## Schedule of Events

<table>
<thead>
<tr>
<th>TIME</th>
<th>EVENT</th>
<th>LOCATION</th>
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<tbody>
<tr>
<td>8:45</td>
<td>Lagoon Autopark (parking lot) opens</td>
<td>Main Gate</td>
</tr>
<tr>
<td>9:30</td>
<td>Lagoon Main Gates to rides opens</td>
<td>Main Gate</td>
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<tr>
<td>9:00 - 11:00</td>
<td>School &amp; teacher registration Main Gate</td>
<td>Main Gate</td>
</tr>
<tr>
<td>9:30 - 11:00</td>
<td>Contest registration &amp; safety approval inspections</td>
<td>Davis Pavilion</td>
</tr>
<tr>
<td>10:00-11:00</td>
<td>Utah/Idaho FIRST Robotics Grudge Match—Semifinals</td>
<td>Maple Terrace</td>
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<tr>
<td>10:00-2:00</td>
<td>MESA Arduino Clean Air Solutions and Mouse Trap Car</td>
<td>Oak Terrace</td>
</tr>
<tr>
<td>12:00 - 1:00</td>
<td>Faculty and staff complimentary lunch</td>
<td>Canyon Terrace</td>
</tr>
<tr>
<td>2:30 - 3:30</td>
<td>Contest winners are posted as judging is completed</td>
<td>Davis Pavilion</td>
</tr>
<tr>
<td>2:00-2:45</td>
<td>Utah/Idaho FIRST Robotics Grudge Match—Finals</td>
<td>Maple Terrace</td>
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<tr>
<td>2:30-3:45</td>
<td>Mindstorm Competitions</td>
<td>Maple Terrace</td>
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<tr>
<td>3:30</td>
<td>Awards Ceremony in Davis Pavilion</td>
<td>Davis Pavilion</td>
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<tr>
<td>9:30</td>
<td>All rides close</td>
<td></td>
</tr>
<tr>
<td>10:00</td>
<td>Park closes</td>
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### Sky Drop Contest

- **10:00-12:00** Registration for the Sky Drop is open
- **11:00-1:30** Eggs can be dropped from the Sky Coaster.
  - Line will close at 1:00, or as soon as the line is finished.
- **2:30** Winners will be announced as soon as the contest is judged.

### Colossus’ Colossal G-Forces Contest

- **9:30-10:30** Contest registration & safety approval inspections
- **10:30-12:30** Colossus open for measurements
- **2:00** Entry forms due

### Physics Bowl Competition (Bighorn Pavilion)

- **9:30 - 10:30** Contest registration
- **10:20** Rules Review/Contest Information/Round 1 time slots Drawing
- **10:30 - 11:00** Preliminary Qualification Round in
  - Round of thirty-two
- **11:00 - 11:45** Round of sixteen
  - Quarter-final round
  - Semi-final round
- **2:45 - 3:00** Consolation round
- **2:45 - 3:00** Championship round
- **3:30** Scholarships and prizes awarded
  - Congratulations to the USU Physics Bowl Champions

### Physics Demonstration, Lagoon: Ride Design and Physics Day Logo Design Contests

- **9:30 - 11:00** Contest registration & safety approval inspections
- **11:00 - 3:00** Judging
- **11:00-2:00** Meet with Judges by appointment as arranged during registration

### USU Physics Day Photo Contest

- **2:00** All photo entries due with #USUPhysicsDay
- **3:00** Contest winners posted @USUAggies

### Student Workbook

- **10:00 - 3:00** Workbooks Collected
- **3:30** All entry forms due. Teachers can pick up solutions.

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**All students who turn in their workbook to the table at Davis Pavilion by 3:30 can enter a random drawing to Win Fabulous Prizes**
Thank you for coming to Lagoon for a day of physics and fun!

You are one of more than 10,000 physics students from more than 125 schools from five states here to enjoy a fun day experiencing Amusement Park Physics first hand.

This Student Workbook is for use in one of many activities that you can participate in today:

- Student Workbook Physics Bowl Contest
- Colossus’ Colossal G-Forces Contest
- Sky Drop (Egg Drop) Contest
- Physics Demonstration Design Contest
- Lagoon Ride Design Contest
- Physics Day Logo Design Contest

The Physics Department at Utah State University and the Idaho National Laboratory are running today’s activities.

The contests are sponsored by Aerostructures, Albany, Apogee, ARDUSAT, ASI, Boeing, Campbell Scientific, Eastern Idaho Regional Medical Center, Embry-Riddle, Hill Air Force Base, Idaho Virtual Academy, IM Flash Technologies, Lagoon, Micron, Northrop Grumman, Ophir-Spiricon, Parker-Hannifin Aerospace, Portage Environment, Rocky Mountain NASA Space Grant Consortium, Space Dynamics Laboratory, US Navy, USU College of Science, USU Emma Eccles Jones College of Education & Human Resources, USU Admissions Office, Utah Virtual Academy, and WiTricity.

More information about Physics Day is available at physicsday.usu.edu. If you have questions or would like to find out more about physics at Utah State University (www.physics.usu.edu), please stop by the Davis Pavilion. We will be glad to see you at Lagoon!

**ABOVE ALL, HAVE A FUN AND SAFE DAY!!!**

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<td>Glossary</td>
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<tr>
<td>Sky Drop</td>
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<tr>
<td>Tidal Wave</td>
</tr>
<tr>
<td>Boomerang</td>
</tr>
<tr>
<td>Which is Hotter?</td>
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</table>
FERMI QUESTIONS

Enrico Fermi was one of this country’s greatest physicists. Among his accomplishments were the 1938 Nobel Prize for nuclear and particle physics and the title, “Father of the Atomic Age” for his role in building the first nuclear reactor. He had a rare talent as both a gifted theorist and experimentalist. One of his legacies is the “Fermi Question,” an insightful question requiring both an understanding of physics principles and estimation skills.

The Fermi Questions given below require information gathered for this workbook, estimation and some clever thinking.

1. This is the 15th year anniversary of the Sky Drop. A contest that challenges students to protect an egg from cracking after it is dropped from the Sky Coaster. Estimate how many eggs have been used for this contest over the years.

   a. First measure how many eggs are dropped per minute. Go to the drop site, set a timer for a minute and count how many eggs dropped.

   b. This contest is only open from 11:00 to 1:30, or 150 minutes. Using your answer in part a, estimate how many eggs will be dropped today.

   c. Using your answer in part b, how many eggs have been dropped for the Sky Drop over the last 15 years?
Here are some physics concepts that you will encounter today. Most of them should be familiar to you after the exciting physics class you’ve been in this year.

**ACCELERATION**: How fast the velocity (either speed or direction) of motion changes with time.

**ACCELEROMETER**: A device to measure acceleration.

**AIR RESISTANCE**: Force resisting motion of a body through air due to the frictional forces between the air and body.

**CENTRIPETAL FORCE**: A force on an object pulling or pushing the object towards the center of its curved path.

**DENSITY**: The mass of a material per unit volume.

**CHARGE**: The amount of electric charge determines the force due to an electric field.

**CONSERVATION OF MOMENTUM**: The total momentum of a system is constant whenever the net external force on the system is zero.

**CURRENT**: The charge flow rate or amount of charge passing a certain point per unit time.

**DENSITY**: The mass of a material per unit volume.

**ELECTRIC POTENTIAL (VOLTAGE)**: The potential energy of a body due to electric force, per unit charge.

**FORCE**: A push or pull. The time rate of change (direction and magnitude) of momentum.

**FLOW RATE**: The amount (or number) of something going past a certain point in a certain amount of time.

**FLUX**: The same as Flow Rate. The amount (or number) of something going past a certain point in a certain amount of time.

**FRICTION**: A retarding force that resists the motion of a body.

**G-FORCE**: Ratio of the magnitude of acceleration on a body to the acceleration of gravity at sea level on Earth (g = 9.8 m/s²).

**GRAVITATIONAL POTENTIAL ENERGY**: The potential energy of a body associated with its position due to the force of gravity.

**GRAVITY**: Attractive force between two bodies, proportional to their masses.

**IMPULSE**: Product of the magnitude of a force on a body times the time over which the force acts on the body.

**INERTIA**: Tendency of a body to remain at rest or in uniform motion in a straight line.

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**Amusement Park Physics Glossary**

Bored? Do some Physics on your Phone!

1) Think about how you can secure your phone while riding your favorite ride. Hold your phone in the position it will be in while you collect data so we can determine what direction will be measured by which axis.

   a) Which axis changes when you move your phone up and down? What color is it?

   b) Which axis changes when you move your phone right and left? What color is it?

   c) Which axis changes when you move your phone forward and backward? What color is it?

2) Now ride your favorite ride and collect data. Make sure you safely secure your phone in the same position you held it for part 1. (If you need it, tape is available in the Davis pavilion).

   a) What part of the ride had the biggest acceleration?

   b) What direction was it in?
KINETIC ENERGY: The energy of a body associated with its motion.

MASS: The amount of material a body contains. A quantitative measure of the inertia of a body.

MOMENTUM: The product of mass times velocity.

NEWTON’S LAWS OF MOTION: Physical laws governing the motion of bodies (at speed much less than the speed of light) expressed in terms of force, mass, and acceleration.

POTENTIAL ENERGY: Energy of a body associated with its position.

POWER: Rate of work done per unit time.

SPEED: The magnitude of velocity.

VELOCITY: The magnitude and direction of the time rate of change of position.

WEIGHT: A force proportional to the mass of a body. Measurement of the gravitational attraction of a body to the Earth.

WEIGHTLESSNESS: A condition under which a body feels no net force proportional to its mass.

WORK: Product of the magnitude of force on a body times the distance through which the force acts.

**Useful Conversion Factors**

<table>
<thead>
<tr>
<th>Conversion Factor</th>
<th>Common Densities (g/cm³)</th>
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<tbody>
<tr>
<td>1 m = 3.28 ft</td>
<td>air</td>
</tr>
<tr>
<td>1 hr = 3600 sec</td>
<td>water</td>
</tr>
<tr>
<td>1 m/s = 3.6 km/hr = 2.24 mi/hr</td>
<td>aluminum</td>
</tr>
<tr>
<td>1 g = 9.8 m/s² = 32 ft/s²</td>
<td>iron</td>
</tr>
<tr>
<td>1 in = 2.54 cm</td>
<td>lead</td>
</tr>
<tr>
<td>1 km = 0.621 miles</td>
<td>plastic</td>
</tr>
<tr>
<td>1 kg = 2.2 lbs</td>
<td>wood</td>
</tr>
<tr>
<td>1 N = 0.225 lbs</td>
<td></td>
</tr>
<tr>
<td>1 Cal = 1 kcal = 1000 cal = 4184 J</td>
<td></td>
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</tbody>
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