's attention. | The writing is dull and unengaging. Though the paper has some interesting parts, the reader finds it difficult to maintain interest. | The writing has little personality. The reader quickly loses interest and stops reading. |
| Tone | The tone is consistently professional and appropriate for an academic research paper. | The tone is generally professional. For the most part, it is appropriate for an academic research paper. | The tone is not consistently professional or appropriate for an academic research paper. | The tone is unprofessional. It is not appropriate for anacademic research paper |
| Grammar,Spelling,WritingMechanics(punctua-tion,italics, capitali-zation,etc. | The writing is free or almost free of errors. | There are occasional errors, but they don't represent a major distraction or obscure meaning. | The writing has many errors, and the reader is distracted by them. | There are so many errors that meaning is obscured. The reader is confused and stops reading. |
| Length & Spacing | Paper and spacing follow directions specified in the assignment. | Paper or spacing nearly follows directions specified in the assignment. | Paper or spacing does not follow directions specified in the assignment. | Paper and spacing does not follow directions specified in the assignment. |
| Quality ofReferences | References are primarily peer-reviewed professional journals or other approved sources (e.g., government documents, agency manuals). The reader is confident that the information and ideas can be trusted. | Although most of the references are professionally legitimate, a few are questionable (e.g., trade books, internet sources, popular magazines). The reader is uncertain of the reliability of some of the sources. | Most of the references are from sources that are not peer-reviewed and have uncertain reliability. The reader doubts the accuracy of much of the material presented. | There are virtually no sources that are professionally reliable.The reader seriously doubts the value of the material and stops reading. |
| Visuals | Figures, graphs, and/or tables are utilized effectively to convey information and are modified from original state | Figures, graphs, and/or tables are utilized effectively to convey information and but are used “as-is” | Figures, graphs, and/or tables not utilized effectively to convey information  | No figures, graphs, and/or tables, or figures, graphs, and/or tables do not add information to the report. |

Modified from <http://www.k-state.edu/assessment/toolkit/measurement/resrubric.pdf>