# Schedule of Events

<table>
<thead>
<tr>
<th>TIME</th>
<th>EVENT</th>
<th>LOCATION</th>
</tr>
</thead>
<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>
</tr>
<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—Seminals</td>
<td>Davis Pavilion</td>
</tr>
<tr>
<td>10:00-2:00</td>
<td>Mindstorm Activities</td>
<td>Maple Terrace</td>
</tr>
<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>
</tr>
<tr>
<td>2:30-3:45</td>
<td>Mindstorm Competitions</td>
<td>Maple Terrace</td>
</tr>
<tr>
<td>3:30</td>
<td>Awards Ceremony in Davis Pavilion</td>
<td>Davis Pavilion</td>
</tr>
<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.
9:30 Sky Drop Contest
10:00 Park closes

**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
11:00 - 11:45 Round of thirty-two
1:15 - 1:45 Round of sixteen
1:45 - 2:15 Quarter-final round
2:15 - 2:45 Semi-final round
2:45 - 3:00 Consolation round
2:45 - 3:00 Championship round
3:30 Scholarships and prizes awarded

**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
   Smart Phone 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 Instruments,
Ardusat, Autonomous Solutions, Boeing, Campbell Scientific, Embry Riddle, Hill
Air Force Base STEM Outreach Program, IM Flash Technologies, Lagoon,
Micron, Ophir Spiricon, Orbital ATK, Parker-Hannifin Aerospace, Portage
Environment, US Navy, USU College of Science, USU Emma Eccles Jones
College of Education & Human Resources, USU Research Foundation, USU
Space Dynamics Laboratory, USU Admissions, Utah NASA Space Grant
Consortium, Utah and Idaho Virtual Academies, 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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Enrico Fermi was one of this country's greatest physicists. Among his accomplishments are 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.

a.) Estimate how many prizes will be won at the various carnival games during Physics Day at Lagoon.

b.) From how high would you have to drop a water balloon in order to have the water boil when it hits the ground?

c.) If we started collecting eggs a week ago how many chickens would we have to collect from to get enough eggs for Physics day?
Amusement Park Physics Glossary

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**: A change in velocity, divided by change in 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.

**CONSERVATION OF MOMENTUM**: The total momentum of an isolated system never changes.

**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 CHARGE**: Physical property of particles or objects that causes them to attract or repel each other without touching; may be positive or negative.

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

**FORCE**: A push or pull; an interaction between two objects.

**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**: The rubbing of one body against another; while it often opposes motion that is not always the case.

**G-FORCE**: The force of attraction between all masses in the universe. \( g = 9.8 \text{ m/s}^2 \).

**GRAVITATIONAL POTENTIAL ENERGY**: Depends on an object’s weight and its height above the ground. \( \text{GPE} = mgh = \text{mass} \times \text{gravitational acceleration} \times \text{height} \).

**GRAVITY**: The force that attracts a body toward the center of the earth, or toward any other physical body having mass.

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

**INERTIA**: The property of an object that resists a change in its state of motion.

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Bored? Do some Physics on your Phone!

Your smart phone has a whole host of sensors built into it in order to make your life easier. There are a number of apps available to utilize these sensors to take real data.

**g-Force Meter** – (Our favorite feature) measures the ratio of normal force to gravitational force \( (F_N/F_g) \) in three dimensions.

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a) Of all the different sensors available in your cell phone which ones could be most useful for egg-drop?

b) Do you think it would be a good idea to use your cell phone to take these measurements?

c) What is an interesting thing that you could measure at Lagoon using your cell phone?
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>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 m = 3.28 ft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 hr = 3600 sec</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 m/s = 3.6 km/hr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 g = 9.8 m/s²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 in = 2.54 cm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 km = 0.621 miles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 kg = 2.2 lbs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 N = 0.225 lbs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Cal = 1 kcal</td>
<td></td>
<td>4184 J</td>
</tr>
</tbody>
</table>

**Common Densities (g/cm³)**

<table>
<thead>
<tr>
<th>Substance</th>
<th>Density (g/cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>air</td>
<td>0.001</td>
</tr>
<tr>
<td>water</td>
<td>1</td>
</tr>
<tr>
<td>aluminum</td>
<td>2.7</td>
</tr>
<tr>
<td>iron</td>
<td>7.9</td>
</tr>
<tr>
<td>lead</td>
<td>11</td>
</tr>
<tr>
<td>plastic</td>
<td>0.9</td>
</tr>
<tr>
<td>wood</td>
<td>0.9</td>
</tr>
</tbody>
</table>

**Helpful Equations**

\[
PE_g = mgh \\
V_{Average} = \frac{V_{Final} + V_{Initial}}{2} \\
KE = \frac{1}{2}mv^2 \\
a = \frac{\Delta v}{\Delta t} \\
\omega = \frac{\Delta \theta}{\Delta t} \\
V_{Average} = \frac{\text{Distance}}{\Delta \text{time}}
\]