**Vocab / Concept Introduced**

- **Design Problem** + situation that people want to change or create
- Quantitative Data
- (Desired Features)
- **Design Problem** + a given need or want
- Criteria + desired feature / criteria for success
- Constraints + available materials / resources (time/cost)
- Prototype
- **Fair Test**
- **Controlled Variables**
- **Qualitative Data**
- **Failure Points**
- **Constraints** + human/environmental impact
- **Trade-off**
- **Optimal** + **Optimize**
- **Iterate**
- Independent variable
- Dependent variables
- **Correlation**
- Causation
- **Precision**
- **Accuracy**
- **Error Analysis**
- Mean, Median, Mode
- **Validity**
- **Criteria** + societal needs/wants
- **Constraints** + satisfy societal requirements
- **Risk Mitigation**
- **Reliability**
- **Slope**
- **Intercept**
- **Correlation**
- **Coefficient**
- **Linear and nonlinear functions**
- **Trigonometric functions**
- **Exponentials**
- **Logarithms**

**Skills Summarized Define the Problem**

- **Simple problem (situation that people want to change or create)**
- Teacher given problem / students understand by:
  - Asking questions
  - Making observations
- Students research and define the problem
- Students define the problem and jointly agree upon design criteria

**Skills Summarized Imagine / Create / Iterate**

- **Simple sketch or model**
- 1-2 solutions
- Multiple solutions
- Identify failure points for aspects of design that can be improved
- Build prototypes
- Develop complex models where inputs and outputs can be tested
- Several criteria
- Multiple solutions
- Combine best features of different designs into a new design
- Optimize performance by prioritizing criteria and making trade-offs

**Test / Reflect (Analyze)**

- Teacher-led investigations
- Compare 2 solutions by:
  - Making observations
  - Making measurements
  - Making comparisons based on data / observations
  - Comparing performance strengths and weaknesses
- Students determine if solution performs as intended / meets the goal by:
  - Collecting, recording and sharing observations
  - Describing patterns and relationships
- Students assess test data to refine their design by:
  - Representing data in tables / graphically to reveal patterns using digital tools where possible
  - Comparing / contrasting data by different groups
  - Assess solutions individually based on how well each meets the criteria and constraints
- Students plan and conduct investigations individually and with a team by:
  - Comparing multiple solutions
  - Using systematic evaluation processes
  - Including fair tests with multiple variables
  - Identifying independent / dependent variables, controls, tools, measurements and amount of data needed
  - Testing inputs and outputs
  - Testing under a range of conditions
- Students define an optimal operational range to meet the criteria by:
  - Using graphical displays of large data sets to identify temporal and spatial relationships
  - Using statistics and probability (mean, median, mode, error analysis) to analyze data
  - Consider limitations of data analysis
  - Seek to improve precision and accuracy of data
  - Identify characteristics of each design that performed best on different tests for different criteria

**Share Your Solution**

- Students make a claim about the effectiveness of a solution supported with evidence by:
  - Comparing ideas
  - Assessing whether the solution performs as intended
  - Students make a claim about the merit of a solution supported with evidence by:
  - Comparing solutions based on how well they meet criteria and constraints
  - Citing relevant evidence about how it meets the criteria / constraints
  - Critiquing peer solutions by citing evidence
- Students make an oral or written argument that supports or refutes the performance of a solution based on evidence by:
  - Evaluating solutions to determine whether they meet criteria / constraints
  - Analyzing / interpreting data for similarities and differences
  - Constructing a convincing argument that supports or refutes solutions
  - Students make and defend a claim or critique based on evidence about the effectiveness of a design solution by basing claims and critiques on:
  - Scientific knowledge
  - Student-generated evidence
  - Prioritized criteria
  - Trade-off decisions
  - Logical arguments regarding relevant societal / environmental / ethical factors.