Element N– Score 3

Writing Sample from "Bicycle Tire Pressure Project"

Improving Bicycle Safety Through Monitoring Tire Pressure,

("…a holistic score of 3 for Element N would be likely. With some changes to the language and the addition of appropriate documentation where needed, that score could increase to a 4 or 5.")
This entry was created under an earlier version of the EDPPSR but corresponds to Element G (construction of a testable prototype) on the current version of the rubric.

Throughout this entry, the style and tone is more informal than appropriate when writing like an engineer. Overall, the entry sounds more like a personal narrative—the story of a group of students' experience, rather than an objective account of the construction of a testable prototype. Expressions such as "luckily for us," "we were amazed," and "being adventurous engineering students" are too informal for this context (a demonstration of an engineering design process) and audience (unfamiliar but interested individuals with a background in engineering design and education).

Context and audience are indeed critical to writing effectively like an engineer. While the designers of this product were no doubt excited when they located ("happened to come across") a 10-bar display that they could use instead of the chip, adherence to a formal style and tone would preclude using the description "in a much cooler way." That's "team-mate talk" (which may include their teacher as well), but when going public with the process they used to construct a testable prototype, less informal language is warranted.
Similarly, the "shout-out" to the person who "knew a great man by the name of Bob" is fine for informal and personal accounts of a process or experience, but has no place in a formal account of the engineering design process.

This entry is clear and well organized, however, and includes some specific detail (particularly in the form of descriptive details about the different sensors and precise measurements) to help explain the topic. The form chosen—a narrative account—is suitable to relay the intended content and is enhanced with appropriate text features (diagram, photographs). These are all characteristics of entries that are assigned a higher score (in the 3-5 range). Appropriate documentation for these text features is always missing, however, and would be a factor in making an overall score decision.

This entry exhibits general control over conventions (grammar, usage, etc.). A rare sentence fragment ("And allow us to display the pressure via LEDs) might have been picked up with a careful rereading for editing purposes.

Remember, no individual entry is scored for writing. However, if most/all of the entries in the portfolio from which this entry has been drawn showed similar characteristics to this one, a holistic score of 3 for Element N would be likely. With some changes to the language and the addition of appropriate documentation where needed, that score could increase to a 4 or 5.

Engineering Design Process Portfolio Scoring Rubric
Component and Element Titles

Component I: Presenting and Justifying a Problem and Solution Requirements

- Element A: Presentation and justification of the problem
- Element B. Documentation and analysis of prior solution attempts
- Element C. Presentation and justification of solution design requirements

Component II: Generating and Defending an Original Solution

- Element D: Design concept generation, analysis, and selection
- Element E: Application of STEM principles and practices
- Element F: Consideration of design viability

Component III: Constructing and Testing a Prototype

- Element G: Construction of a testable prototype
- Element H: Prototype testing and data collection plan
- Element I: Testing, data collection and analysis

Component IV: Evaluation, Reflection, and Recommendations

- Element J: Documentation of external evaluation
- ***Element K: Reflection on the design project***
- Element L: Presentation of designer's recommendations

Component V: Documenting and Presenting the Project

- Element M: Presentation of the project portfolio
- Element N: Writing like an Engineer

Please Note: Elements M and N require no submission from the portfolio author(s) and are intended to be scored based on the portfolio work as a whole from what has been submitted from Elements A through L

Element N: Writing like an engineer

While all other elements are assigned a score based only on the contents (text, graphics, video, etc.) for a given entry, the score for Element N is based on a review of all the writing done within and across a portfolio. The score decision may be considered holistic, since it is applied to the work overall.

Most writing by K-12 students occurs in the context of English Language Arts. The most common types of writing are narrative—accounts of real or imagined events experienced by the writer or someone else—and expository—presentations of ideas and information about a topic. With the introduction of the Common Core State Standards (CCSS) in most states, argumentative/persuasive writing—the presentation and support of opinions based on the evaluation of evidence—will also need to be part of students' writing repertoire. The CCSS include not only standards for English Language Arts but also for Literacy in History/Social Studies, Science, and Technical Subjects. It is thus more important than ever that students learn and become comfortable with the discourse conventions of the various STEM disciplines. That includes being able to "write like an engineer."

What does it mean to "write like an engineer"? Volumes could be written on the subject, but some of the most critical features of such writing are the following:

- A focus on discipline-specific content (the processes and products of engineering)
- The development of texts with facts, definitions, concrete details, and quotations from experts (duly identified)
- The use of timely, relevant, and accurate data and supporting evidence
- The use of timely, relevant, and credible sources and the complete and accurate citation of those sources
- The establishment and maintenance of a formal style; this includes language choices, syntax, and text features/text structures appropriate to the audience and purpose for a given piece of writing
- The strategic use of techniques such as analogy, simile or metaphor to convey and develop understanding of key ideas; that is, use of these techniques not simply for color or effect but to enhance readers' understanding
- Use of precise language and discipline-specific language
- An objective voice, particularly when setting forth and evaluating claims/counter-claims
- Attention to audience through the use of details and examples that anticipate the audience's concerns and level of expertise
- Attention to the norms and conventions of writing by engineering professionals
- Command of the conventions of standard English grammar and usage, along with correct capitalization, punctuation, and spelling

A few excerpts from various portfolio entries may serve to illustrate what it means to write like an engineer.

Element N: Writing like an Engineer

5 Abundant evidence of the ability to write consistently clear and well organized texts that are developed to the fullest degree suitable for the audience and purposes intended (to explain, question, persuade, etc.); texts consistently demonstrate the ability to adjust language, style and tone to address the needs and interests of a variety of audiences (e.g., expert, informed, general/lay audience) and to use a wide variety of forms which are commonplace among STEM disciplines (e.g., notes, descriptive/narrative accounts, research reports); where required by convention, appropriate documentation in standardized form (e.g., APA) is consistently evident.

4 Evidence of the ability to write clear and well organized texts that are generally well-developed for the audience and purposes intended (to explain, question, persuade, etc.); texts generally demonstrate the ability to adjust language, style and tone to address the needs and interests of a variety of audiences (e.g., expert, informed, general/lay audience) with minor exceptions and demonstrate the ability to use a variety of forms which are commonplace among STEM disciplines (e.g., notes, descriptive/narrative accounts, research reports); where required by convention, appropriate documentation in standardized form (e.g., APA) is generally evident.

3 Adequate evidence of the ability to write usually clear and generally organized texts that are at least partially developed for the audience and purposes intended (to explain, question, persuade, etc.); texts demonstrate the ability to adjust language, style and tone to address the needs and interests of several different audiences (e.g., expert, informed, general/lay audience) but may be unsuccessful at doing so on occasion; texts demonstrate the ability to use a several different forms which are commonplace among STEM disciplines; where required by convention, appropriate documentation in standardized form (e.g., APA) is sometimes evident, although attempts at documentation may reveal minor errors

2 Only some evidence of the ability to write clear and organized texts that are at least partially developed for the audience and purposes intended (to explain, question, persuade, etc.); texts demonstrate some ability to adjust language, style and tone to address the needs and interests of at least two different audiences (e.g., expert, informed, general/lay audience) but adjustments are not evident—although warranted—in a number of instances; texts demonstrate the ability to use at least two different forms which are commonplace among STEM disciplines; where required by convention, appropriate documentation in standardized form (e.g., APA) is frequently missing or incorrect.

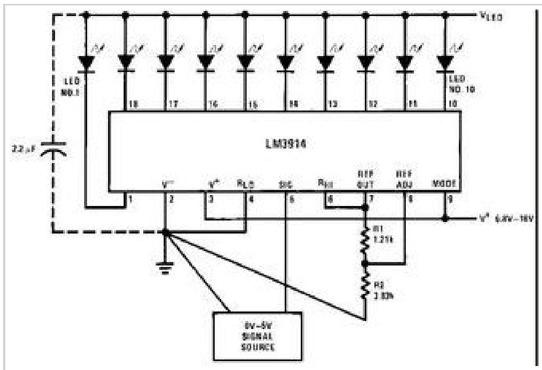
1 Little evidence of the ability to write clear and organized texts that are at least partially developed for the audience and purposes intended (to explain, question, persuade, etc.); texts demonstrate little ability to adjust language, style and tone to address the needs and interests of at least two different audiences (e.g., expert, informed, general/lay audience) but many adjustments are not evident— although warranted; texts demonstrate the attempt to use at least two different forms which are commonplace among STEM disciplines; appropriate documentation in standardized form (e.g., APA) is usually missing or incorrect.

0 Virtually no evidence of the ability to write even somewhat clear and organized texts that are developed for the audience and purposes intended (to explain, question, persuade, etc.); texts demonstrate virtually no ability to adjust language, style and tone to address the needs and interests of at least two different audiences (e.g., expert, informed, general/lay audience); there may be evidence of an attempt to use at least two different forms which are commonplace among STEM disciplines but these are not correctly differentiated; there is virtually no evidence of any attempt to provide documentation in standardized form where needed.

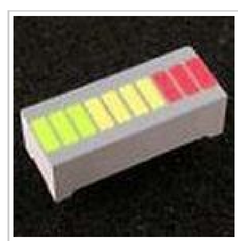
Bicycle Tire Pressure

With the start of our prototyping process we had to find a sensor that measured pressure. With extensive research and a little help from our mentor Mrs. Ma[redacted] she directed us to a website DigiKey that had a wide variety of pressure sensors to choose from. After searching through the site, we came across a match a sensor that had everything we needed it to do. What we needed it to do was measure up to 100psi, and has a 0.5-4.5 voltage output. We did our research on this sensor, looking for a patent to see the background about this product. But, the problem is that it costs $89. Instead of buying this $89 product from DigiKey we found the manufacturer of the product and luckily for us, the manufacturer was located in Wisconsin, SSI Technologies. We kindly called SSI Technologies in hopes of them hearing our story and being generous enough to donate the sensor to us. With great thanks, they decided to send us the sensor for free.

When we received our sensor our next step was to test the sensor to make sure it worked. After two weeks of testing the sensor and not getting the correct voltage output, we were at a dead stop on how this sensor functioned. One thing we did know is that this sensor was not compatible with the Schrader valve of the bicycle tire. We had to figure out a way to somehow adapt the sensor so that it fit properly to the Schrader valve. Thank you to [redacted] she knew a great man by the name of Bob who worked at Advanced Screw who specializes in creating modifications. We went over to Advanced Screw and just like we did with SSI Technologies we talked to Bob and told him about what we have been doing and eventually asked him if he could be able to somehow make an adapter that connects to the Schrader valve stem of the bike to the end of the pressure sensor. He was unsure if he was able to make sure an adapter but said he would try his best. The next day we received a phone call from Bob asking us to come down to the shop because he finished the product. When we got there we were amazed that he could make such an adapter that did everything we needed it to. In addition, he gave us a schematic sheet that showed us the dimensions of the adapter. One thing that we decided would be more efficient for our testing purposes is that if we could have the same adapter that had a pump attached to it to make it easier to allow pressure to enter/leave without removing the adapter. Now we could measure the pressure and connect it to the valve stem.



The next important step in the prototyping process is verifying that the new product would give us the correct voltage read out in correlation with the pressure in the tire. Thus, we needed to test if the sensor was linear (which we thought it was) or not. We repeatedly tested different pressures and recorded the voltage output on a graph. Through the graph that was created after measuring pressures from 30psi – 100psi we concluded that this sensor was indeed linear. After looking at the graph we wanted our pressure sensor to measure from 40 psi – 90 psi. But, the sensor read that at 0.5 volts was 0 psi and that at 4.5 volts was 100 psi. The graph showed that the voltage actually went higher than displayed in that at 90 psi was 4.7 volts. Next we decided that we needed to take that information and somehow display that information to the riders. We decided with notifying them through lights on the handlebars (not final design) because it is safer and more effective than our other options which included: vibrating handlebars, a sound emitter, and a tire cap light. We found a chip that did exactly what we needed it to do. It allows us to alter the range of pressure from 0-100psi to 40-90psi. And allow us to display the pressure via LEDs. The chip was called LM3914. We found the inner workings of the chip on the internet and being adventurous engineering students we learned the chip in a matter of a couple days and got the pressure sensor to read from 40-90psi.



We weren’t done there though. We happened to come across a 10 bar display that did what the chip did in a much cooler way. Both ways are effective but for our prototype we went with the much cooler looking 10 bar display chip. Our initial prototype has been constructed and ready for testing. Our initial prototype consists of the pressure sensor from SSI Technologies, the two adapters (one plain adapter and one with a valve for air) made by Bob from Advanced Screw, the main component of the design is the LM3914 chip, and the display of the 10 bars.