LESSON AUTHOR:	
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School District:	Franklin Community Schools
School Name:	Custer Baker Intermediate
School City, State:	Franklin, IN
Grade Level:	Grade – 6 – High Ability / General Education Split
Subject:	SCIENCE / MATH (STEM)
Time Duration:	45 minutes (1 Class Period)

LESSON PLAN TITLE: INDEX CARD CHALLENGE LAB – CHALLENGE

• CONCEPT DESIGN - USING THE ENGINEERING DESIGN PROCESS – LEVEL III.

INDIANA ACADEMIC STANDARDS:

• SCIENCE - **6-8.E.1** - Identify the criteria and constraints of a design to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

• MATH - **6.GM.2** - Know that the sum of the interior angles of any triangle is 180º and that the sum of the interior angles of any quadrilateral is 360º. Use this information to solve real-world and mathematical problems

LEARNING OBJECTIVES / OUTCOMES:

• **OBJECTIVES:** SCIENCE SWAT: Design the index card tower solution given scientific lab challenge.
(W/DOK) = LEVEL 4 - DESIGN
• **OBJECTIVES:** MATH SWAT: Interpret angles given an engineering design challenge and a protractor.
(W/DOK) = LEVEL 2 – SKILL / CONCEPT
• **OBJECTIVES:** SWAT: Work with partners and small groups to develop a cooperative learning environment.
• **OBJECTIVES:** SWAT: Communicate with peers by contributing input.

ESSENTIAL QUESTION (S):

1. **How do the constraints and tradeoffs influence the height and strength of the index card tower?**
2. **How do specific angle measurements affect the index card manipulation to engineer a taller tower?**

VOCABULARY DEFINITION (S):

1. **Constraint:** A restriction on the degree of freedom one has in providing a solution to problem or challenge.
2. **Trade-off:** Sacrificing one asset to gain another that is considered equally valuable or useful.

ASSESSMENT SUMMARY:

Students will be assessed informally by observing active participation and checking for understanding, (e.g., students listened and read the directions to complete the challenge). Students will be formally assessed by activity completion and five criterion list items.

ACCOMMODATIONS / DIFFERENTIATION ASPECTS FOR INSTRUCTION:

HIGH ABILITY:	• Within the high-ability curriculum, accelerated leveled content supports rigor and engagement. I will use the qualitative data gathered from the student surveys to incorporate student interest to increase engagement. **[CONTENT / PROCESS]** • **[STUDENT PRACTICE]:** Design representation and product representation choice. **[PROCESS / PRODUCT]** • **[STUDENT PRACTICE]:** Allow students to choose whether they want to work with partners or individually. **[PROCESS]**
GENDER: (MALE)	• Provide multiple means of product representation, (e.g., visual, auditory, and tactile), throughout the lesson due to spatial awareness and hands-on opportunities. **[CONTENT/PROCESS/PRODUCT]** • Develop a task list or agenda to ensure students stay on track. Present the task list within the Google Slide presentation to read-aloud. Providing organization will assist the students by supporting focus and developing organizational skills. **[PROCESS]**
RELIGION:	**(N/A)**
LOW SOCIO-ECONOMIC (SES):	• Due to possible lower vocabulary levels, allow students extra time to process new TIER 3 academic vocabulary and concepts. **[PROCESS]**
BEHAVIORAL / HIGH RISK (SEL):	• Provide students with "brain breaks" in a dedicated area when students get over-sensitized. **[ENVIRONMENT]**
CULTURAL:	• During questioning strategies, provide questions that relate to different cultures. **[CONTENT / PROCESS]**
ELL:	**(N/A)**

INSTRUCTIONAL PRACTICES / STRATEGIES:

PREPARATION:	**SCAFFOLDING:**	**GROUPING OPTIONS:**
☐ Content adaptation ☒ Links to background knowledge ☒ Links to past learning ☒ Strategy incorporation	☐ Modeling ☐ Guided practice ☒ Independent practice ☒ Comprehensible input	☐ Whole class ☐ Small groups ☒ Partners ☒ Independent
PROCESS INTEGRATION: ☒ Reading ☒ Writing ☒ Speaking ☒ Listening	**APPLICATION:** ☒ Hands-on ☒ Meaningful ☒ Links to objectives ☒ Promotes engagement	**ASSESSMENT:** ☒ Individual ☒ Group / Partners ☒ Formal ☒ Informal
Other Strategies:	Choral Read-aloud, Brainstorming, PBL	

MATERIALS AND RESOURCES REQUIRED FOR LESSON:	
TECHNOLOGY:	• Chromebooks – One-to-one • Google Doc • Google Drive • Digital Doc Cam - Projection
PRINT MATERIALS:	• Blank Sheet of Paper (per/student) • Engineering Design Process Foldable • Per Team (2-3 Students) / Individual – Challenge Handout and Guidelines
SUPPLIES:	• Meter Sticks (8) • Pencil • Index Cards (2 packs 100 count) • Scissors • Protractor • Online Digital Stopwatch • Per Team / Individual - 12 Index cards • Student-made Engineering Design Process Foldable
INTERNET RESOURCES:	• **Video Review:** STEM Challenge Index Card Tower Matt Farrell (2017, April 25) https://www.youtube.com/watch?v=M2_bPQuRZE4&t=1s • Chrome Browser – Search Index Card Tower Designs
OTHER RESOURCES:	(N/A)

ACTIVITY PREPARATION: (TEACHER)

1. Load Google slide deck and project.
2. Place 2-3 sheets of blank white paper on each student pod station. (8 pod stations)
3. Stack 18 stacks of 12 index cards in lab bins. (1 set of 12 / per pair – plus individuals)
4. Place a protractor in each science lab bin.
5. Place the challenge information sheet in each science lab bin.
6. Place meter sticks on the floor in the middle of the pod station tables. (8 / meter sticks)

LESSON DELIVERY AND INSTRUCTION: (SEQUENCE)

ANTICIPATORY SET: (Duration: 3-5 minutes)	**ACTIVATE PRIOR KNOWLEDGE:** Say, "We have been learning about the engineering design process. Also, we have done a similar index card challenge. Can you think of a time when you used the engineering design steps to build or construct a prototype? Put your thoughts in your brain's "parking lot" for the moment." **HOOK:** Show engineering design video – Index Card Challenge III. *(Start – 2:46 4:36).* **STATEMENT OF LEARNING OBJECTIVE:** Say, "Today, we are going to learn how to brainstorm with new partners and create a prototype using the engineering design process. ***It's important to be able to design AND apply the engineering design process, because you may have to help build a sound structure, (e.g., garage or mini-barn). Also, you will have the opportunity of working with***

	different personalities to find solutions in engineering (e.g., example cooperative jobs/industries) teams. *(Show slide with learning objectives, the "WHY," and I can statement.)*
LEAD IN (WARM-UP): (Duration: 5 minutes)	1. **[MODEL - WE DO]:** Chorally read the engineering design steps. 2. Project the slide with the new vocabulary. a. (Constraint and Trade-off). 3. Ask the students if they know the definitions? a. Randomly select 2-3 students to answer. 4. Project the definitions and vocabulary terms and discuss. 5. Have students record the new vocabulary and definitions in their Engineering Design Process foldable. 6. Discuss real-world examples of constraints and trade-offs and how they affect our daily life. 7. Ask the students to explain the definitions in their own words. a. Check for understanding and ask if the students have any questions. 8. Project the new "INDEX CARD CHALLENGE III" Collaborative doc.
SEQUENTIAL STEP-BY-STEP PROCEDURES: (Duration: 5 - 7 minutes)	**[INPUT/DEFINE]:** Explain to the students that we are going to use the engineering design process to build the tallest index card tower. By using the engineering design process foldable, index cards, and challenge, we will try to make the tallest index card tower. During this challenge, the students need to describe trade-offs and constraints. Next, the students will need to use the protractors and meter sticks to brainstorm angles and height measurements. Finally, explain to the students how they will be assessed (e.g., participation, criteria, and completion.) 1. Tell the students they will be working in partners or may choose to work independently. 2. Divide the class into student pairs by random number selection and ask if any students want to work independently. 3. Call on student pairs to come to the front left of the room to pick-up their science lab bins and supplies. *4.* Direct the students where they can choose to sit throughout the classroom. *(Students may use hard surfaces only.)* 5. Introduce and read-aloud the index card challenge handout and project the collaborative Google "INDEX CARD CHALLENGE III" doc. 6. Check for understanding and ask the students if they have any questions about the challenge. a. (Thumbs-up / Thumbs Down) 7. Review the five criteria that must be on their brainstorming design sheets. a. Constraints - Describe b. Trade-offs - Describe c. Write or Draw Angles d. Label and measure possible lengths of cuts or tears e. Show / Draw or Write example of design solution 8. Explain once they write or draw all five criteria, the teacher must review and sign-off on their plan. 9. The students will receive their 12 index cards once the teacher reviews the design plan. The students are not to tear or begin constructing their prototypes until the teacher reviews the plans. 10. Tell the students they have 20 minutes to construct and build their towers. The towers must free stand for 10 seconds to count. They may measure the tower and place the

	measurement next to their names in the collaborative Google "INDEX CARD CHALLENGE III" doc. a. All measurement units will be metric. (CM)
STUDENT PRACTICE: **(ACTIVITY – LAB)** (Duration: 20 minutes)	1. Assess the class to see if they are ready. Remind the students they may use their Chromebooks to look at design plans. 2. Use an attention signal and ask the students if they are ready. Set the digital stopwatch to 20 minutes. 3. Say, "Go!" 4. Move around the classroom and observe the activity. Be available to sign-off on the design plans. 5. Check to make sure the students are not using any unlisted materials or supports. 6. Observe student activity participation and take anecdotal notes. 7. Monitor the collaborative Google doc to ensure students are entering the correct measurements and not deleting information. 8. After 20 minutes, call time. 9. State the winner of the tallest index card tower. a. Data input into the Google doc after the 20 minutes will not count. 10. Organize and clean-up areas and stations.
ASSESSMENT (S):	**1. Informal:** Monitor students for participation. **2. Informal:** Monitor students for checks for understanding. **3. Formal:** Students complete the index card tower challenge. 4. **Formal:** Students complete the engineering design solution sheet – based on five criteria. *(Teacher must sign-off on the hand-drawn solutions before prototype construction.)*
CLOSURE: (Duration: 5 minutes)	1. Ask students to recall the engineering design process in their own words and check for understanding. (Elicit answers through random selection). 2. Ask students what the purpose of the challenge and how it applies to real-world applications. *(Elicit answers through random selection).*
EXTENSIONS:	• Challenge students to use the engineering design process with the same parameters to hold an object with mass / weight. • Invite students to create a presentation using real-world applications or industries using the engineering design process. • Have students utilize the Chrome browser to search for index card or engineering design competitions.

TEACHER REFLECTION:
1. What went well? 2. What did not go well? 3. What adjustments can be made to ensure success?

ACTIVITY TITLE:

STEM - Index Card Tower Challenge III

STEM Challenge Competition:

Design and construct the tallest index card tower. The tower is free standing and remains self-supporting for 10 seconds.

Challenge Materials:

1. 12 index cards per activity partners or independent student
2. Blank Paper
3. Meter stick
4. Protractor
5. Scissors
6. Chromebook – (You may use to brainstorm design ideas.)
7. Lab Bin

Students may NOT use any other materials.

Challenge Rules:

1. Each partner team or individual must complete the design planning and the tower construction within 20 minutes.
2. Each student team or individual must show the teacher the design plans before proceeding with tower construction. Index cards will not be provided until the teacher initials the design plans.
3. The index cards may be cut or torn into pieces and reassembled as desired. (No other materials may be used during the challenge. If students use additional materials, the team will be disqualified.)
4. A tower shall be declared free-standing if it remains self-supporting for 10 seconds. The tower must stand on a flat surface designated by the teacher.
5. Teams and individuals may re-design and construct their towers with new plans, as needed. Students must document new design plans on the backside of the blank paper.
6. Once the teams measure the tower, record the measurement units into the collaborative Google Doc chart next to the team names.
7. Measure the index card towers using the metric measurement units (e.g., CM or centimeters).
8. Determine the tower height by measuring the tower's perpendicular distance from the tower base to its highest point.
9. The teacher will call time after 20 minutes. Once the teacher calls time, no more data may be entered into the Google Doc data chart.
10. The highest tower will be named the winner.

ASSESSMENT CRITERION CHECK LIST:

Each design planning document must include:

1. Challenge Constraints – Define
2. Challenge Trade-offs – Define
3. Label – Write or Draw Angles
4. Label and measure possible lengths of cuts or tears
5. Show / Draw or Write example of design solution