VEX ROBOTICS

CAREER READINESS

ORTHOPAEDIC SURGERY

REPAIRING THE BODY'S C-CHANNELS

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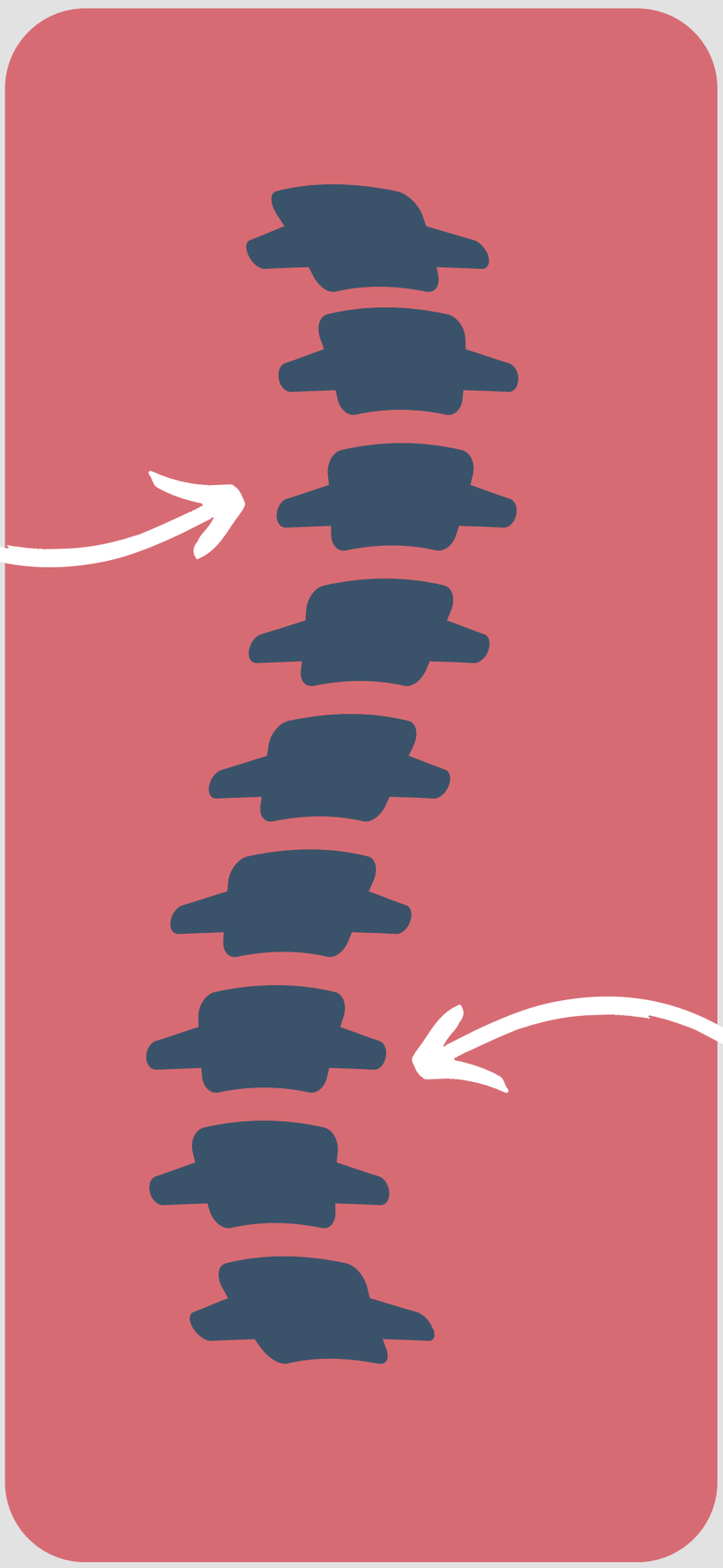
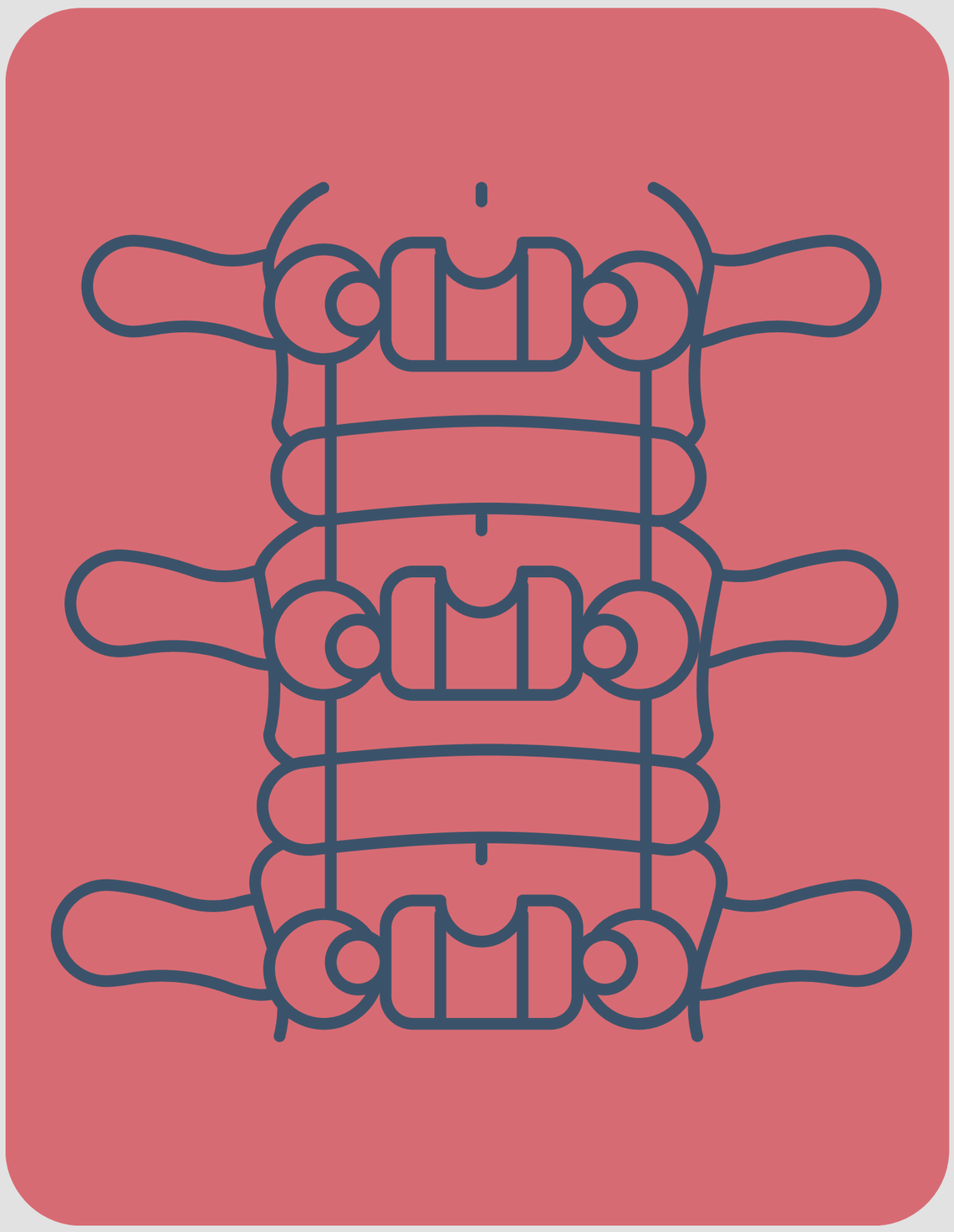
THANKS TO DR. JOHN M. FLYNN, MD FOR THE INTERVIEW

INTRODUCTION

A few months ago, one of our team members had a spinal fusion operation. This encounter with the field of orthopaedic surgery inspired us to learn more about it, and we made the connection that VEX robotics processes are very similar to those of orthopaedic surgeons.



CURVATURE OF THE SPINE

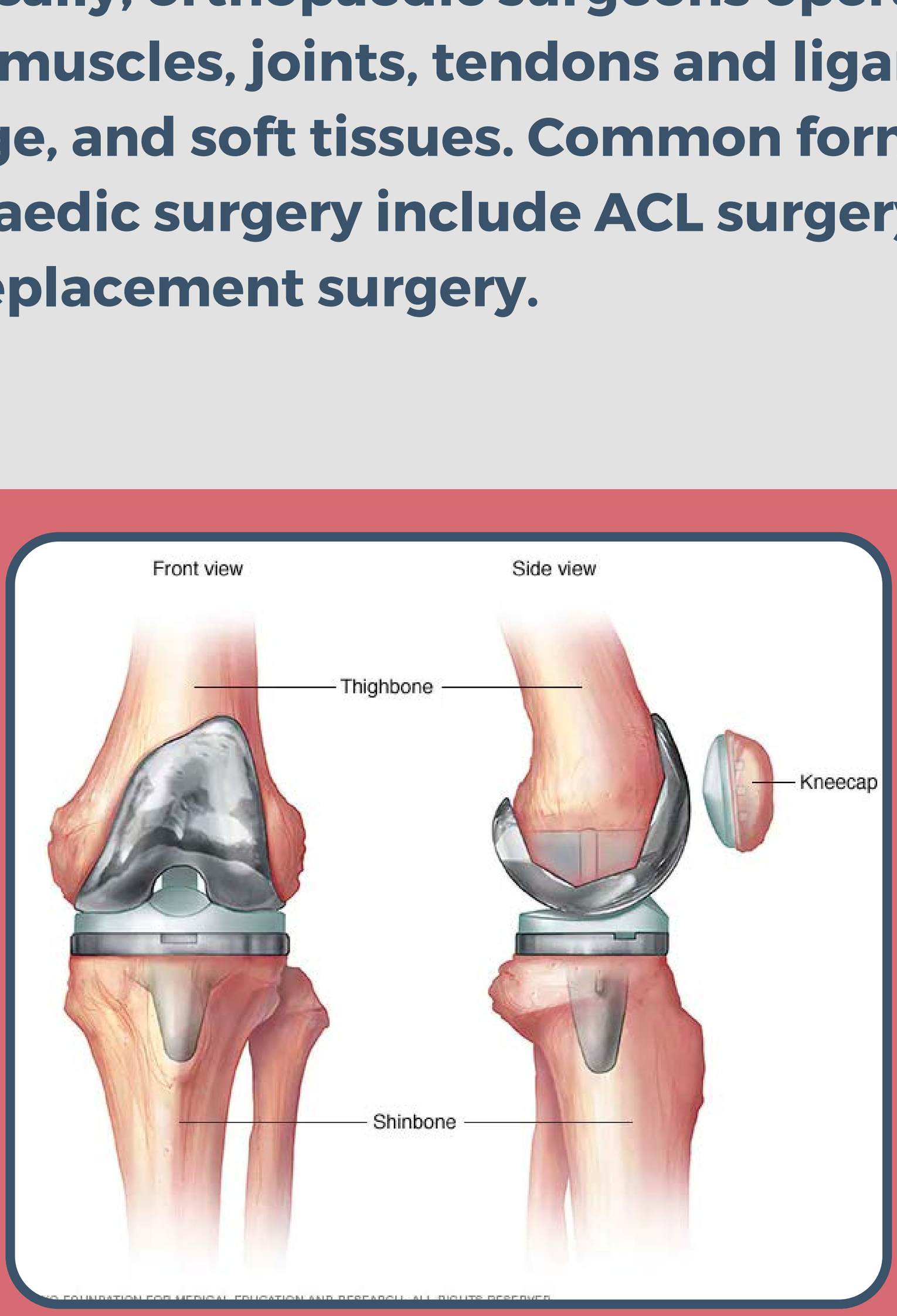


SPINAL FUSION

WHAT IS ORTHOPAEDIC SURGERY?

Orthopaedic surgery specializes in the diagnosis, treatment, and repair of ailments in the human musculoskeletal system.

Specifically, orthopaedic surgeons operate on bones, muscles, joints, tendons and ligaments, cartilage, and soft tissues. Common forms of orthopaedic surgery include ACL surgery and knee replacement surgery.

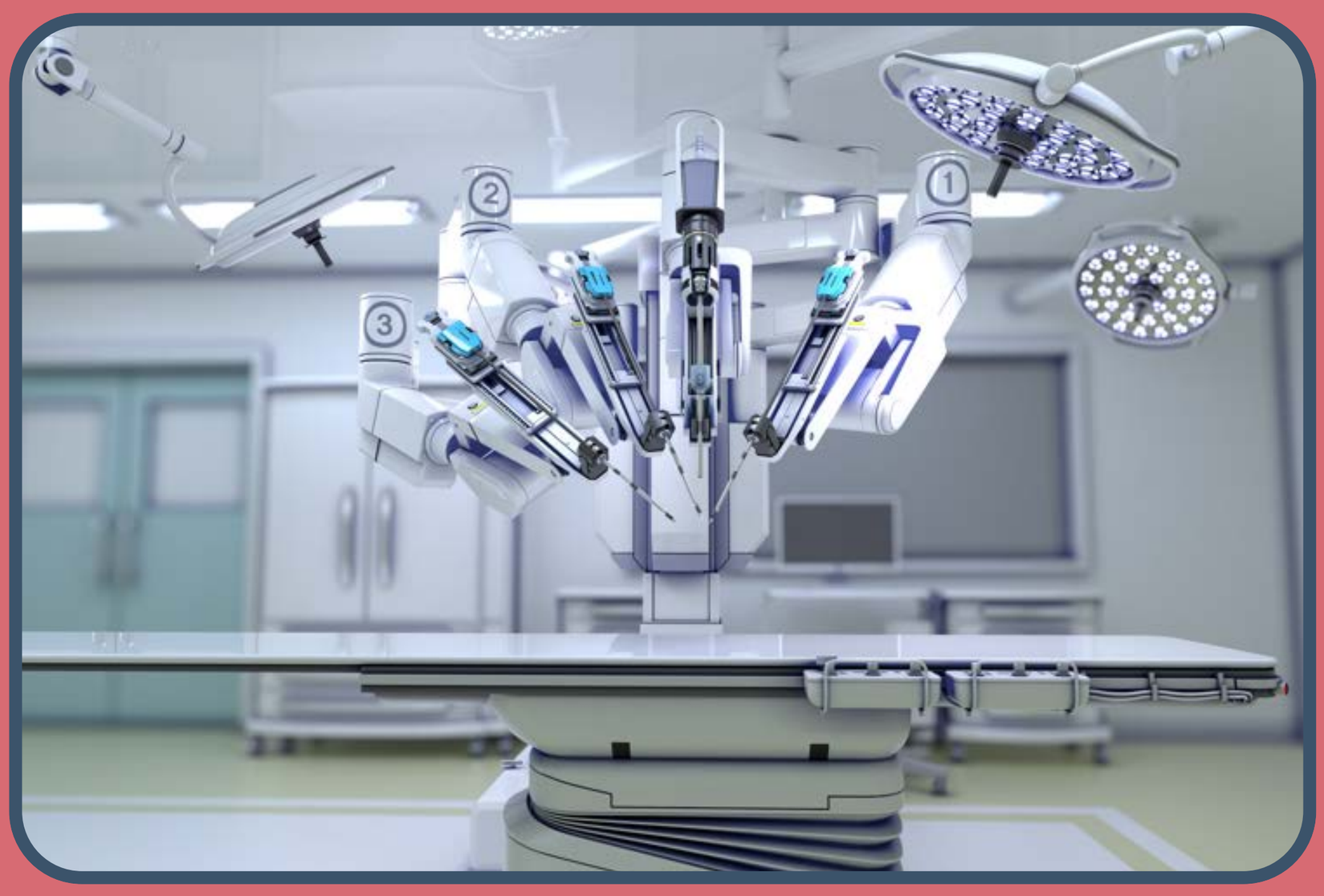


KNEE REPLACEMENT SURGERY

MAYO CLINIC

WHY DID WE CHOOSE ORTHOPAEDICS?

We chose orthopaedic surgery because, at first glance, surgery does not seem related to robotics. Even so, utilization of the Engineering Design Process is commonplace in orthopaedic practices to ensure a safe, healthy, and positive experience for patients undergoing these operations. Not many people think of surgery as a STEM field, but it possesses many of the characteristics that are associated with robotics.



DA VINCI SURGICAL SYSTEM

UROLOGY AUSTIN

CHARACTERISTICS COMPARISON

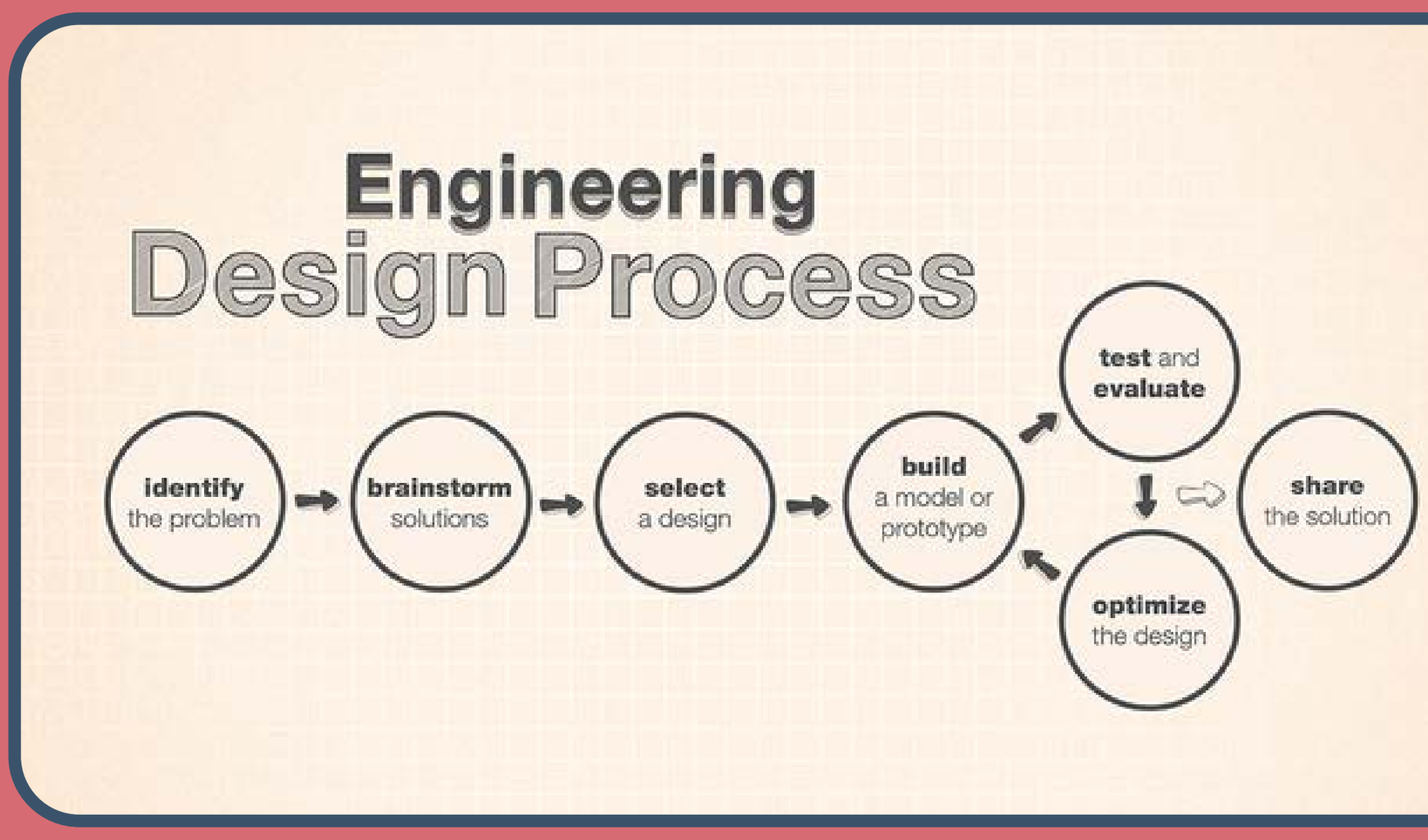
	Vex Robotics	Orthopaedic Surgery
Critical Thinking	Designing and programming robots involve solving intricate problems.	Surgical procedures require quick thinking and problem-solving skills. Robotics experience can enhance the ability to analyze complex situations under pressure.
Fine Motor Skills	Building and manipulating robots improve fine motor skills.	Surgeons need excellent dexterity and fine motor skills for delicate procedures. Robotics experience contributes to developing these skills.
Teamwork/Collaboration	Robotics projects are collaborative efforts that require effective teamwork.	Surgeons work in interdisciplinary teams. Learning to collaborate in a robotics setting contrbutes to effective teamwork in a surgical environment.
Communication	Presenting and explaining robotics projects hones communication skills.	Clear communication with patients, colleagues, and medical staff is crucial in surgery. Robotics experience can contribute to effective communication in a medical context.
Spatial Awareness/ Visualization	Designing and assembling robots require spatial awareness and visualization.	Surgeons must navigate complex anatomical structures during procedures. Robotics experience can enhance spatial awareness and visualization skills.

CHARACTERISTICS COMPARISON CONTD.

	Vex Robotics	Orthopaedic Surgery
Attention to Detail	Building and testing robots demands attention to detail.	Precision is essential in surgery. Robotics experience helps develop a keen eye, ensuring accuracy in surgical procedures.
Adaptability/ Innovation	Robotics projects often involve adapting to unforeseen challenges and innovating solutions.	Surgical procedures may present unexpected challenges. Robotics experience can foster adaptability in unforeseen circumstances mid-surgery.

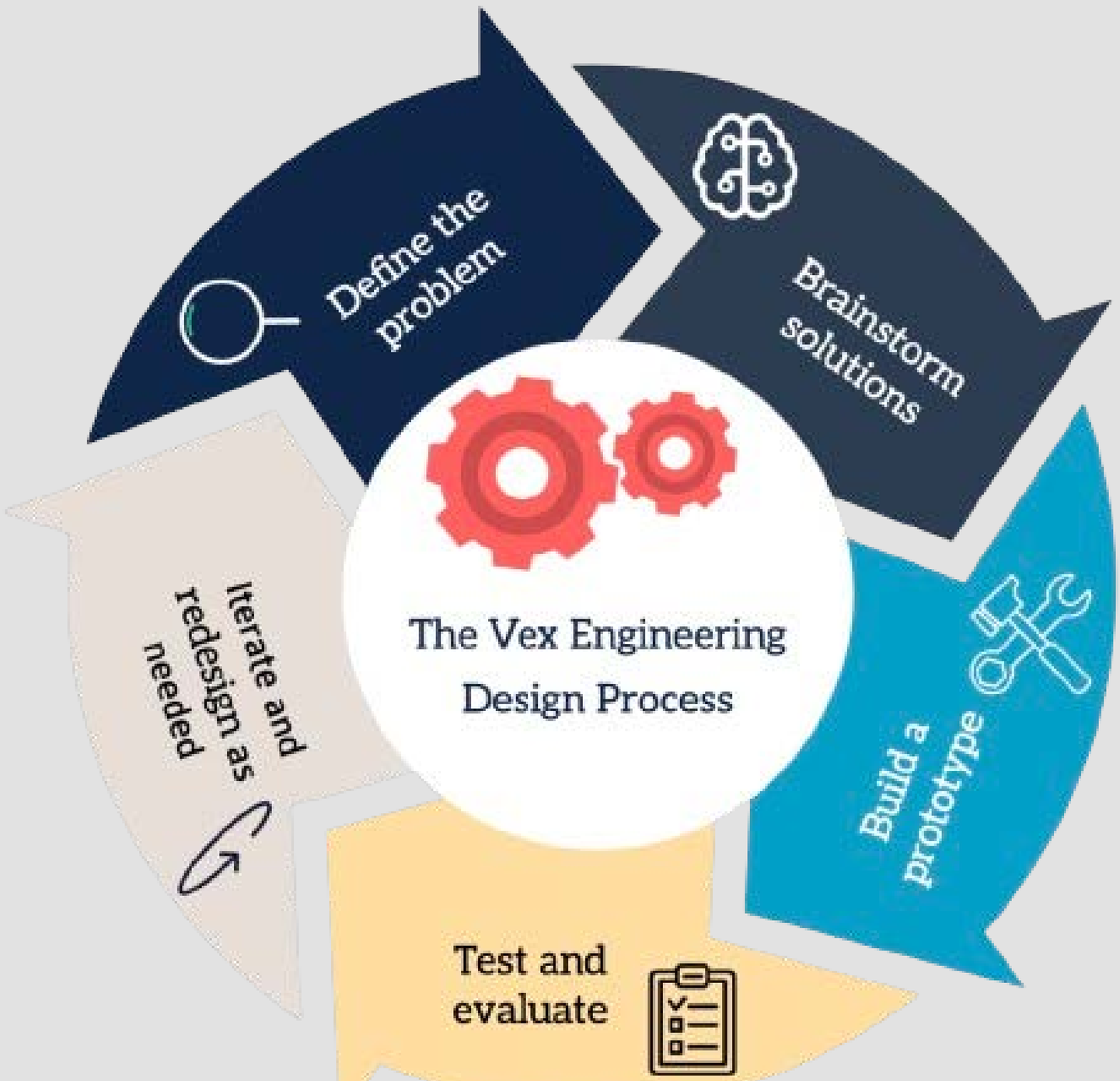
DESIGN PROCESS

The Engineering Design Process is not only crucial in engineering, as demonstrated by its use in STEM careers all around the globe. The order of steps may vary from field to field, depending on how they are employed. However, its underlying purpose remains constant; it compiles and organizes the steps necessary to iterate on and create a successful result.



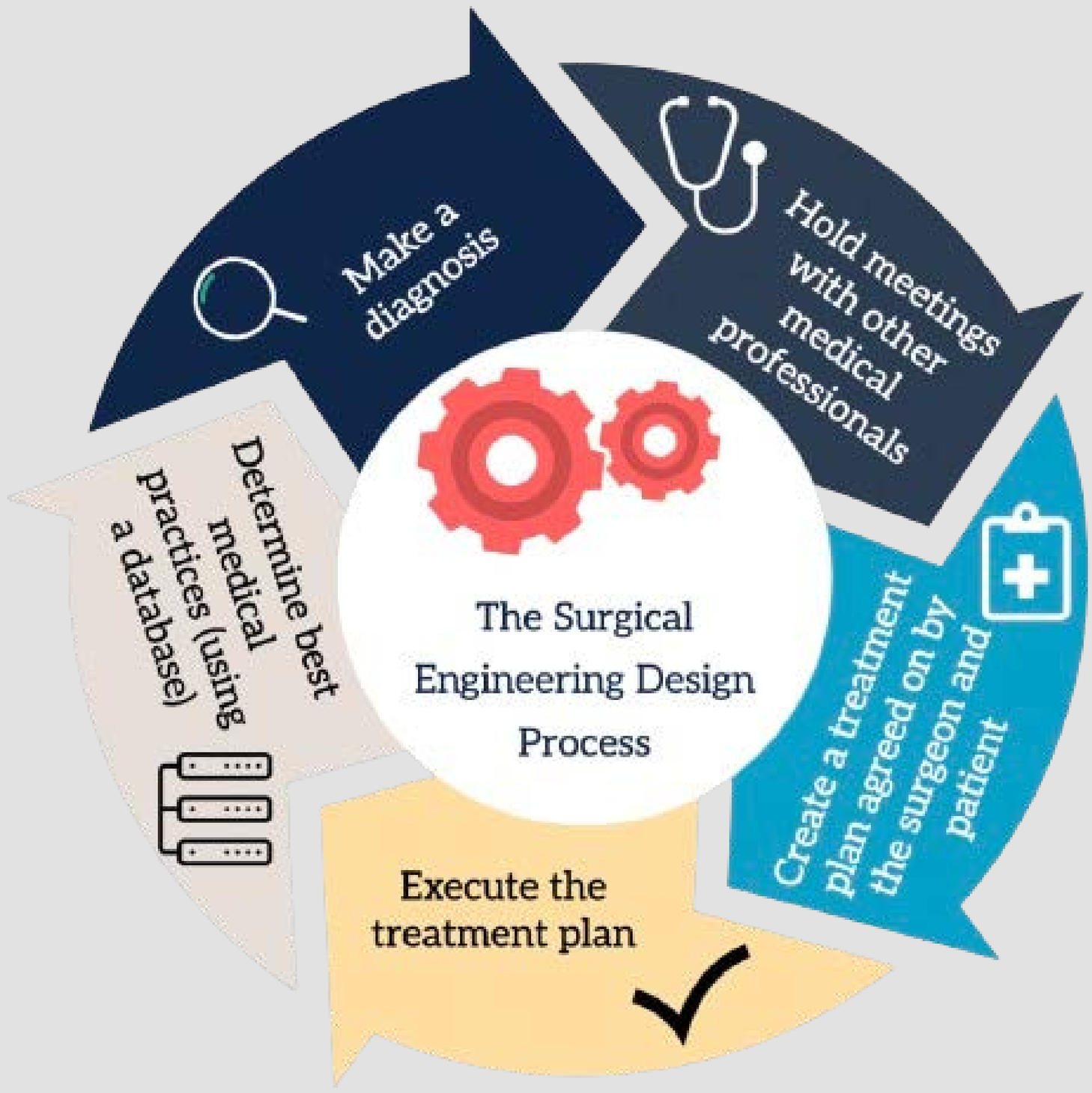
NASA JET PROPULSION LABORATORY

DESIGN PROCESS CONTD.



THE VEX EDP

THE SURGICAL EDP



DESIGN PROCESS CONTD.

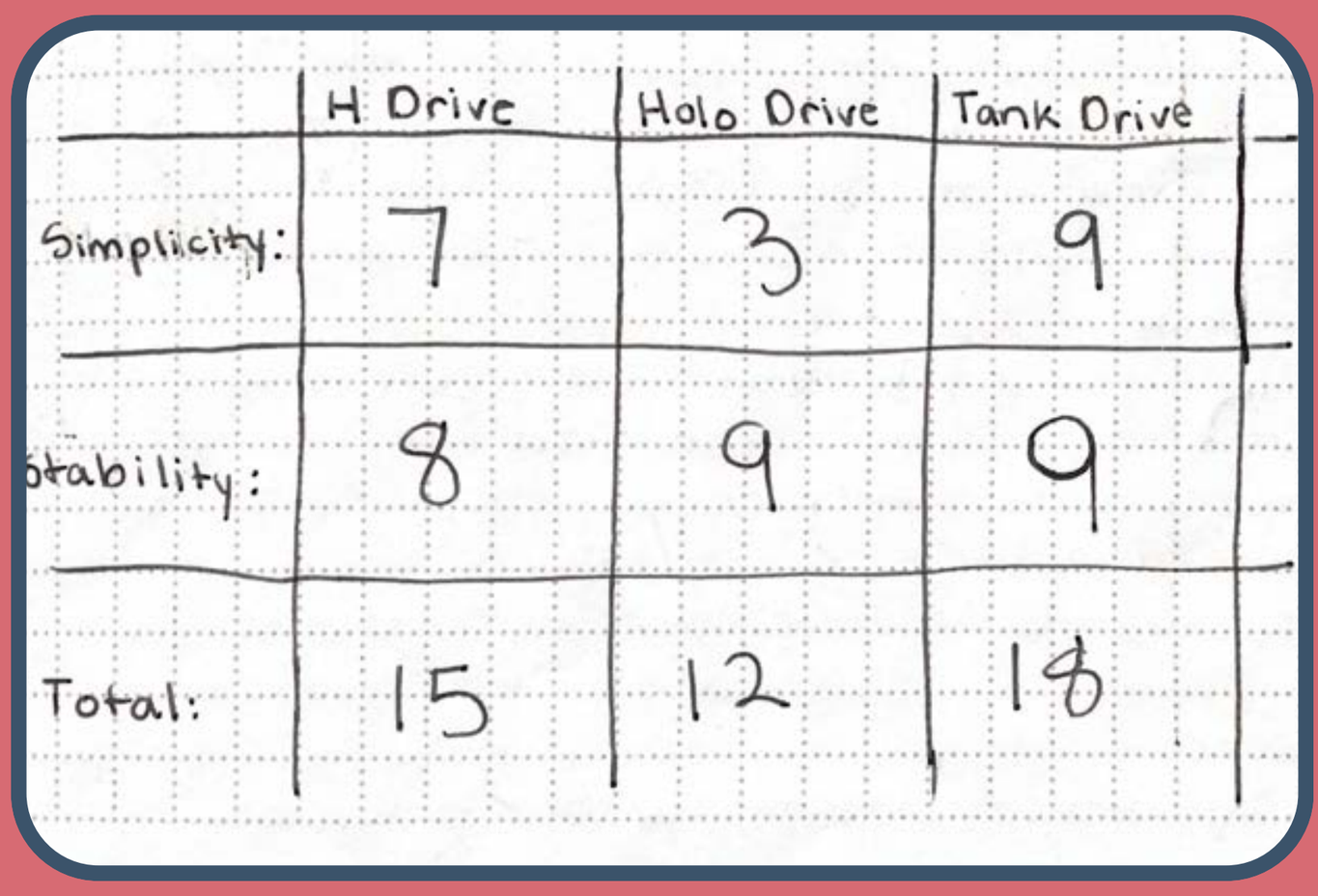
The surgical design process is strikingly similar to the process our VEX team uses daily. To learn more about the process that orthopaedic surgeons use, we interviewed Dr. John M. Flynn, MD, who gave us valuable insight into how he used the design process to pioneer the use of a technique known as image-guided navigation to treat pediatric spinal deformities.

DR. JOHN M. FLYNN

CHOP

DESIGN PROCESS CONTD.

He noticed that techniques to fix scoliosis, a sideways curvature of the spine, had not changed since the 1990s, which is how he defined the problem. For brainstorming solutions, Dr. Flynn is a member of several national research groups, which he attends to learn about new technologies and solutions. When we brainstorm solutions, we come together to discuss our ideas and whether they would be a good fit for the year's competition. We also research what other teams have built and build on their ideas.

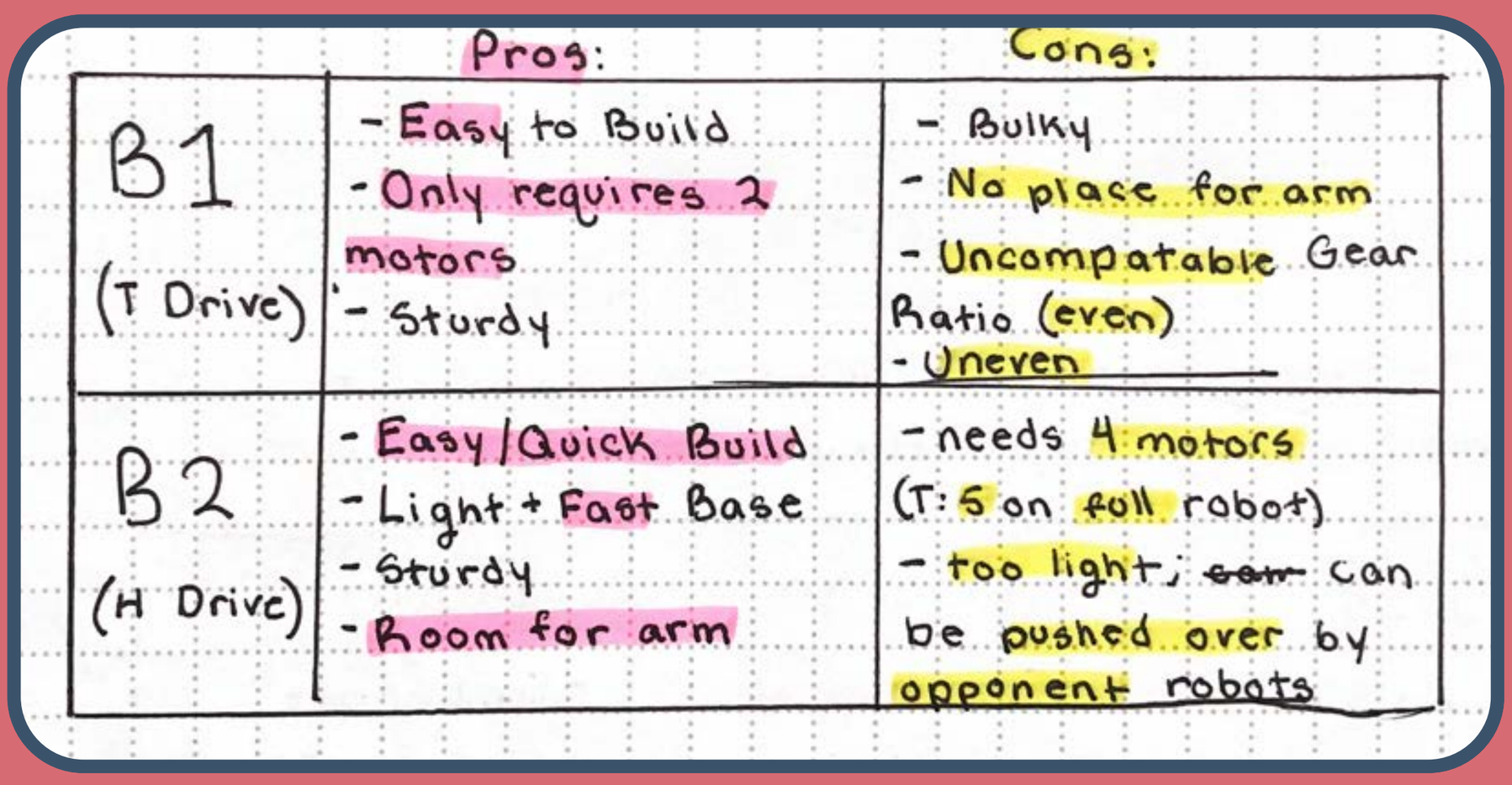


	H Drive	Holo Drive	Tank Drive
Simplicity:	7	3	9
Stability:	8	9	9
Total:	15	12	18

A DESIGN MATRIX FOR OUR BASE DESIGN

DESIGN PROCESS CONTD.

Dr. Flynn inferred that if surgeons use image-guided navigation in adults with degenerative spines, it could aid in making pediatric orthopaedic surgery safer. His adaptation of this technique to children undergoing surgery for scoliosis falls under the Design a Solution portion of the process. To test and evaluate the efficacy of solutions, he communicated, "We take data out of a database to determine best practices and iterate over them." This approach of poring over a database to determine best practices is not dissimilar to how our VEX team selects the best solution to a problem using design matrices and our engineering notebook.



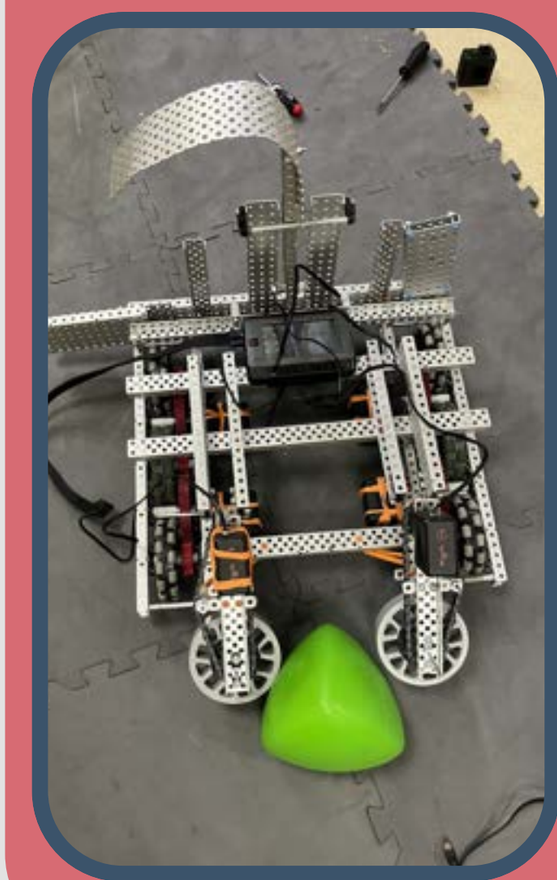
	Pros:	Cons:
B1 (T Drive)	- Easy to Build - Only requires 2 motors - Sturdy	- Bulky - No place for arm - Uncompatable Gear Ratio (even) - Uneven
B2 (H Drive)	- Easy/Quick Build - Light + Fast Base - Sturdy - Room for arm	- needs 4 motors (T: 5 on full robot) - too light; ~~can~~ can be pushed over by opponent robots

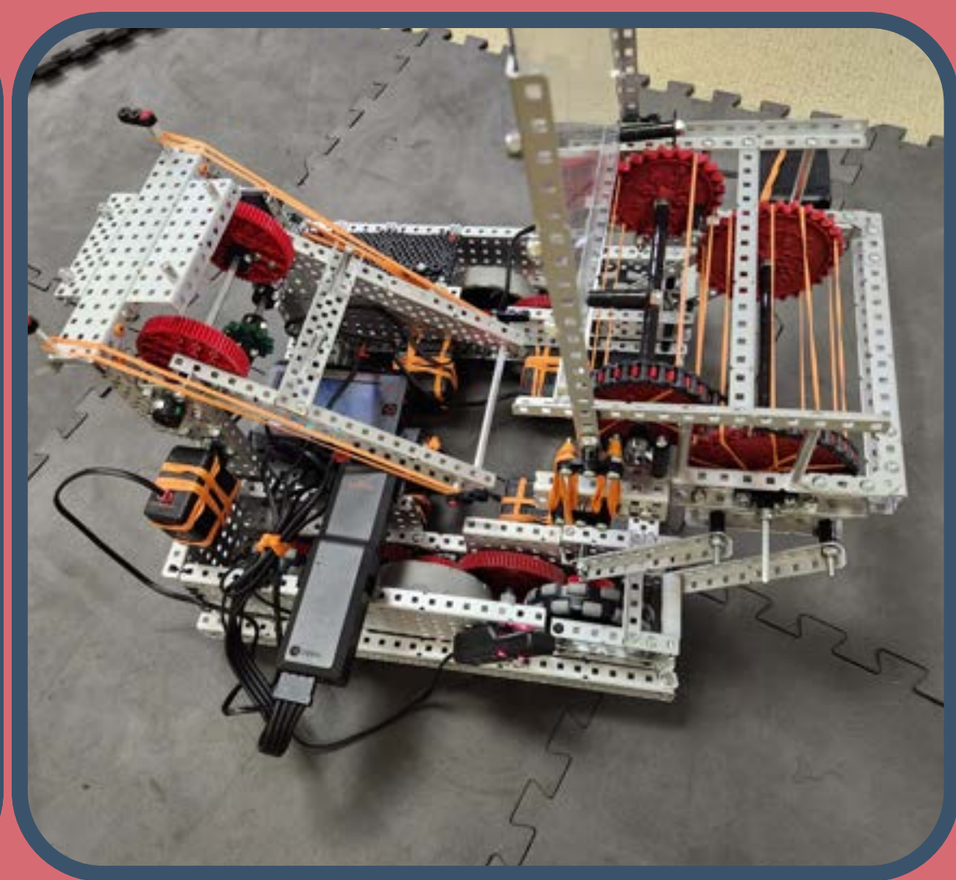
A DESIGN MATRIX ILLUSTRATING PROS AND CONS

DESIGN PROCESS CONTD.

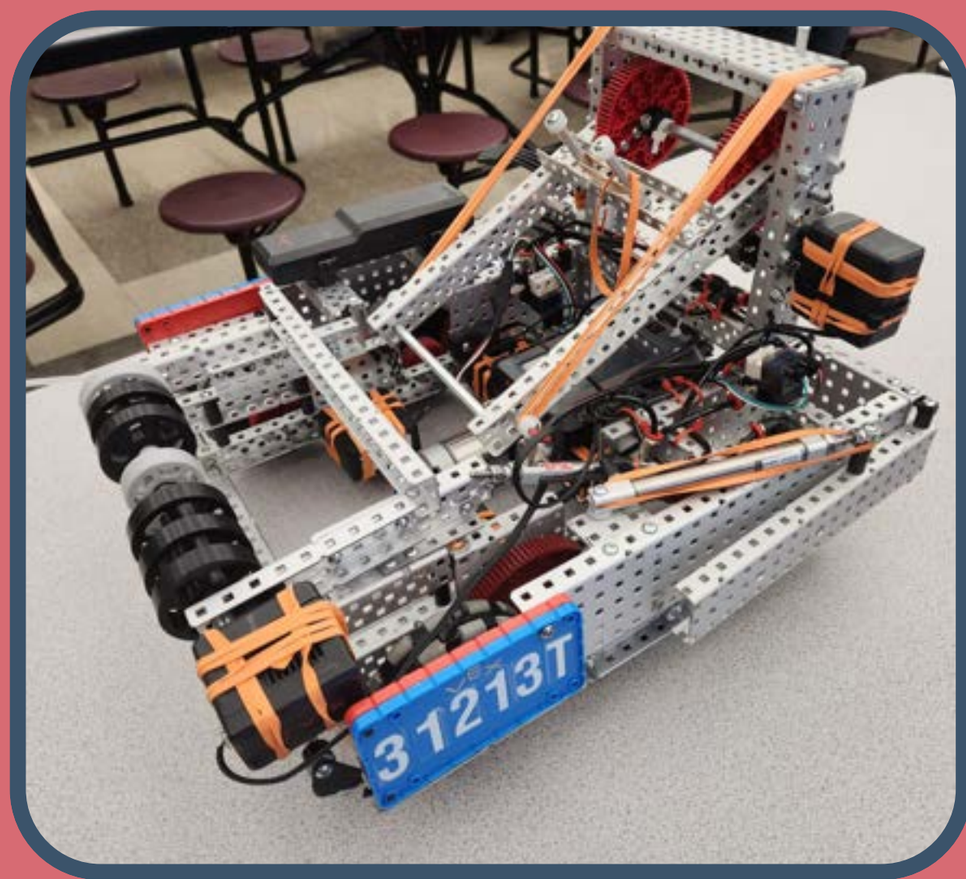
The images below illustrate how we used the EDP to evolve our robot's design over the course of this competition.

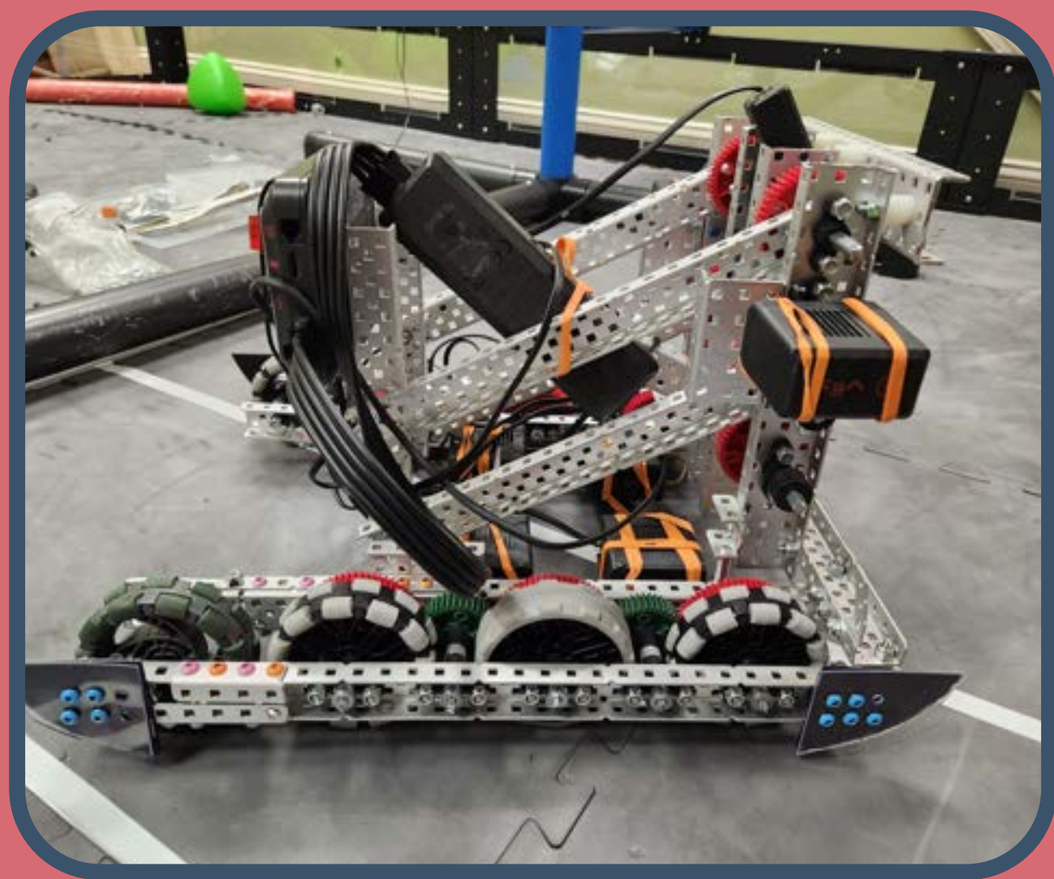
THE EVOLUTION OF OUR INTAKE, FROM TWO SIDE-ROLLERS (LEFT), TO A RUBBER BAND ROLLER, TO A FLEX-WHEEL ROLLER (RIGHT).





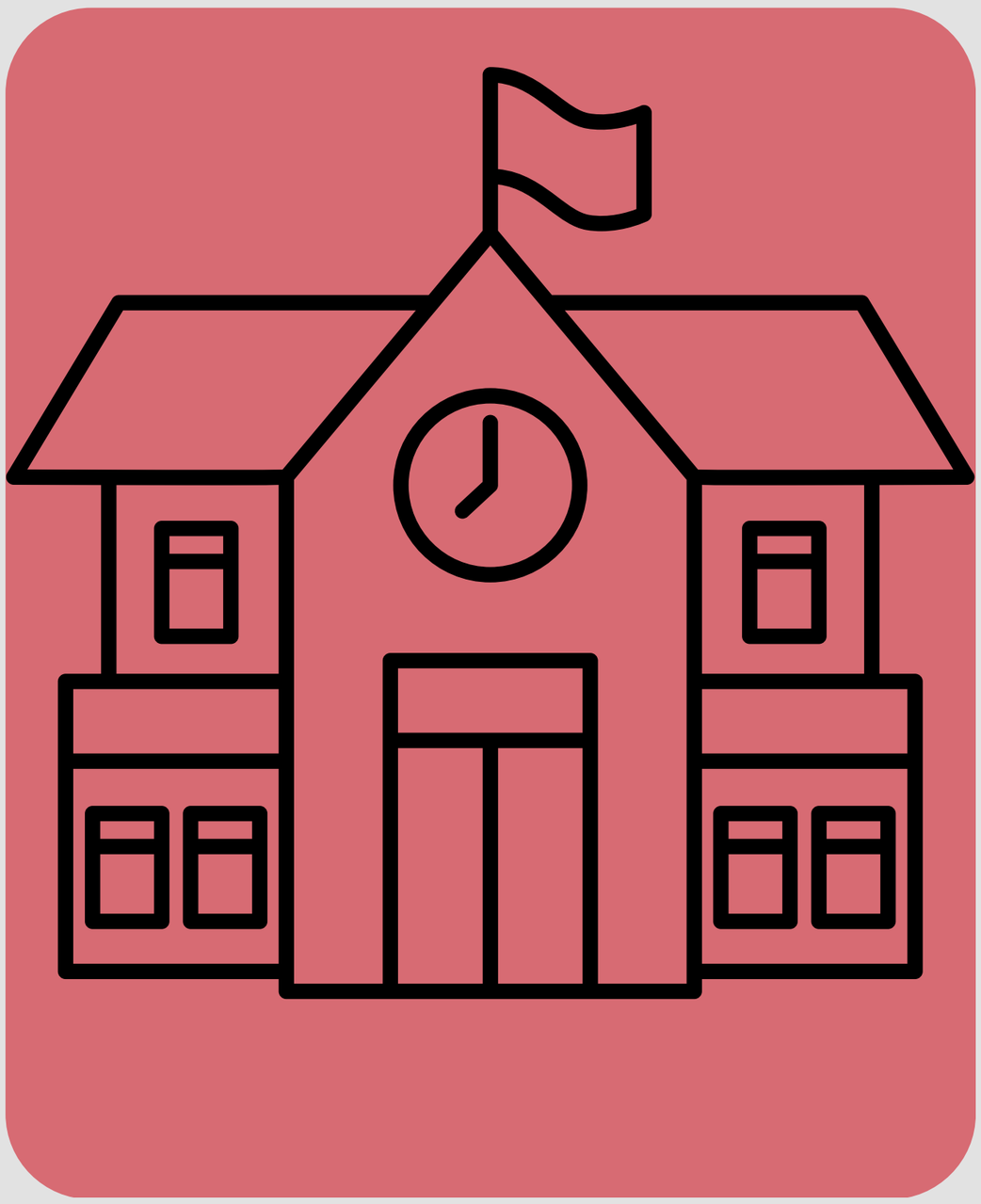
THE EVOLUTION OF OUR ENTIRE ROBOT. THE LEFTMOST IS OUR FIRST ROBOT WHICH PLACED US SECOND, AND OUR NEWER ONE ON THE RIGHT IS YET TO SEE COMPETITION.





OTHER SIMILARITIES

There are more similarities between VEX and orthopaedic surgery than just the Engineering Design Process. For example, Dr. Flynn explained that he loves seeing tangible results of his work clearly and that it fits well with his personality as he likes to fix things. He also mentioned that to do well in medical school, being a team player is a must. Our team members display these attributes while building our robot, further demonstrating the connection between robotics and surgery.



MEDICAL SCHOOL

TEAMWORK

ABOUT DR. FLYNN

Dr. John M. Flynn, MD, is the chief of the division of orthopaedics at Children's Hospital of Pennsylvania (CHOP). He graduated from Johns Hopkins University and the University of Pittsburgh School of Medicine.

CHOP

CHILDREN'S HOSPITAL OF PHILADELPHIA

DR. JOHN M. FLYNN, MD

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ABOUT DR. FLYNN

OUR VEX TEAM

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VIKAS

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