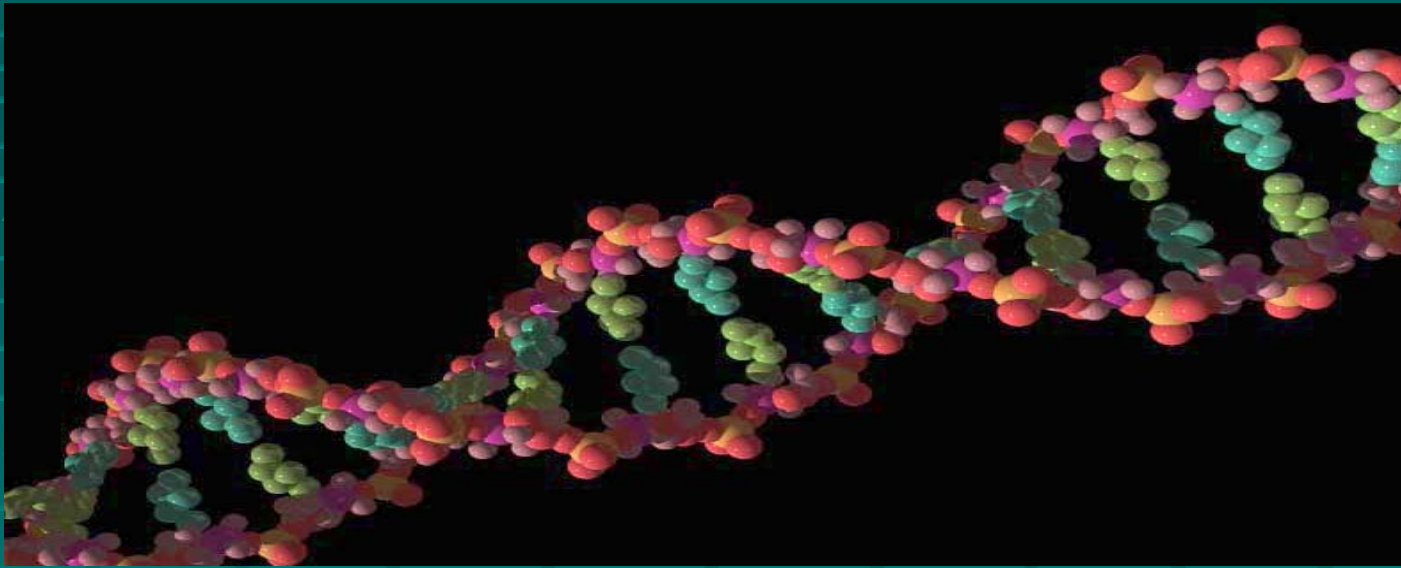


The Codon Decoder



By: Vera E. Mihalcik and Cameron Jahn

Marta Valle Secondary School

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SMART Science and Mechatronics Aided Research for Teachers

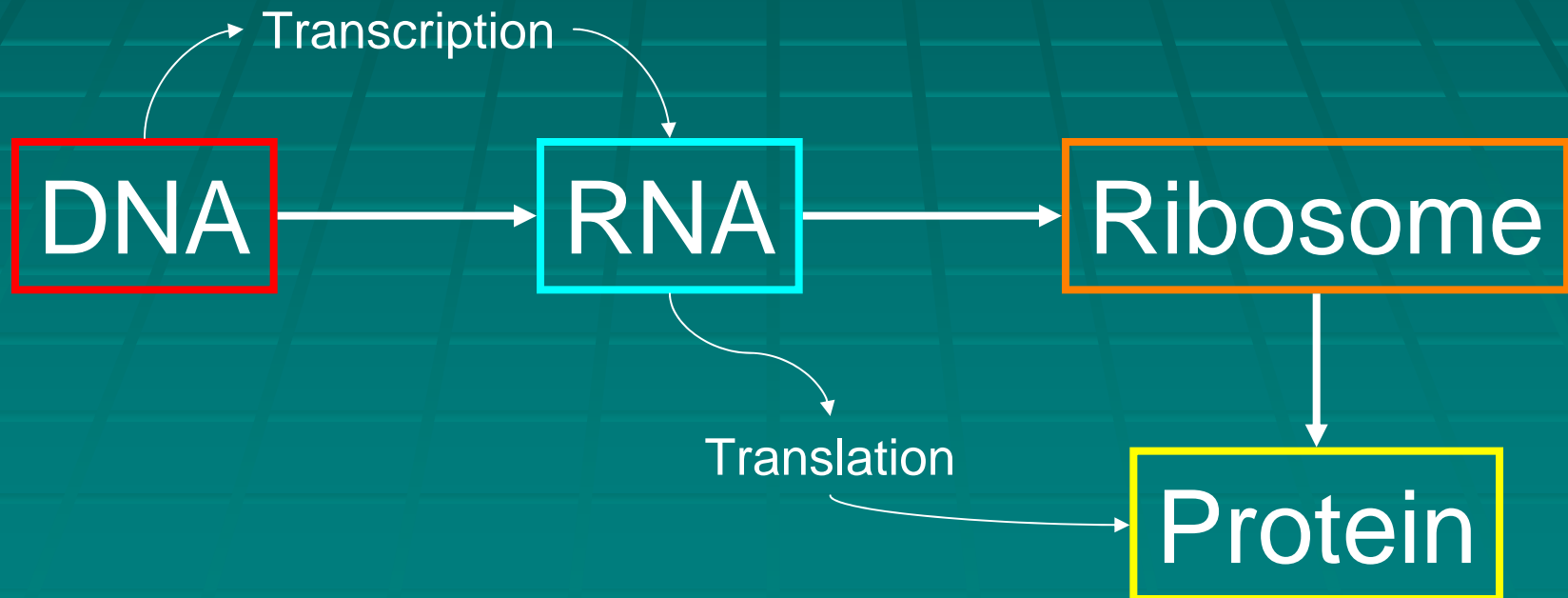
July-August 2005

Project Goals

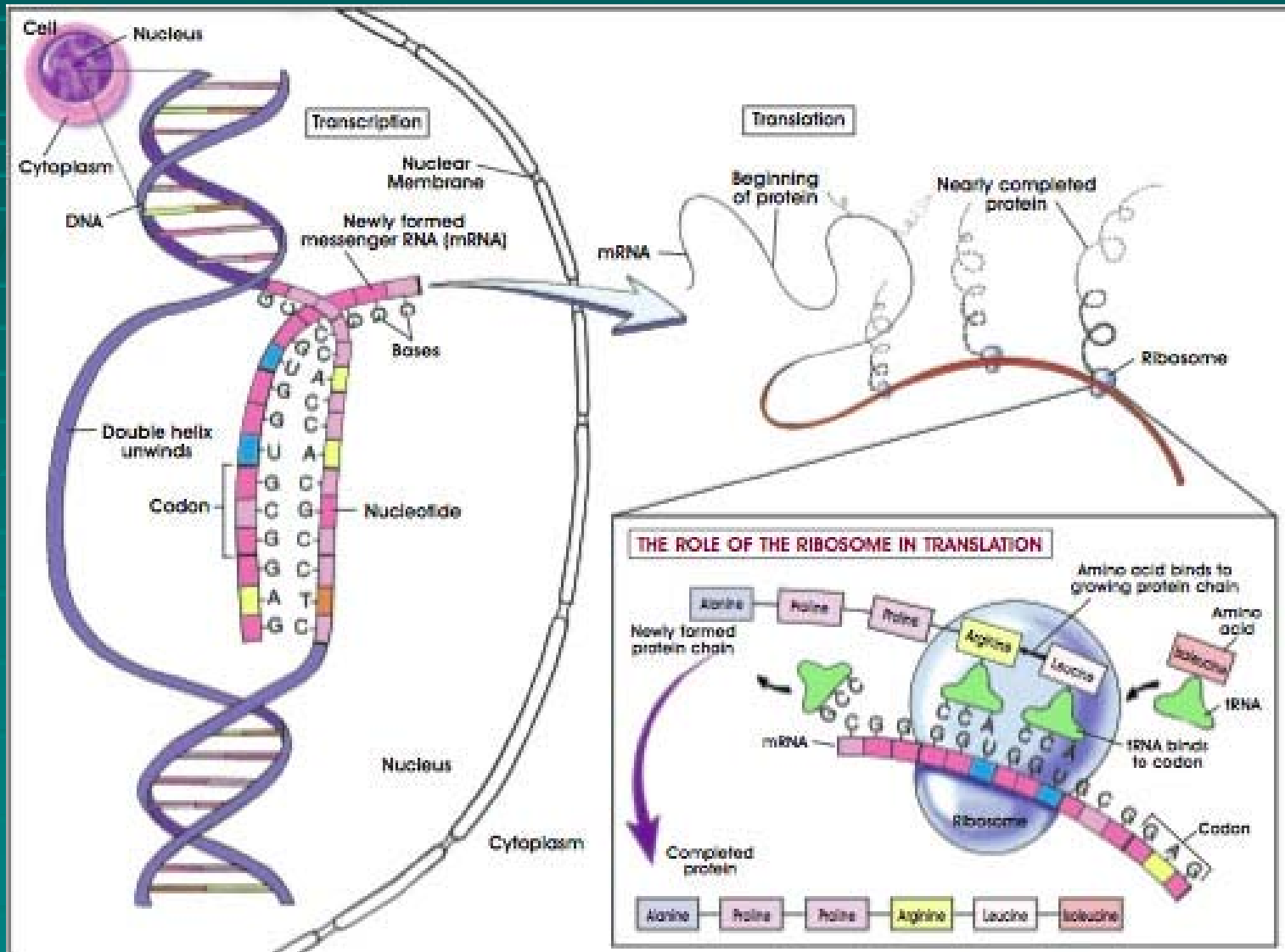
- To help students learn abstract biological concepts by making them tangible and fun.
- To engage students in hands-on learning activities and make the topic interesting.
- To promote the use of technology in the classroom.

Theory

Protein Synthesis



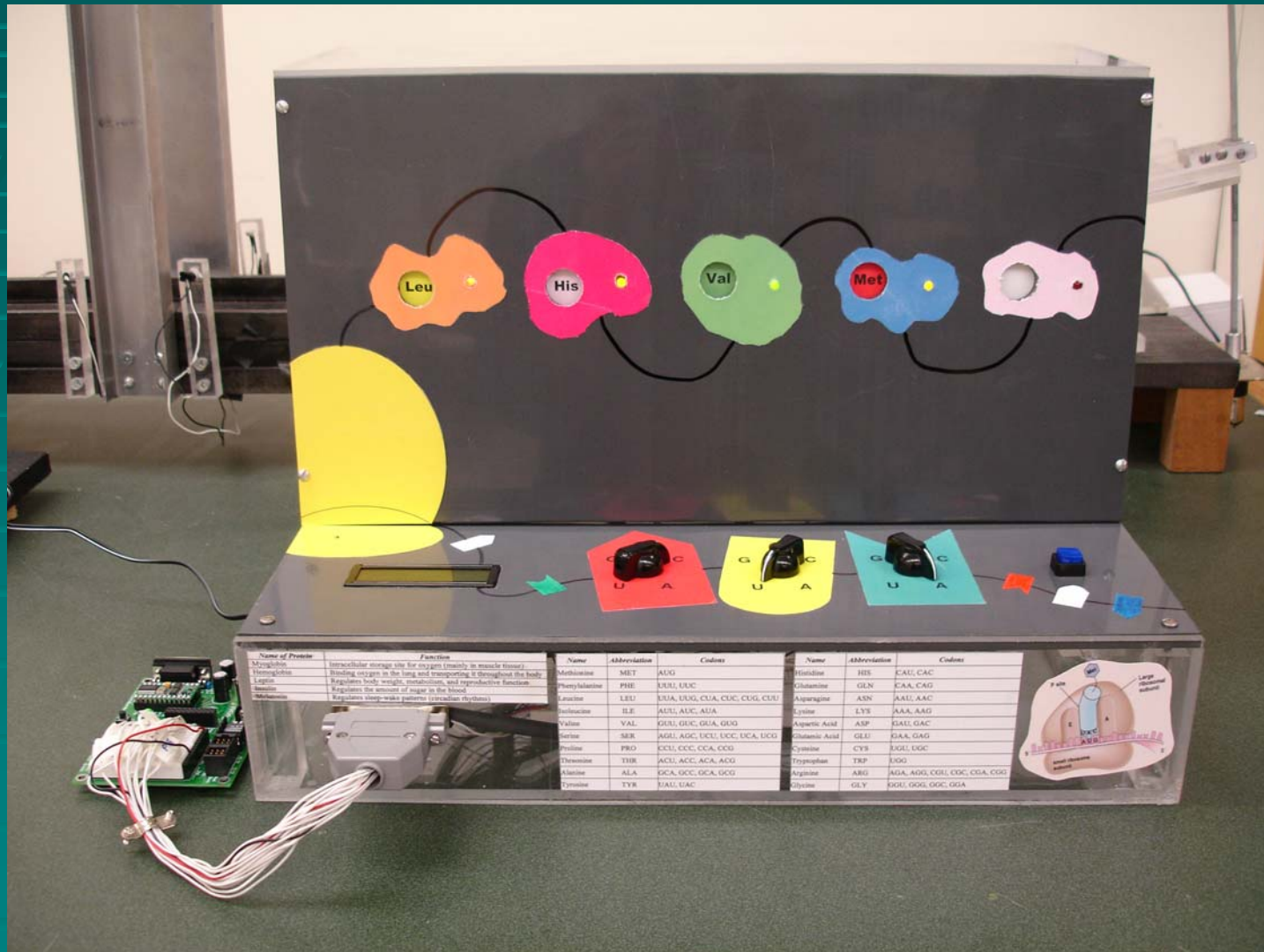
Theory



Theory

<u>Name</u>	<u>Abbreviation</u>	<u>Codons</u>
Methionine	MET	AUG
Phenylalanine	PHE	UUU, UUC
Leucine	LEU	UUA, UUG, CUA, CUC, CUG, CUU
Isoleucine	ILE	AUU, AUC, AUA
Valine	VAL	GUU, GUC, GUA, GUG
Serine	SER	AGU, AGC, UCU, UCC, UCA, UCG
Proline	PRO	CCU, CCC, CCA, CCG
Threonine	THR	ACU, ACC, ACA, ACG
Alanine	ALA	GCA, GCC, GCA, GCG
Tyrosine	TYR	UAU, UAC
Histidine	HIS	CAU, CAC
Glutamine	GLN	CAA, CAG
Asparagine	ASN	AAU, AAC
Lysine	LYS	AAA, AAG
Aspartic Acid	ASP	GAU, GAC
Glutamic Acid	GLU	GAA, GAG
Cysteine	CYS	UGU, UGC
Tryptophan	TRP	UGG
Arginine	ARG	AGA, AGG, CGU, CGC, CGA, CGG
Glycine	GLY	GGU, GGG, GGC, GGA

The Codon Decoder

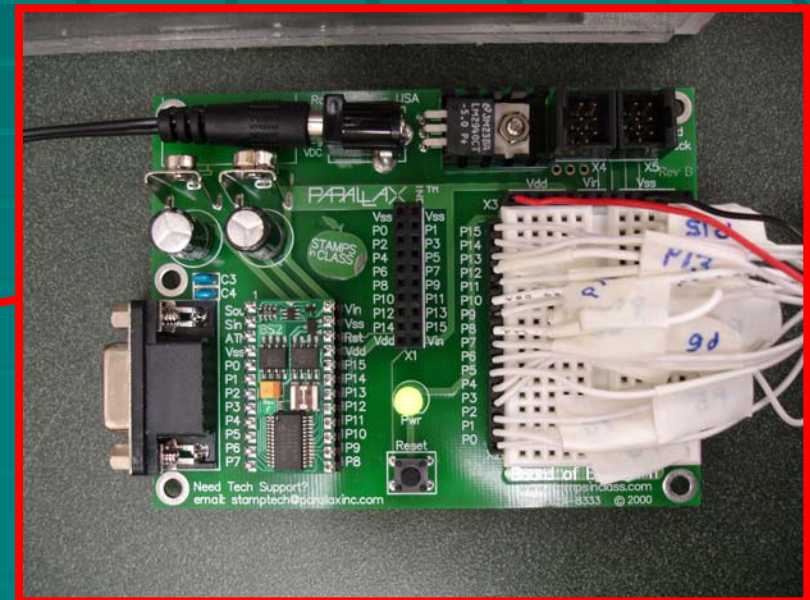
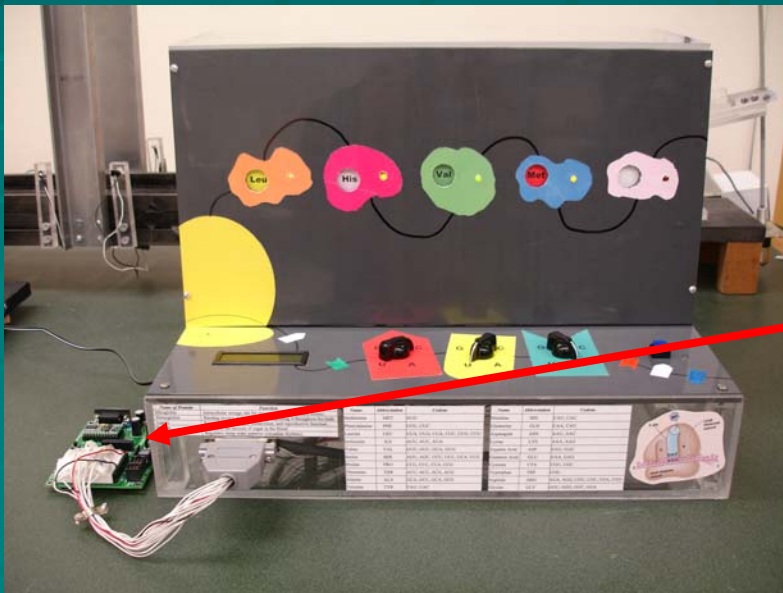


Purpose

- Models the process of protein synthesis within the ribosome.
- Allows students to control which amino acids are created by manipulating RNA coding.
- Demonstrates interactions between cellular molecules.

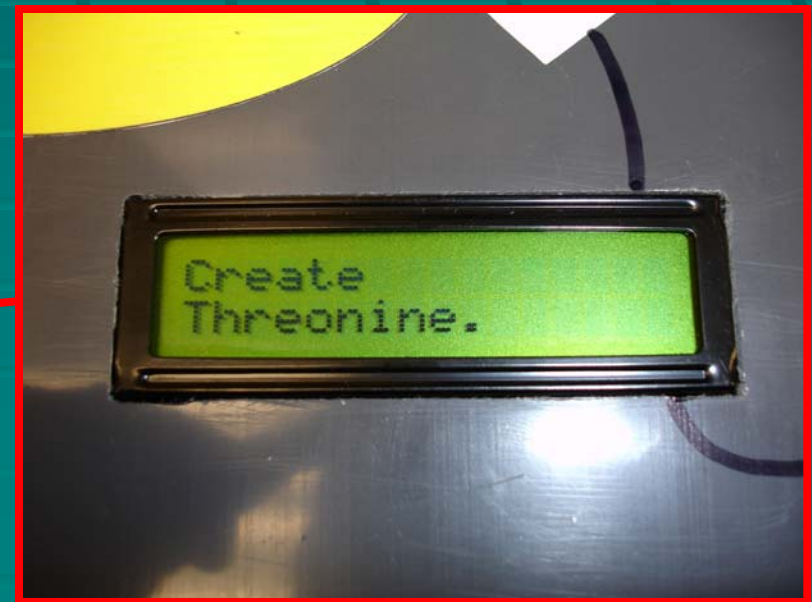
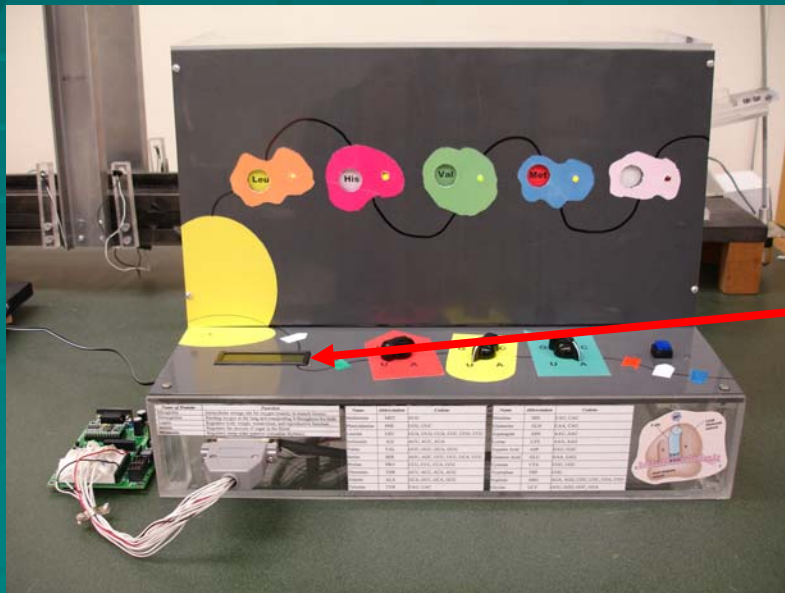
Parts and Components

Control Board - Controls electronic components by utilizing a BS2 microcontroller.



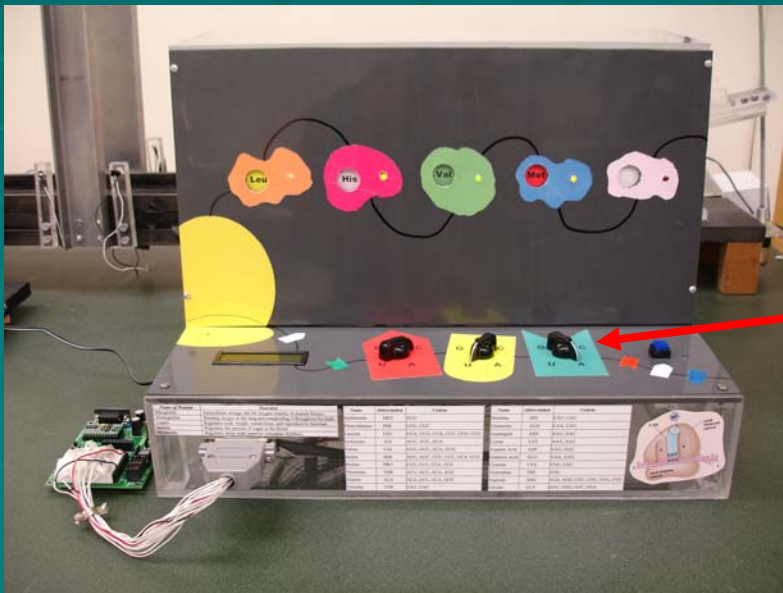
Parts and Components

LCD Display - Gives instructions, shows various proteins created.



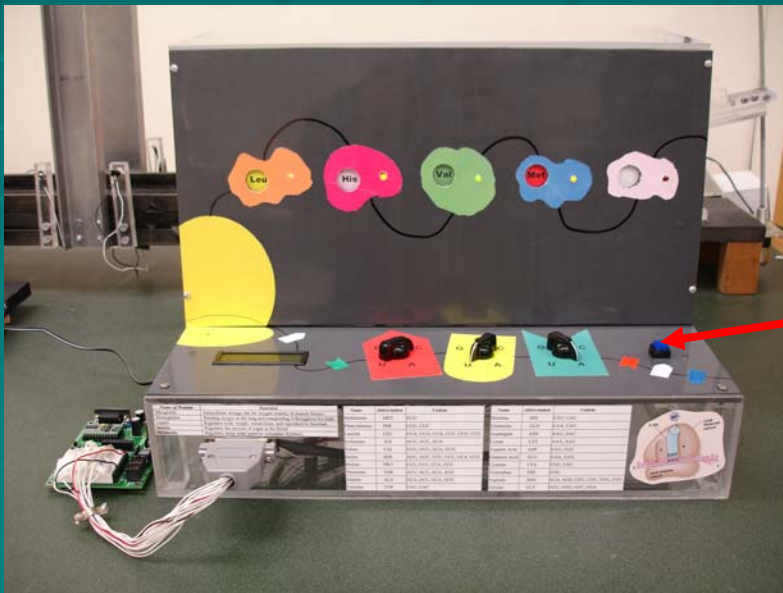
Parts and Components

Potentiometer Knobs - Control input values for nitrogenous bases.



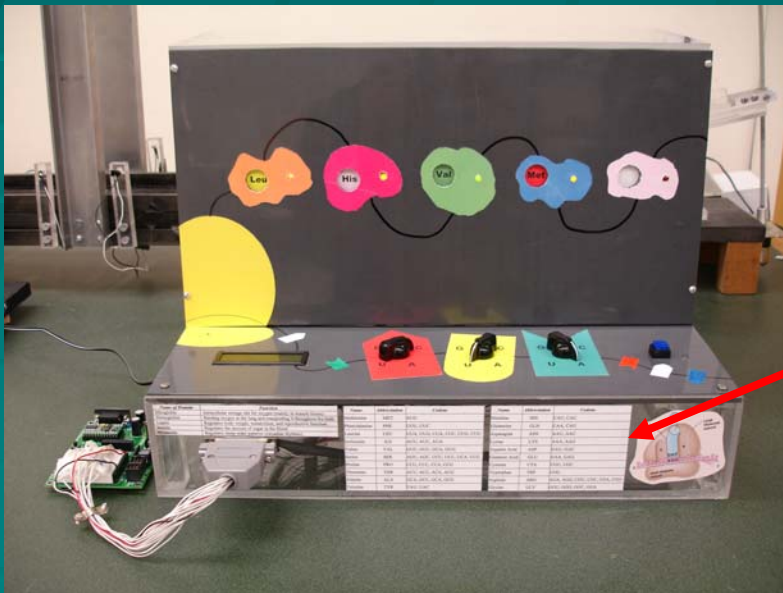
Parts and Components

Button - Moves user through the different steps of the program.



Parts and Components

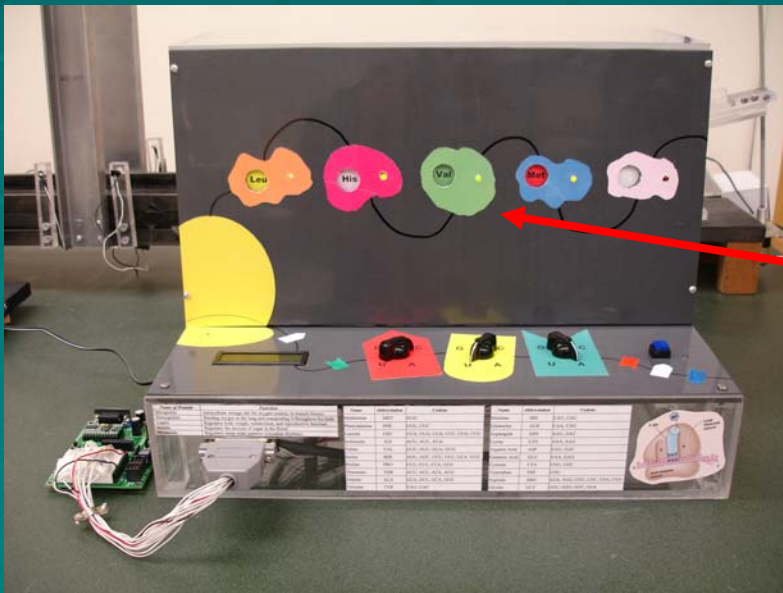
Key - Gives abbreviations and defines which codons will create the various amino acids.



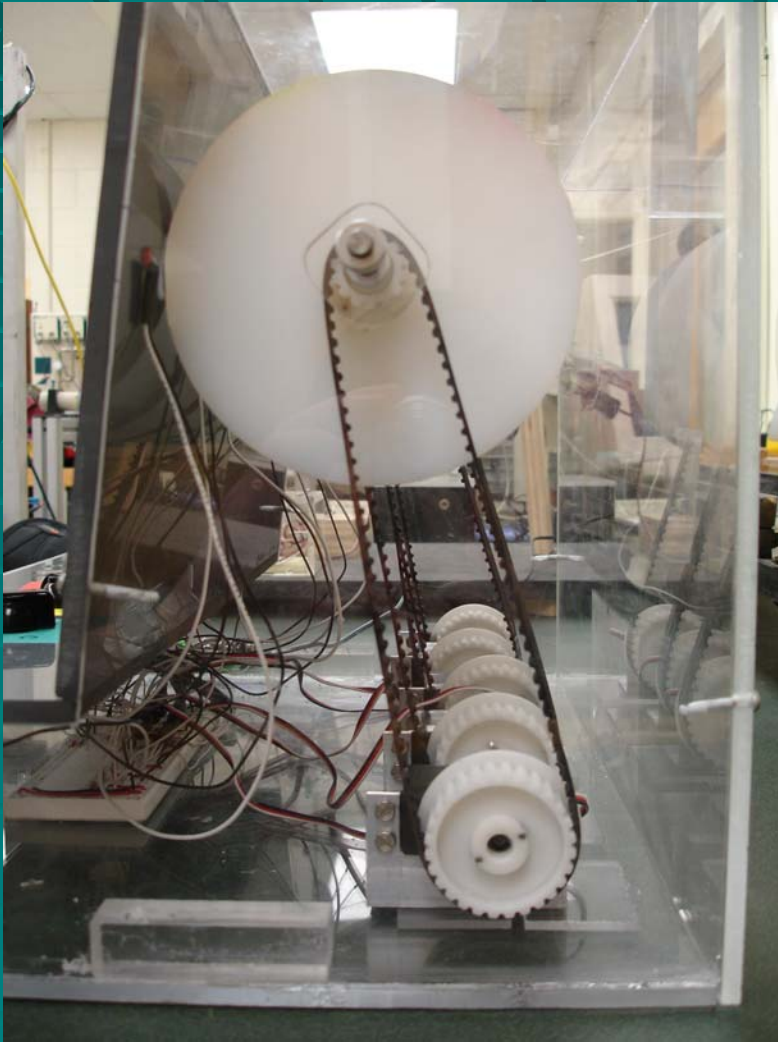
<i>Name</i>	<i>Abbreviation</i>	<i>Codons</i>
Methionine	MET	AUG
Phenylalanine	PHE	UUU, UUC
Leucine	LEU	UUA, UUG, CUA, CUC, CUG, CUU
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Valine	VAL	GUU, GUC, GUA, GUG
Serine	SER	AGU, AGC, UCU, UCC, UCA, UCG
Proline	PRO	CCU, CCC, CCA, CCG
Threonine	THR	ACU, ACC, ACA, ACG
Alanine	ALA	GCA, GCC, GCA, GCG
Tyrosine	TYR	UAU, UAC

Parts and Components

Display Windows - Show a growing chain of amino acids that is the beginning of a protein.



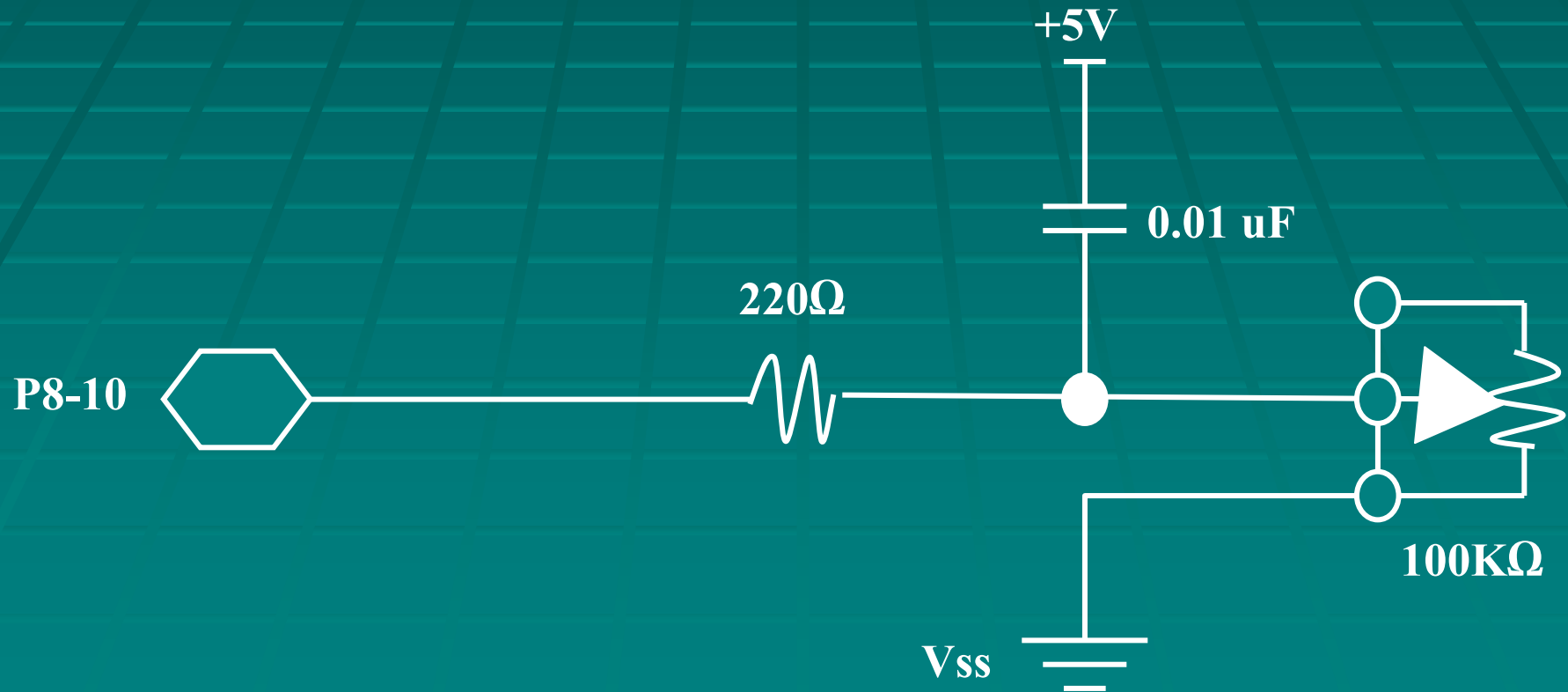
Parts and Components



Mechanics - Display wheels are controlled by a system of servo motors, pulleys and timing belts.

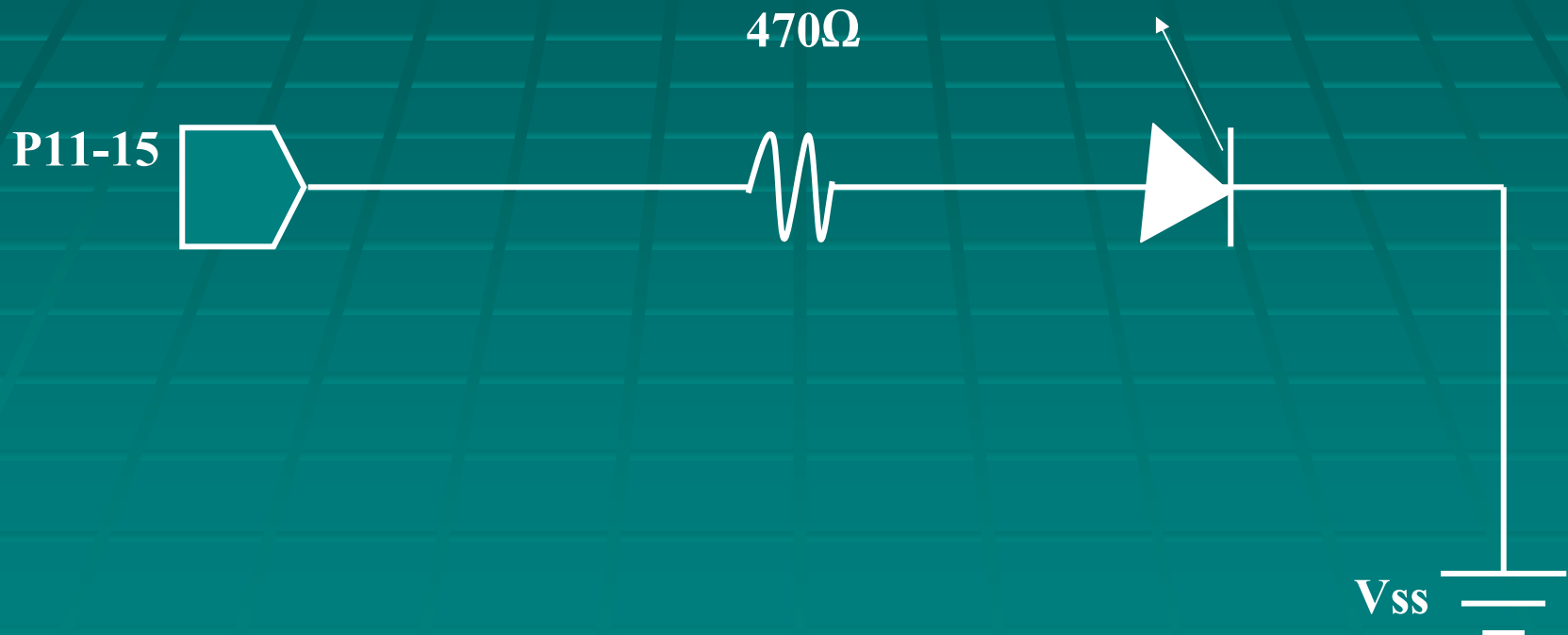
Circuitry

Potentiometer Circuit



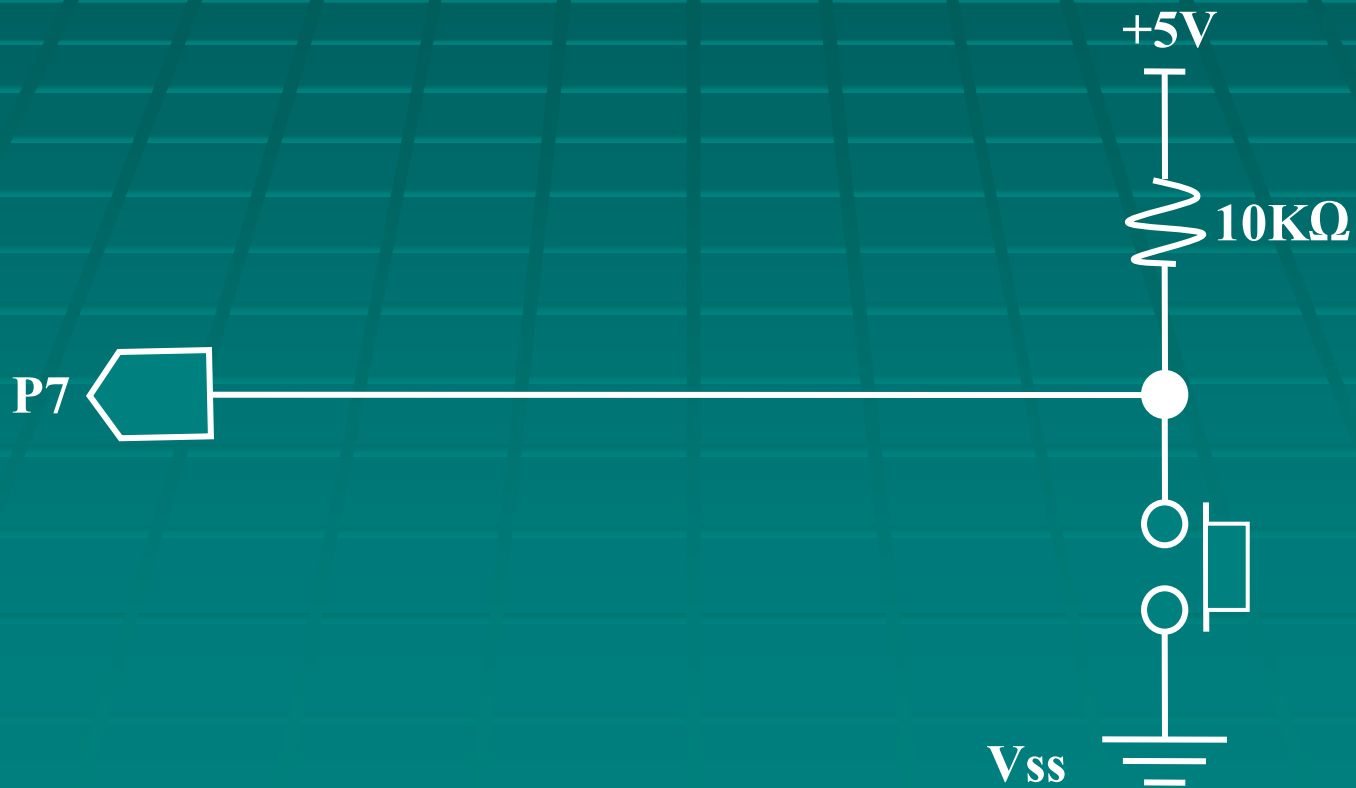
Circuitry

LED Circuit



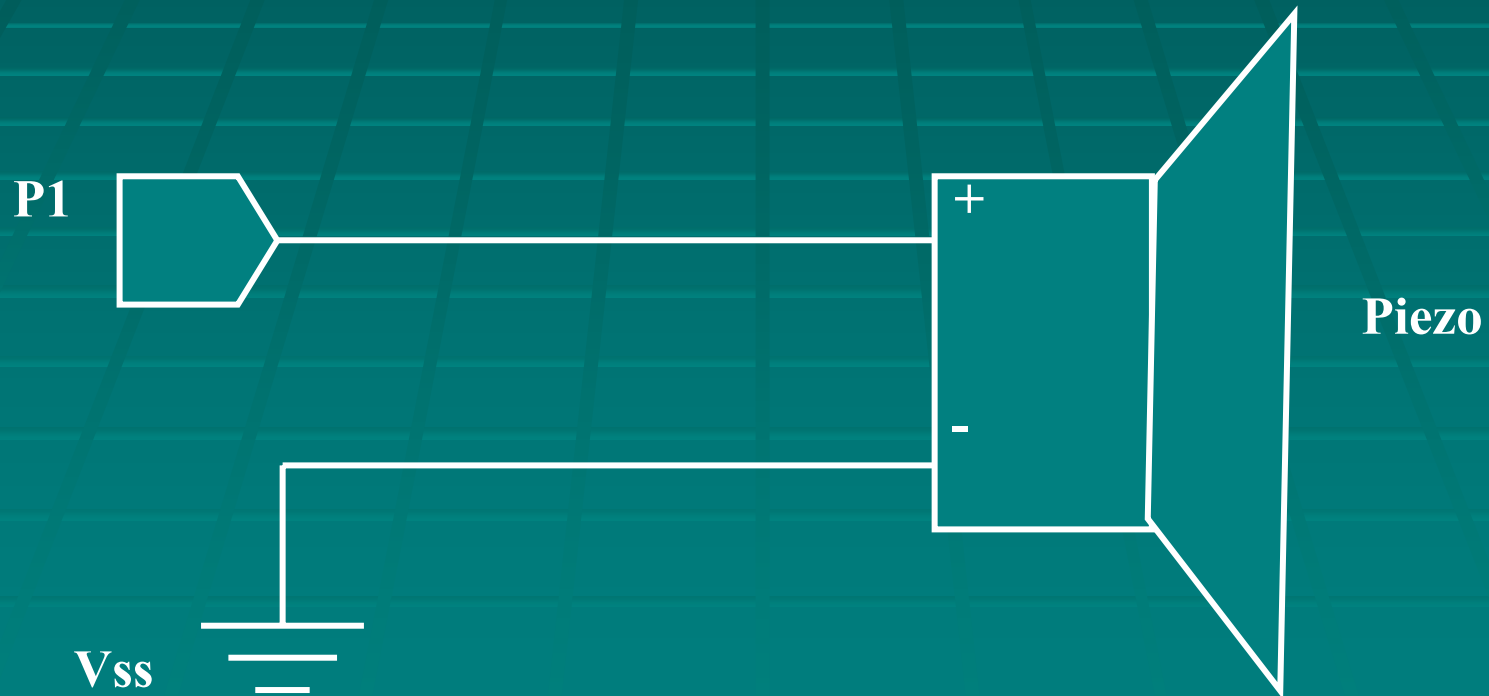
Circuitry

Button Circuit



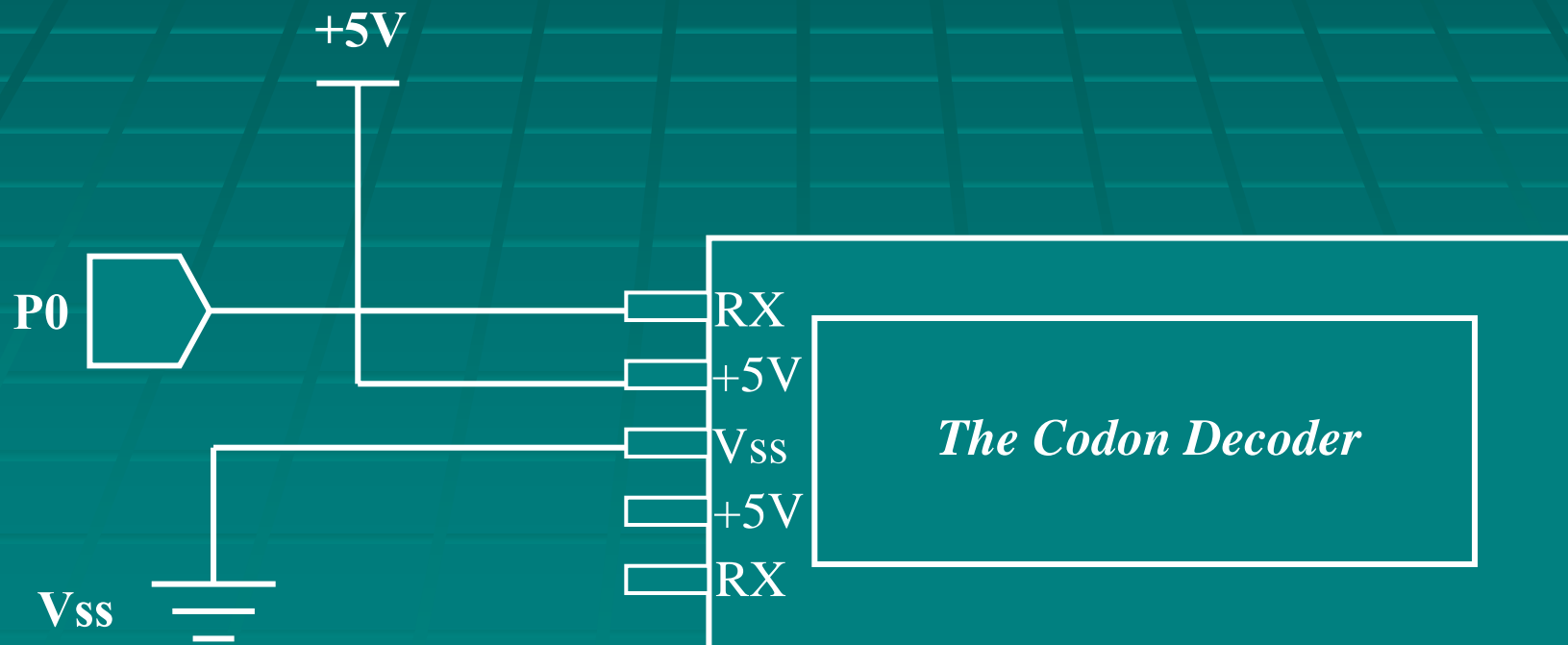
Circuitry

Speaker Circuit



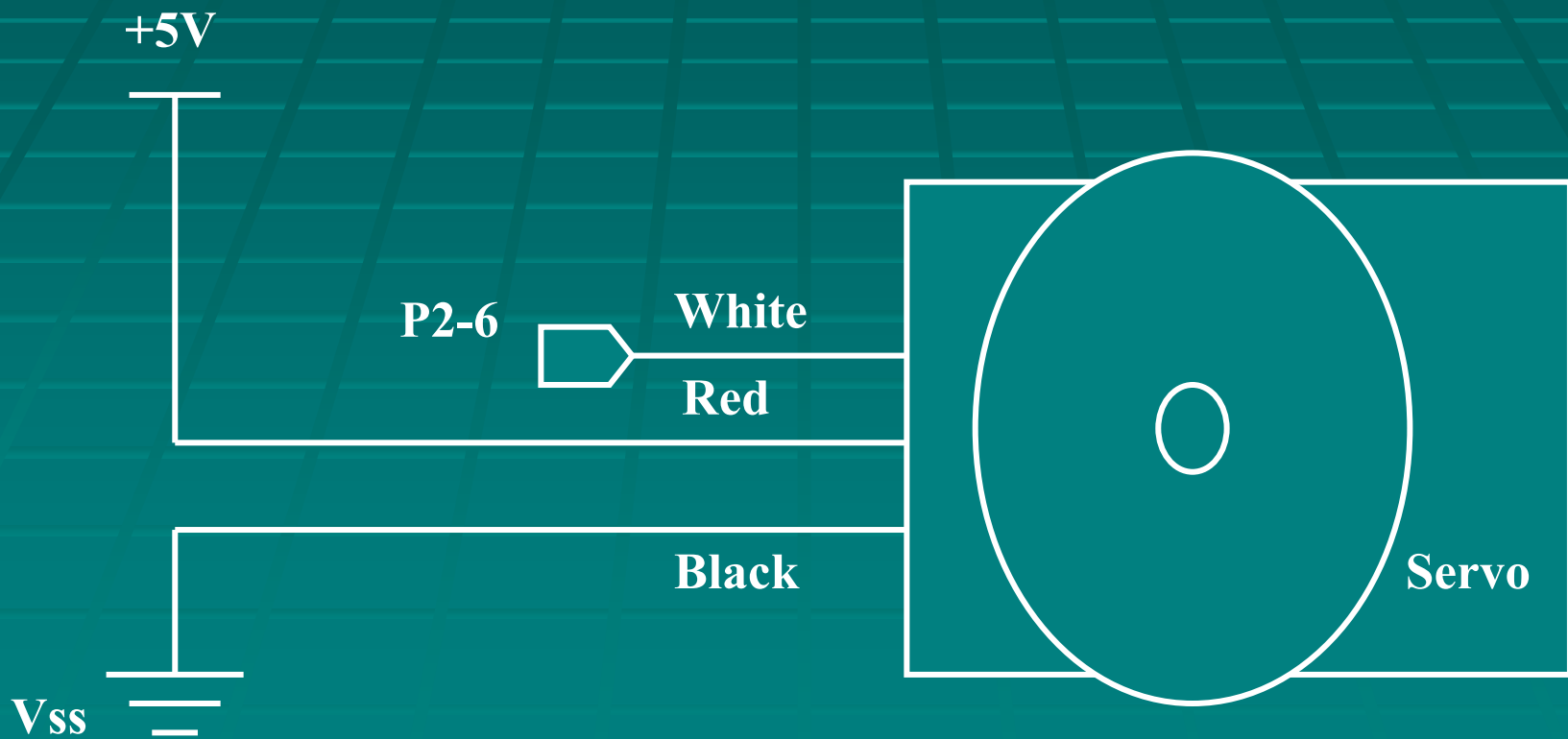
Circuitry

Serial LCD Circuit



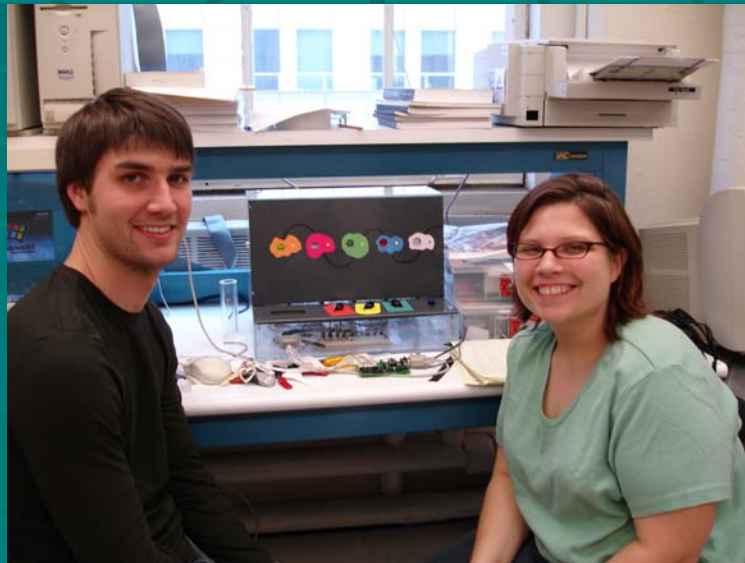
Circuitry

Servo Motor Circuit



Next Steps

- Expansion of program to include more proteins and other capabilities.
- Development of the Codon Decoder as a classroom assessment tool.



Acknowledgements

- National Science Foundation
- Polytechnic University
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