**Robot Prototype Design**

Technology has come a long way. Scientists and engineers are constantly working to help improve our lives by finding ways to life-hack, i.e. they try to create technology that find more efficient, simpler, yet more sophisticated and advanced ways to perform tasks for us, or to help us explore and discover new information. Among such technology are the development of robots. According to JPL scientists (Personal interview, NASA Spaceward Bound 2014), a robot is any machine that takes in information about its surroundings/environment or after it performs a task, and then acts upon that information on its own.

However, scientists and engineers have historically used nature to inspire the design of their robots, what is termed as “bio-inspired engineering.” For example, the LEMUR Robot, [JPL’s Rock Climbing/Cave Crawling robot](https://www.youtube.com/watch?v=AjPZAYNqQrQ) (which I saw during my week-long desert expedition with NASA) is based on the design of a gecko lizard. Meanwhile, engineers elsewhere are developing [a jelly-fish like robot](http://www.newsela.com/articles/jellyfish-robot/id/2137/).

In our own science class, we have been discussing the parts of the skeletal system and how the structure of our bones and joints allow for the types of movements and functions we need to perform. In learning about the human body and its various organ systems, we can come to appreciate the intricately beautiful and complex design of our own bodies as well as those of other animals.

*(Your Project):*

With all this in mind, you are now going to assume the role of a mechanical engineering team. You will be working with your table groups, or your engineering team, to develop a ***bio-inspired robot prototype***. Your prototype design **MUST be inspired by the design of one or more animal organ system, and the structural design must be inspired by the skeletal system (incorporate the use of different types of joints found in the skeletal system).**

There are four tasks involved in your prototype design, and each member will be responsible for a task:

***Task 1: Principal Investigator***

*Your job is to gather information/research previous robot designs to get an idea of what’s already out there and has worked. You will need to:*

1. *Pick* ***one*** *current robot design existing in the engineering community. For example, JPL’s Lemur Robot or the Jellyfish Robot (see introduction above), or some other type of bio-inspired robot.*
2. *Conduct research (at least 1-2 sources) on the robot.*
3. *In 2-3 well-written paragraphs, you need to explain the following about that robot:*
   * Background of robot: who’s creating it and what stage of development it is in
   * Purpose: what is the function of the robot? What is it meant to do?
   * Bio-inspired design: What was the bio-inspiration and why? How did the engineers incorporate the bio-design (i.e. how is the robot like the animal or biological structure or function) Explain and evaluate if and how the bio-inspiration might be a sound/effective design for the robot.

\*Make sure you cite evidence, quotes or paraphrasing, from your sources\*

***Task 2: Concept Manager***

*Your job is to lead your team in concept design of your team’s robot. Your will need to:*

1. *Lead a team discussion as to what problem your robot is meant to help with or solve (i.e. what is the purpose and function of your robot), as well as how you will develop its design, bio-inspired of course.*
2. *Write 2-3 well-developed and well-written paragraphs which clearly explain the following about your group’s robot design:*
   * Purpose:
     1. What problem is your robot meant to solve? Why is this an important problem to solve? (It would be a good idea to find research to back up your claims about the problem, to show it really is a problem)
     2. How will your robot address that problem
   * Design:
     1. What is the bio-inspiration for robot and why your team chose this bio-design? How does it help achieve its purpose
     2. Explain how you incorporated the structure and/or function of an organ or parts of the body system into the robot’s design, especially which type of skeletal system joints were incorporated into the robot. BE SPECIFIC.
     3. What materials will be used to construct the robot and why?

***Task 3: Mechanical Engineer***

*Your job is to actually design/”build” the robot. In this task, you will need to do the following:*

1. Draw a **detailed** version of the original bio-inspiration and LABEL/IDENTIFY the aspects within the bio inspiration that will be incorporated into your design.
   * For example, if your design is inspired by a gecko, you would draw a gecko, and label and identify the aspects of the gecko’s feet which make it an effective design.
2. Draw or build (out of home-craft materials) a **detailed** concept of your robot prototype. You must also **LABEL each part of the robot with a caption of how it corresponds to the bio-inspiration and how that allows it to execute its function**. ALL JOINTS MUST BE LABELED
   * For example, if your robot has a ball-and-socket joint, label it and in a few words explain how it allows the limb of the robot to have a full near-360 degree range of motion, which is important for the robot to move in any direction efficiently.

YOUR DRAWINGS MUST BE VISUALLY APPEALING, NEAT, **EXTREMELY DETAILED** AND COLORFUL!\* (We should be able to get a good idea of exactly what your group’s robot will look like based on your drawings/model)

***Task 4: Data and Financial Chief***

*A prototype design can often be meaningless unless there is data to back-up its effectiveness, especially if you consider cost of production. Your task will involve the following:*

1. Write 2 paragraphs explaining:
   1. How your team will test your robot? (i.e. what tests will you perform) and Why?
   2. What type of data will you collect? (Consider what variables you will be testing, and how you will represent that data—what type of graphs, etc.).
2. Write 1 paragraph explaining your projected cost of production for your robot, and timeline of production, and why.

YOUR GROUP’S WORK WILL BE ASSESSED USING THE RUBRIC ON THE FOLLOWING PAGE.

**Robot Prototype Design**

***Total Score: /35***

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| **Criteria** | **Exceeds Standards**  **(93%-100 %)** | **Meets Standards**  **(85%-92%)** | **Approaching Standards**  **(70-84%)** | **Far Below Standards**  **(69% and below)** |
| Fulfillment of Project  Requirements  /15 | -All requirements were fulfilled for the project  -ALL required components were included, **expertly** and **thoroughly** executed and/or explained.  -Information presented is exceptionally researched from a wide variety of RELIABLE sources, when needed  - The **most significant**, important and **relevant** information is provided  -Information provided meets the requirements for the project  -Information presented is **highly interesting, clear and comprehensible**  -Information is **accurate and strongly well-reasoned (uses evidence)**  -Skillfully integrates information into the robot design  -All sources are cited according proper format | -All requirements were fulfilled for the project  -ALL required features were included, **fairly well** executed and/or explained. -A few minor improvements could be made here and there.  -Information presented is well researched from a variety of mostly RELIABLE sources, when needed  - Mostly significant, important and **relevant** information is provided  -Information provided meets **most of the requirements for the project**  -Information presented is fairly interesting, mostly clear and comprehensible  -Information is mostly accurate and fairly well-reasoned  -Information is fairly well integrated into the app design  -All sources are cited with attempt at proper format | - MOST (missing 1-2) requirements were fulfilled for the project  -MOST (missing 1-2) required features were included, **somewhat well-executed** and explained. More details or a few **major** improvements could be made to **one or more** aspects of the project.  -Information presented is somewhat well researched from a few credible sources  - Some significant, important and relevant information is provided, however **there could be more information or there is unimportant information included.**  -Information provided meets some of the requirements for the project  -Information presented is mildly interesting, somewhat accurate, and shows **some reasoning, though not the most sound.**  -Some sources are cited | -Several requirements (more than 2) were unfulfilled for the app design  -Several required features were **missing** or were **poorly executed and poorly explained**. Several aspects of project required **major improvements.**  -Limited information on topic is presented. It is evident that only minimal research was conducted  - Information is minimal, uninteresting and unimportant  -Information is inaccurate or shows no evidence of any reasoning.  -Information provided does not meet several of the project requirements  -No sources cited |
| Robot Design  /10 | -The robot design is **EXCEPTIONALLY creative and UNIQUE.**  -The robot contains **highly interesting/engaging, unique features**  -The robot design demonstrates a **strong and sound** understanding of biological inspiration (structures, functions) and is very clearly apparent.  -Skeletal system is **strongly represented and expertly incorporated** | -The robot design is **fairly creative and fairly unique**.  -The design contains some interesting and engaging features  -The robot design demonstrates a **fair understanding** of the biological inspiration (structures and functions)  -Skeletal system is **fairly well represented and incorporated in some aspects** | -The robot design is somewhat creative, however fairly standard/common in nature.  -There are a few interesting features  -The design demonstrates a basic understanding of the biological inspiration  -Skeletal system is **somewhat represented and incorporated into a few aspects** | -The robot design is bland and lacks creativity.  -It is minimally engaging and only functions to meet the information requirements.  -There design does **not demonstrate bio-inspiration**  -Skeletal system is **not represented or incorporated into design.** |
| Aesthetics and Language Conventions    /5 | -Robot design is presented in an exceptionally aesthetically pleasing/visually appealing manner  -Robot design is clear and easy-to-understand  -Robot design is colorful and NEAT,  -Information is organized and neatly presented (has clearly labeled sections and presented in a folder)  -Demonstrates consistently proper, correct grammar, spelling  -Writing is exceptionally well written | -Robot design is fairly aesthetically pleasing/visually appealing  -Tobot design is clear and easy-to understand  -Robot design is fairly neat and fairly colorful and information is fairly well organized and neatly presented (has clearly labeled sections and presented in a folder)  --Writing is clear with mostly proper and correct grammar and spelling  -Writing is fairly fluent and clear | -Robot design is somewhat aesthetically pleasing but can be significantly improved  -Robot design is somewhat neat but lacks a wide array of color.  -Information is somewhat disorganized, some sections labels are missing,  --Writing contains some errors in grammar and spelling  -Writing can sometimes be confusing and somewhat fluent | -Robot design is not aesthetically pleasing  -Robot design is sloppy and messy.  -Information is disorganized and presented in scattered pieces  -There are several errors in grammar and spelling  -Writing is unclear and vague |
| Team Collaboration  /5 | -Teacher observations and project shows that the team collaboration was very productive, time-effective, and supportive of each other (everyone was helping each other)  -Team effort was strongly unified and worked toward the same common goal  -All members contributed equally and there was an even distribution of work and contribution of effort was strongly consistent among all members. No members were left out at any point or non-participative.  -Any issues were resolved within the group, in a positive, encouraging and productive way and in a timely manner | -Teacher observations and the project shows that the team collaboration was mostly productive, mostly time-effective, and fairly supportive of each other.  -Team effort was mostly unified toward the same common goal  -Most members contributed equally and there was an even distribution of work and contribution of effort was fairly consistent. For the most part, no members were left out at any point or non-participative  -Most issues were resolved easily within the group in a mostly positive, encouraging, and productive way and in a fairly timely manner. Minor teacher intervention was required once or twice. | -Teacher observations and the project shows that the team collaboration was somewhat productive.  -Member use of time was often ineffective/inefficient and somewhat wasteful and unproductive  -Some members were not supportive of each other  -Team effort was somewhat divided and project appears to be a collection of individual work loosely tied by the same common goal  -Member contributions were unevenly distributed and not everyone contributed an equal effort. Some members were left out or altogether unparticipating.  -Issues within the group were resolved, however not in the most productive or positive way. Teacher intervention was required a few times. | -There is no evidence of team collaboration  -Team work was extremely unproductive  -Several members demonstrated very ineffective/inefficient use of time  -Members were not very supportive of each other, and there were several unnecessary disputes and the use of discouraging words  -Team effort was starkly divided and project is just a collection of individual pieces without any unity  -Member contributions were severely unevenly distributed. Some members of the group assumed the largest responsibilities while others did not do their part.  -Members were not helpful of each other.  -Issues with the group were ineffectively resolved and required much teacher intervention. |