6th Grade Math Decision Making (6DMM)

Automating the Packing Challenge

Automated Packaging Challenge

Module Description	Students will examine automated manufacturing process models, for packaging, and write procedures to decide on the most consistent effective procedure to make the most packages. Students will decide if an automated process will help meet demand. Students reason quantitatively using measures of center and variability to decide on the most effective procedure. The module covers basic GSE concepts in measures of center, spread and interquartile range. *Module features the work of Dr. Ellery Ingall of Georgia Institute of Technology Earth & Atmospheric Sciences.*	
Related Mathematics Georgia Standards of Excellence	MGSE6.SP.3 Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number. MGSE6.SP.4 Display numerical data in plots on a number line, including dot plots, histograms, and box plots. MGSE6.SP.5 Summarize numerical data sets in relation to their context, such as by: c. Giving quantitative measures of center (median and/or mean) and variability (interquartile range). d. Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data was gathered.	
Module Timeline	**50-minute class periods:** 4 days Day 1: Sections 1, 2 Day 2: Sections 2, 3 Day 3: Sections 3, 4 Day 4: Section 4	**90-minute blocks:** 3 days Day 1: Sections 1, 2 Day 2: Sections 2, 3 Day 3: Section 4
Documents Included in the Download	<u>Student Materials Folder</u> • Student Edition *(recommended to be printed double sided)* • Student Data Collection Sheets *(recommended to be printed double sided)* <u>Teacher Materials Folder</u> • Materials List • Annotated Teacher's Edition • Teacher's Edition • Teacher Preparation Guide • Videos	

5E Stage	Student Activities How will students engage actively in the three dimensions throughout the lesson?	Teacher Activities How will the teacher facilitate and monitor student learning throughout the lesson?
Engage How does the lesson capture student interest, activate prior knowledge, and connect to a complex question, global issue, or real-world problem?	• Discuss how we purchase food items and connect it to the challenge. *(1.1)* • Discuss how assembly lines work and automated machines improve production. *(1.1)* • Read the challenge and discuss what is being asked. *(1.2)*	• Show students pictures of various candies to spark interest • Guide students through text • Facilitate a class discussion about decision making
Explore How does the lesson allow students to develop a common base of experiences by actively investigating the phenomenon or problem?	• Students will brainstorm and write a procedure to create four equal bags of candy the fastest. *(1.3)* • Students will conduct the packaging process according to their procedures. *(1.3)*	• Make sure students have written their procedure down. • Monitor the groups during the challenge to ensure that each member is following their procedure.
Explain How does the lesson allow students to develop, share, critique, and revise their own explanations before connecting those to accepted scientific explanations and terminology?	• Students will share their data with the class and find the Five-Number Summary of the time. *(1.3,1.5,1.6)* • Students will analyze their groups color consistency. *(2.1,2.2,3.1)*	• Verify that students have recorded their data on their investigation sheet. • Monitor students in their discussion about choosing an automated machine.
Elaborate How does the lesson allow students to extend their conceptual understanding of the three dimensions through opportunities to apply knowledge, skills, and abilities in new experiences?	• Students will gain extra practice with box plots using The Five-Number Summary by analyzing automated machine data by completing the Packaging Company Machines Specifications Factory *(4.1)*	• Assist students in creating box plots using The Five-Number Summary. • Assist students in completing the Decision Matrix. • Assist students in completing their Pitch Planning Sheet.
Evaluate How does the lesson—through both formative assessments embedded throughout the lesson and a summative assessment that might coincide with the elaborate phase— make visible students' thinking and their ability to use practices with core ideas and crosscutting concepts to make sense of phenomena and/or to design solutions?	Formative: Ongoing questioning and discussion *(all sections)* Candy Sort Data Collection Sheet *(1.3,1.5,1.6,2.1,2.2)* Box and Whisker (Box Plot) Sheet *(3.1)* Packaging Company Machines Specifications Sheet *(4.1)* Decision Matrix Sheet *(4.2)* Summative: Pitch Planning Sheet (4.3)	

	1.1	1.2	1.3	1.4	1.5	1.6	2.1	2.2	3.1	4.1	4.2	4.3
Engage	—	—										
Explore			—									
Explain			—		—	—	—	—	—			
Elaborate			—							—		
Evaluate			—		—	—	—	—	—	—	—	—

Section 1 – The Candy Automated Packaging Challenge *(50 minutes)*

The focus of Section 1 is to introduce students to the Candy Automated Packaging Challenge. Working in teams, students are tasked with creating four bags of candy that contain approximately the same number of candy pieces with the same number of each color. Students will then evaluate the consistency and speed of the process using a five-number summary.

Preparation

Materials	Student Pages
• Video #1: How Candy Canes Are Made • Plastic gloves • 4 small zip-lock bags per group • 48 of each color candy (bagged) per group • Cardboard Tray • Stopwatch	• Candy Sort Data Collection Sheet- Page 1
Prep the Day Before: Have videos prepped and ready. Have trays sorted with plastic gloves, stopwatch, baggies and candy needed for each group.	

Planning

GSE	MGSE6.SP.4. Display numerical data in plots on a number line, including dot plots, histograms, and box plots. MGSE6.SP.5 Summarize numerical data sets in relation to their context, such as by: c. Giving quantitative measures of center (median and/or mean) and variability (interquartile range).
CCSSM	CCSS.Math.Content.6.SP.B.4 Display numerical data in plots on a number line, including dot plots, histograms, and box plots. CCSS.Math.Content.6.SP.B.5.c Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.

Key Terms and Concepts	Essential Questions	Assessment and Grading Opportunities
• Consistency • The Five Number Summary • Interquartile Range	• How does the lower and upper quartile help determine how consistent data is?	• Discussion Questions: **Formative** • Participation: **Formative** • Candy Sort Data Collection Sheet: **Formative**

Section 2 – Analyzing Your Data *(50 minutes)*

During this section students analyze their data from the candy sort in Section 1. Their goal was to sort the candy equally by number and type as quickly as possible. They apply statistics and create dot plots to visualize their data more effectively and see just how well they accomplished this goal.

Preparation

Materials	Student Pages
• Video: M&M Manufacturing Plant • Colored pencils	• Candy Sort Data Collection Sheet- Page 2
Prep the Day Before: Have videos prepped and ready. Colored pencils should be ready for students.	

Planning

GSE	MGSE6.SP.4. Display numerical data in plots on a number line, including dot plots, histograms, and box plots. MGSE6.SP.5 Summarize numerical data sets in relation to their context, such as by: c.Givingquantitativemeasuresofcenter(medianand/ormean)andvariability(interquartilerange).
CCSSM	CCSS.Math.Content.6.SP.B.4 Display numerical data in plots on a number line, including dot plots, histograms, and box plots. CCSS.Math.Content.6.SP.B.5.c Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.

Key Terms and Concepts	Essential Questions	Assessment and Grading Opportunities
• The Five NumberSummary	• How do you use measures of central tendency and variation to determine how accurate the packaging process is? •	• Discussion Questions: **Formative** • Participation: **Formative** • Candy Sort Data Collection Sheet: **Formative**

Section 3 – Another Way to Analyze Data *(50 minutes)*

During this section students will learn how a box and whisker plot can be used as another way to analyze data. They will use their five number summary data from the Candy Sort Data Collection Sheet to create a box and whisker plot.

Preparation

Materials	Student Pages
• N/A	• Candy Sort Data Collection Sheet • Candy Sort Data Collection Sheet: Box and Whisker (Box Plot) Sheet
Prep the Day Before: If you previously collected the Candy Sort Data Collection Sheet, have that student ready to give back to students.	

Planning

GSE	MGSE6.SP.4. Display numerical data in plots on a number line, including dot plots, histograms, and box plots. MGSE6.SP.5 Summarize numerical data sets in relation to their context, such as by: c. Giving quantitative measures of center (median and/or mean) and variability (interquartile range).
CCSSM	CCSS.Math.Content.6.SP.B.4 Display numerical data in plots on a number line, including dot plots, histograms, and box plots. CCSS.Math.Content.6.SP.B.5.c Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.

Key Terms and Concepts	Essential Questions	Assessment and Grading Opportunities
• Box and Whisker Plot	• What information does a box plot give us about a data set?	• Discussion Questions: **Formative** • Participation: **Formative** • Candy Sort Data Collection Sheet Box and Whisker Plot: **Formative**

Section 4 – Choosing an Automated Packaging Machine *(50 minutes)*

Students will use their knowledge of data and statistics to judge the accuracy and consistency of a process. They will have to decide about which candy making robotic machine and packaging equipment to buy. Students will complete a statistical analysis about the different machines. This data will be used as evidence when they make their decisions. A decision matrix will help students sort the data so it can be more carefully considered. Once they have made a decision they will then write a pitch to their investors where they communicate their decision and other pertinent information.

Preparation

Materials	Student Pages
• Video #3: Shark Tank • Colored pencils (red, green, yellow)	• Pitch Planning Sheet • Decision Making Matrix Sheet • Packaging Company Machines Specifications Sheet
Prep the Day Before: Have videos prepped and ready and colored pencils ready for students.	

Planning

GSE	MGSE6.SP.4. Display numerical data in plots on a number line, including dot plots, histograms, and box plots. MGSE6.SP.5 Summarize numerical data sets in relation to their context, such as by: c. Giving quantitative measures of center (median and/or mean) and variability (interquartile range).
CCSSM	CCSS.Math.Content.6.SP.B.4 Display numerical data in plots on a number line, including dot plots, histograms, and box plots. CCSS.Math.Content.6.SP.B.5.c Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.

Key Terms and Concepts	Essential Questions	Assessment and Grading Opportunities
• Decision matrix • Pitch	• What conclusions can be drawn from the data?	• Discussion Questions: **Formative** • Participation: **Formative** • Packaging Company Machines Specifications Sheet: **Formative** • Decision Making Matrix Sheet: **Formative** • Pitch Planning Sheet: **Summative**