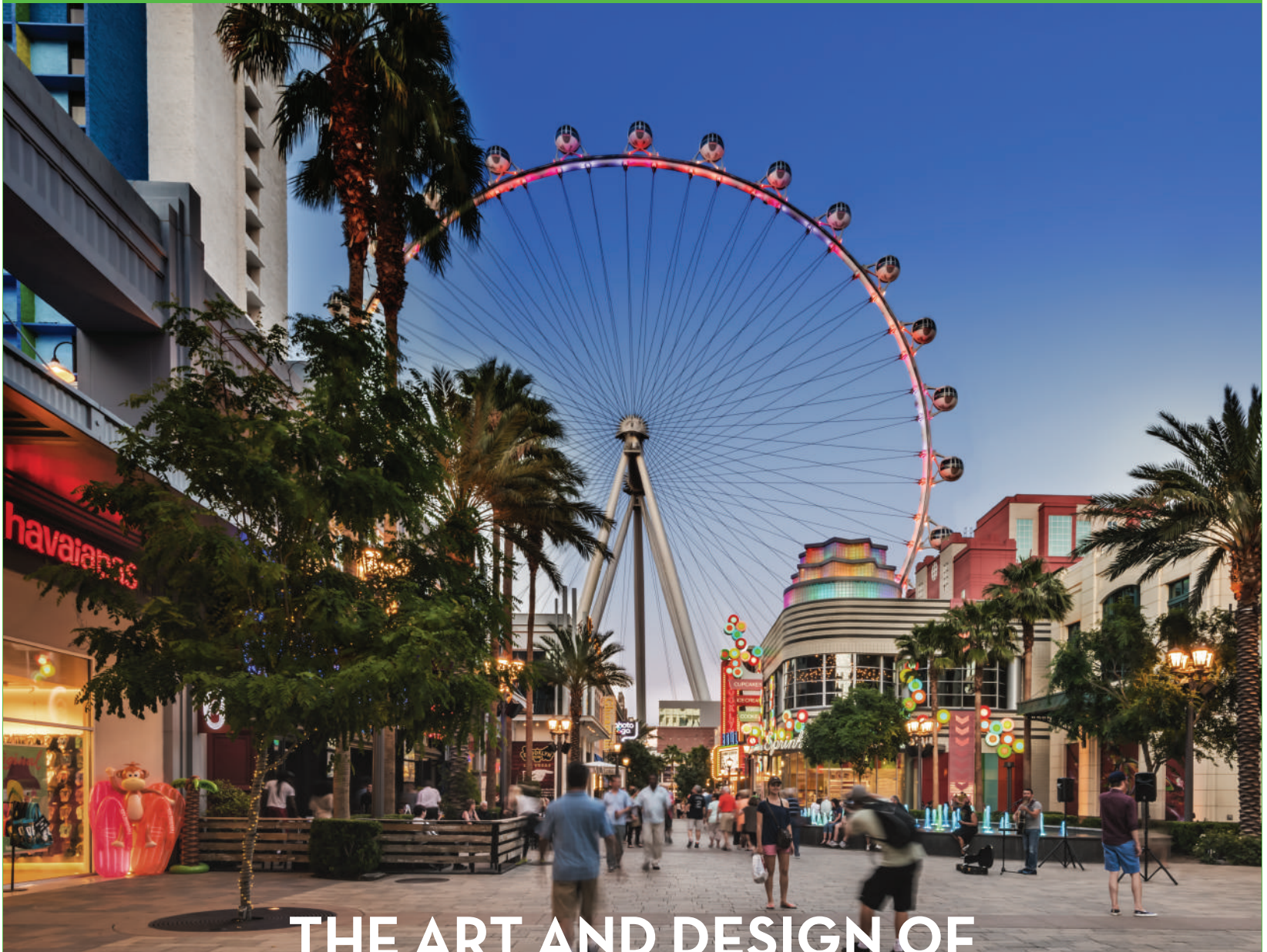




THE ART AND DESIGN OF THE HIGH ROLLER OBSERVATION WHEEL

Teacher Guide
Grades 6-8

“HOW CAN YOU DESIGN A SAFE AND ENJOYABLE FERRIS WHEEL THAT CONTINUALLY MOVES?”

LESSON:



BACKGROUND AND PLANNING INFO:

This lesson guides students through a design process that will help them create a model that describes the sum forces acting upon a Ferris wheel that meets the criteria and constraints true to the needs of the High Roller Observation Wheel. Students will participate in drawing designs, testing forces, as well as have the opportunity to take a trip to collect data and make observations at the High Roller to propose answers to the question, “How can you design a safe and enjoyable Ferris wheel that continually moves?”

Students will express their understanding by asking questions, brainstorming solutions, creating a draft of their solution, critiquing their peers, revising their models and recording their ideas in their design notebooks.

These activities are designed for a student to have an actual wheel to work on and create a design to make it continually move. Old bicycle wheel on a wooden spindle, clamped to tables, or something similar, is suggested for each group of 3-4 students.

SUMMARY OF ACTIVITIES

A. ASK QUESTIONS TO DEFINE THE PROJECT:

Students will use the guidance provided by the teacher and their design notebooks to describe the goal of their design that will help them understand the sum forces acting upon the Ferris wheel, while at the same time using the materials provided to describe their findings. **(50 Minutes)**

B. IMAGINE THE POSSIBILITIES:

Students will work in groups of three or four to express and evaluate their initial ideas that address the design problem of how to make a Ferris wheel move continuously. Students will create diagrams to share their ideas with each other. Students will also take this time to evaluate their ideas according to the criteria and constraints that they defined in the last section. **(50 Minutes)**

C. PLAN YOUR DESIGN:

Students will work in their groups to plan and record the solution they select from the ideas they brainstorm in the last section. **(30 Minutes)**





D. CREATE A DRAFT:

Working in their groups, students use provided materials to create a model that will make their ideas about a solution to the proposed problem explicit within their group and so that they can communicate their ideas to other groups. **(50 Minutes)**

****FIELD TRIP SHOULD TAKE PLACE AFTER D****

E. IMPROVE YOUR DESIGN:

Using the results of the testing phase, as well as the data they collected and observations during the field trip, students will revise their design solution, justifying each change or revision with data from testing or field trip. **(50 Minutes)**

NEXT GENERATION SCIENCE STANDARDS:

Students who demonstrate understanding can:

Plan an investigation to provide evidence that the change in an objects motion depends on the sum of the forces on the object and the mass of the object. [Clarification statement: Emphasis is on balanced (Newton's First Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton's Second Law), frame of reference, and specification of units.] [Assessment Boundary: Assessment is limited to forces and changes in motion in one-dimension in an inertial reference frame and to change in one variable at a time. Assessment does not include the use of trigonometry]

A. ASK QUESTIONS TO DEFINE THE PROJECT

Teachers will divide students into groups of 3 or 4. Provide them with video clips that will spark their initial thinking about the lesson's Big Question. In each task

teachers may employ "Big Paper" activity, graffiti wall participation, etc. for students to share their ideas and then students should record their constraints and criteria in their field notebooks.

TASK #1: IDENTIFYING CRITERIA FOR SUCCESS (10 MINUTES)

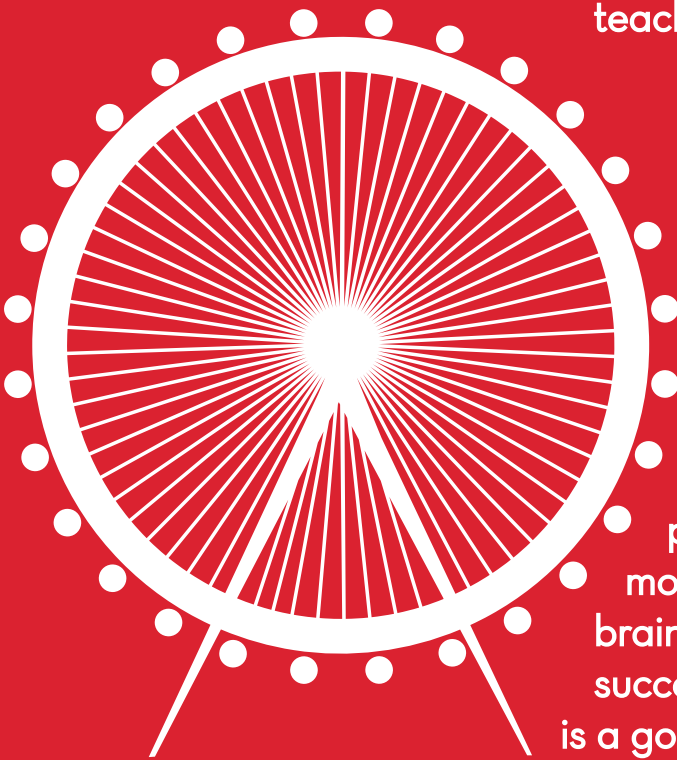
Teacher will guide students to consider the video of the moving wheel as they think about potential design solutions that address the problem of making a wheel that continuously moves. In their small groups, students will work to brainstorm the criteria to make their project successful. How will they know that their solution is a good one for the challenge set forth? Students

should use their design notebooks to record their ideas.

TASK #2: (5 MINUTES)

Teacher will allow time for students to consider the forces needed to keep the following examples in motion. Include time for small or whole group discussion to discuss student findings.

- Driving a car on a straight road
- Marbles rolling on a track
- Pendulum swinging
- Riding a bike down hill





TASK #3: Teacher will show video clips of the High Roller, or other observation wheels. Students will graph the motion of the wheel on a speed vs. time graph and identify forces that must be needed to keep the wheel in motion. (10 MINUTES)

TASK #4: Teachers will guide students to figure out the problem created by the High Roller (move the wheel at a constant speed) and identify how they will know if our project is a success. (5 MINUTES)

TASK #5: Teachers will guide students to understand the criteria as to what will make their wheel a success. This is where teachers can add their own set of criteria. (10 MINUTES)

TASK #6: Teachers will guide students to understand the limitations of their design process. This is where teachers would put the limitations as to materials used. Example: No water usage, device must be able to be removed at the end of class. No glue, etc. (10 MINUTES)

TASK #7: Students will discuss as a class and come up with agreed upon criteria and constraints as to what will be successful for the project.



B. IMAGINE THE POSSIBILITIES:

Teachers will guide students to be creative and communicate all of the ideas that they have that will address the problem of creating a continuously moving wheel. Students will work in their small groups to describe three ideas, select the best option and communicate their idea to the whole class.

TASK #1: BRAINSTORM IDEAS-

Teachers should hand out WORKSHEET A to each student to guide students to brainstorm ideas. Students can do this for homework or during class (15 MINUTES)

TASK #2: EVALUATE IDEAS-

Instruct students to use their design notebooks to evaluate each other's design ideas through the lens of their criteria and constraints for the project's result. Groups can share the design that they select as their best solution with the whole class. (20 MINUTES)

C. PLAN YOUR DESIGN: Teachers should guide students to use their design notebooks to plan what they need to do and materials they will need to implement their design. This might include a plan for materials, time, money, information resources, expertise, etc. that will be required in order to complete a draft. The second activity is designed for students to make their design plan explicit.

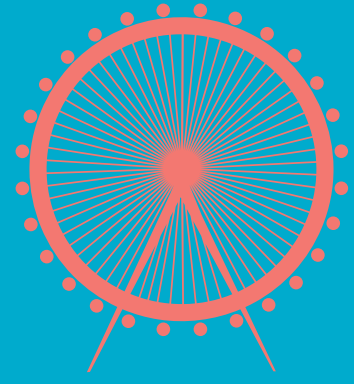
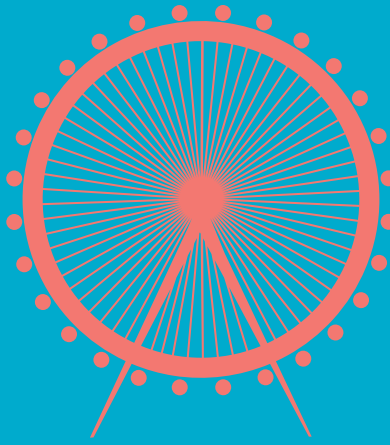
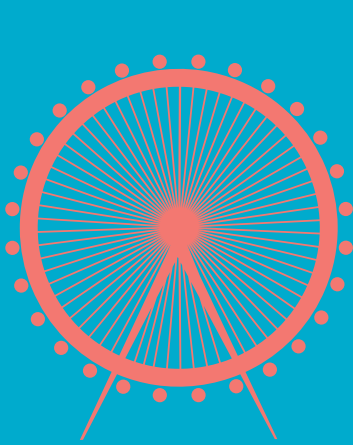
TASK #1: DESCRIBE WHAT YOU WILL NEED (15 MINUTES):

Prior to articulating their work or design plan, students can be guided to describe the materials, the amount of time, any additional information they might need to research on their own or ask an expert, etc. Students will use the questions and prompts in their design notebooks to inspire them to consider each of these important needs and communicate them to the other students in their group.

TASK #2: DESCRIBE THE PLAN (15 MINUTES):

In their design notebooks, they will work as a group to decide upon tasks to be completed and an order of operations so that they can successfully complete a draft/prototype of their idea.





D. CREATE A DRAFT:

In this section, students create a prototype or draft that they understand to best satisfy the criteria and constraints laid out in the first section. It is up to the design of the lesson whether this draft is a written piece, a blueprint, a physical model, or whatever design that students can use to make their ideas concrete. This section should contain three parts. First, students will create their draft. Second, they will test their draft and their ideas for how it achieves the goals of the project with the whole class.

TASK #1: CREATE YOUR DRAFT (30 MINUTES):

Students are given access to materials for the development of their draft. Direct students to use the questions and answer prompts to journal their development process, including the challenges and the things that work well. They should have a space for sketching and revising.

TASK #2: TEST YOUR DRAFT (20 MINUTES):

Students will test their draft based on the criteria for success established in the beginning of the lesson. All students should have the same criteria for success in mind and each idea should undergo the same testing.

Design notebooks include tables for recording testing data and space and prompts for students to record any additional observations or ideas during the testing process.

The teacher should also provide a data sheet on the board for students to contribute to, so that they can benefit from the tests and design solution implemented by others.



FIELD TRIP TO THE HIGH ROLLER OBSERVATION WHEEL:

STUDENTS ATTENDING FIELD TRIP:

Students who are going on the field trip will complete Worksheet B: Field Trip Collection Sheet. This will guide students through 3 separate activities during the field trip. Students will have time to make observations from the promenade, ride the wheel and ask questions about the wheel to an expert.

STUDENTS WHO ARE STAYING AT SCHOOL:

Due to the lack of space, behavior issues, or other reasons, not all students will be able to attend the field trip. For students who are at school the day of the field trip, you can unevenly weight the wheels they have been working on and have students complete Worksheet C: Unevenly Weighted Wheel Test.



E. IMPROVE YOUR DRAFT:

In this section, students will incorporate the ideas of their peers and the things that they learned on their trip to the High Roller to improve their draft. This section contains two parts. First students will propose their changes and use a scaffold provided by the lesson design to justify each of those changes, using evidence from class resources (including their peers) and from the field trip. Then, they will make the changes to their draft and complete their design.

TASK #1: PROPOSE CHANGES TO THE PROTOTYPE (10 MINTUES):

Students should be provided with a mechanism (table, questions, etc.) to record each change they might make to their original design/draft. With each proposed change, they should record a justification, based on information they obtained through testing, observation, the ideas of their peers, or things they learned on their trip to the High Roller.

TASK #2: MAKE FINAL CHANGES (40 MINUTES):

Finally, students will make changes to the prototype based on what they learned. A final step might be to present their final design as a whole class and discuss the changes in the forum.