ROBOTICS IN YOUR FUTURE

Performance Standards 12A/11B/13A.J

Students will apply the processes of technological design to investigate new biological technologies:

- *Knowledge:* understand the advances and necessary processes essential for biological technologies used in human prostheses.
- *Performance:* apply and test the appropriate strategies of technological design and analysis to investigate robotics adaptive technologies.
- *Communication:* correlate adaptive technology design innovations, human variables, scientific and engineering principles and technology constraints from test models.

Procedures

1. ***In order to know and apply concepts that explain how living things function, adapt and change (12A); the concepts, principals and processes of technological design (11B); and the accepted practices of science (13A),*** students should experience sufficient learning opportunities to develop the following:
   - Formulate proposals for testing innovative designs that replicate human muscular control (demonstrated by picking up 12 oz. aluminum can and pouring its liquid contents into separate container).
   - Generate ideas for design criteria and constraints which will comparatively mimic necessary task requirements.
   - Research sources of scientific and engineering information associated with muscular and nervous control.
   - Design and conduct technological innovation testing within classroom parameters of preparations, procedures, clean-up, peer decisions and review.
   - Incorporate appropriate safety, available technology and equipment capabilities into construction of design.
   - Develop sequence of design process with visualizations.
   - Repeat procedural steps for multiple trials and data collection.
   - Use consistent metric measuring and recording techniques with necessary precision.
   - Graph data appropriately to show relation to variables in design solution proposal.
   - Interpret and represent results of analysis to produce findings.
   - Compare data sets to the success criteria for suitability, acceptability, benefits, etc.
   - Evaluate prototype solutions to the overall design success.
   - Propose explanations for sources of error in the data set with regard to product design flaws.
   - Report the process observations and results of investigation, using available technologies.
   - Propose and analyze logical explanations of successes or errors.
   - Identify limitations of investigation methods, sample sets, technologies or procedures.
   - Explain application to appropriate scientific principles and human needs.

   Note to Teacher: This activity relates to the knowledge associated with the Standard 12A, while addressing the Performance Descriptors for Stage J within Standard 11B. Connections to scientific research studies and their implications are a focus of Standard 13A. The use of robotics has been and will continue to be incorporated into many industrial occupations related jobs. Students need to understand the general principles of robotics and their use and the implications within their area of career training.
2. Have students review and discuss the assessment task and how the rubric will be used to evaluate their work.
3. Begin the activity by discussing how the use of robotics has changed and continues to change the lives of people who have lost limbs. With the continued advancements in the field of robotics, people have been able to live more normal lives. The ability for robotic arms to perform common tasks people take for granted every day is now becoming possible. This activity is designed to have your students research the field of robotics, evaluate an existing robotic kit and modify that kit so it is able to perform the task of picking up an ordinary aluminum soda can and then pour the contents out into a cup. Invite a medical expert (from local hospital, university, etc.) to provide an applicable overview of anatomical and physiological principles of muscular and nervous control and the latest research innovations and projections in prostheses and adaptive technologies. Students should research an array of available robotic kits within parameters of class budget and time parameters. Determine design success parameters (such as maximum mass of device, maximum mass to be held, duration of test, spill tolerances, etc.) Divide the class into groups to do in-depth studies into the kits and what changes would need to be modified to perform the task. Groups should then present their proposals for

class review. Evaluate advantages and disadvantages of each proposal according to success criteria. Construct and test prototypes, following appropriate sequencing and safety procedures. Record anecdotal, graphic and visual observations of construction and tests. Analyze collected data according to success criteria and explain any sources of errors. Make conclusions as to the performance of the arm according to the success criteria, the limitations of the investigation and the correlation to human anatomical and physiological requirements. Suggest possible modifications that can be made to increase the performance of the arm.

4. Evaluate each student's work using the science rubric as follows and add the scores to determine the performance level:
   - *Knowledge:* The descriptions and explanations of advances and processes involved with the biological technologies are complete and correct.
   - *Performance:* The model testing procedure and analysis were correct and complete.
   - *Communication:* The correlations between adaptive technology design innovations, human variables, scientific and engineering principles and technology constraints from test models are well reasoned and presented completely and correctly.

Examples of Student Work

- Meets
- Exceeds

Time Requirements

- Time required depends on the time required to build the robotic arm – 4 to 10 class periods

Resources

- Use of internet for catalog resources for robotics kits and components
- Resource materials for anatomical/ physiological principles of muscular and nervous control
- Robotic arm kit and necessary components
- Timers, scales, technologies for collecting data and recording observations, etc.
- Aluminum cans

SCIENCE RUBRIC

Exceeds - must receive no more than one 3 and the rest 4s in the other areas of the rubric.
Meets - may receive no more than one 2 and a combination of 3s and 4s in the other areas of the rubric.
Approaches - may receive no more than one 1 and a combination of 2s, 3s or 4s, in the other areas of the rubric.
Begins - must receive at least a 1 in all 3 areas of the rubric.

	KNOWLEDGE Knows and understands scientific terms, facts, concepts, principles, theories and methods.	**APPLICATION** Applies scientific knowledge, skills and methods to manipulate, analyze, synthesize, create and evaluate.	**COMMUNICATION** Communicates scientific knowledge and applications through writing, speech and visual displays.
4	• Descriptions of scientific terms, facts, concepts, principles, theories and methods are complete and correct.	• Applications are thorough, appropriate and accurate.	• Written, oral and/or visual communication is well organized and effective.
3	• Descriptions of scientific terms, facts, concepts, principles, theories and methods are mostly complete and correct.	• Applications are mostly thorough, appropriate and accurate.	• Most of the written, oral and/or visual communication is well organized and effective.
2	• Descriptions of scientific terms, facts, concepts, principles, theories and methods are somewhat complete and correct.	• Applications are somewhat appropriate and accurate.	• Some of the written, oral and/or visual communication is organized and effective.
1	• Descriptions of scientific terms, facts, concepts, principles, theories and methods are minimally present or correct.	• Applications are minimally appropriate and accurate.	• Little of the written, oral and/or visual communication is organized and effective.
0	• All descriptions of scientific terms, facts, concepts, principles, theories and methods are missing and/or incorrect.	• All applications are missing and/or incorrect.	• All of the written, oral or visual communication is missing and/or lacks organization.
Score			