**IPRO 314 - ABSTRACT**

# THE FIRST ARTIFICIAL KIDNEY: BUILDING A WORKING REPLICA OF KOLFF'S ROTATING DRUM

## FACULTY AND STUDENT MEMBERS

**Project Advisor:**
Paul Fagette, PhD, Department of Biomedical Engineering

**Project Sponsor:**
Museum of Science and Industry
Patricia Ward, PhD, Dept. of Science and Technology

**Student Members:**
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## SIGNIFICANCE:

Students will recreate, from the original plans, a working replica of the first clinically successful artificial kidney. Designed, built, and implemented in 1942, Willem Kolff's rotating drum was the first successful extra-corporeal medical technological device. It provided a successful technological reference point for subsequent development of dialysis devices. This device literally established the field of artificial organs. There are no working models in the Western Hemisphere. Two exist in Europe, both in the Netherlands.

## TEAM PURPOSE AND GOALS:

Overall, to build a working model of the rotating drum to present to the Museum of Science and Industry.
To enable students interested in healthcare, BME, MBB, etc., to understand the relationship between basic mechanical forces and device design.
To enable students to work as cross disciplinary team members and contribute to solving design and construction issues for an artificial organ.
To enable students to understand the development of the design of an artificial organ from an historic example.
To understand the interplay of knowledge bases from chemistry, materials, physiology, etc., required to develop an artificial organ.
To understand the relationship between clinical needs and requirements and design of an artificial organ.

## MAJOR ACTIVITIES AND TASKS:

**Project teams follow the 4 major component parts: hollow axle, wooden drum, blood pump, and stand and basin. The first major effort involved translating 2 dimensional plans into 3-D CAD. The adjustable blood pump is easily the most challenging and will require the most time. Each team will have to derive a working model from 2-D plans designed in 1946 with very basic materials.**

## POTENTIAL FOR ACHIEVING INTERPROFESSIONAL LEARNING OBJECTIVES:

**This project certainly presents a complex engineering problem that requires considerable multi-disciplinary teamwork. A mechanical blood pump, the wood lattice, the unique hollow axles, etc., are in themselves, a complex problem. There are no resources other than the plans thus the students have to figure and explain each component to derive a workable design. They will have to expand their understanding of device development and the practical application of engineering/science principles. The nature of each component is complicated to the point that only a team with multiple skills will be able to resolve the needs. Physiological limitations will have to be reconciled with engineering and technical aspects in order to meet a basic clinically defined goal.**

## POTENTIAL FOR RIGOROUS APPLICATION OF AT LEAST TWO ACCEPTED RESEARCH, DESIGN, BUSINESS OR OTHER TYPES OF METHODOLOGIES ASSOCIATED WITH PROFESSIONAL PRACTICE:

**The rotating drum utilizes two basic engineering concepts: flow and mass transport. The device is designed to replicate the human kidney by using diffusion as the operative mechanism to remove metabolic waste products, e.g., urea, from the blood. A common engineering research rubric is to reduce an area of study to the basic forces at work and then follow those forces through the process. The use of the major concepts will give focus and a working overview for the entire project.**

**In terms of educational practice, the class will follow a format already established. General guidelines will be given but then each team has to develop a research format and time line. The students will then follow a simple rule: form follows function. They will have to derive the component parts from 2-D plans made in 1947, expand them to 3-D. The basic premise is one of problem solving. Each successive step reveals new complexities and problems that have to be solved. The main idea is that students understand basic engineering/scientific concepts at work through application.**