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Physics 1010
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Freezing Rain Accident

Freezing weather conditions and ice on our roads has always been an issue for Utah drivers. These conditions followed by neglectfulness by drivers' results in major crashes and car pile-ups. Traffic accidents seem to plaster the news reports in the Utah winter. Accidents caused by freezing rain however are rare indeed. Abiding by multiple laws of physics such as Newton's 3rd Law of Motion, the friction force, acceleration, and inertia, could have prevented these accidents. Yet there remains one law, the law of thermodynamics, which may have caused the accidents regardless of the necessary steps taken by the drivers. All of these elements of physics were involved in this article.

Morgan, Emily. "'Very rare' freezing rain creates chaos on roads." *Deseret News.* Deseret News,

24 Jan. 2013. Web. 28 Mar. 2016.

http://www.deseretnews.com/article/865571361/Freezing-rain-causes-icy-roads-dicey-commute-Thursday.html?pg=all

SALT LAKE CITY — Freezing rain wreaked havoc on commuters Thursday, caused nearly 250 accidents, shut down the Salt Lake City International Airport for hours and generally baffled many who had never seen the stuff before.
Experts say freezing rain in Utah is rare.
And while Thursday may have marked the end of the icy precipitation, the 0.08 inches that had fallen by midday was the largest accumulation of freezing rain in almost 30 years, according to Trevor Alcott of the University of Utah. Alcott looks at conditions at the airport and reported that this was only the ninth incidence of freezing rain since 1940.
It was also the coldest measured, as the previous eight incidences occurred when temperatures were 26 degrees or warmer. Thursday's rain came in 20-degree weather.
KSL meteorologist Grant Weyman said the freezing rain is "very rare" for the Beehive state and can be explained best by one thing: the inversion.
"A lot of people, they see the fog and call that the inversion, but that's actually not accurate," Weyman said. "It's warm air above cold air. What warm air above cold air will do is trap whatever is in there. So if there's haze, if there's smog, it just gets trapped."
He said Utahns have seen this inversion for the past 10 days, and when it started to rain in the upper, warmer air, it came through and hit the cold valley air, creating freezing rain.
"It starts as rain and then it comes into the cold air and freezes," Weyman said. "So what it was doing in some cases it was rain on people's windshield, but it would freeze on contact with the surface. It was actually glazing ice on the bridges, the overpasses and stuff like that."
This is so unusual, he said, because storms that blow in usually come with enough wind to mix the cold and warm air and eliminate the inversion.
"If it weren't for this inversion, it would have been sprinkles and nobody would have cared," Weyman said. "But because of this colder pocket of air, it became an icy mess.

"You'd think since we often have inversion, it would happen more. … It was just the perfect storm of these really cold temperatures and this weak storm."
The unusual conditions led to a number of frustrations Thursday, especially for those on Utah's roads and those dependent on its largest airport.
Three Utah Highway Patrol troopers were also hit within three hours Thursday while responding to accidents on I-15 and all sustained minor injuries.
All airport runways were closed due to the weather conditions around 9:30 a.m. About that same time, a Frontier Airlines airplane slid while on the taxiway after losing traction while landing.
"We were about to close the runways, and that was an indication we needed to," said airport spokeswoman Barbara Gann, adding that airport officials had already noticed a decline in friction, which is how they monitor an aircraft's braking ability.
Passengers on the flight said they hardly noticed the slide and the airplane made it to its arrival gate. Gann said there was no damage to the airplane or injuries to passengers.
One of the airport's three runways reopened just before 1 p.m. and a second opened around 3:15 p.m. The runways handled both departures and arrivals.
Still, the situation caused a host of problems and Gann advised those with flights to check with their respective airlines for flight status information. With two conventions in Salt Lake City, she said hotel rooms were also scarce and suggested that those with rooms should stay in them and make sure their flights are leaving before venturing to the crowded airport.
There were multiple crashes on Utah's roadways spanning as far south as Spanish Fork.
"It's terrible," said Utah Highway Patrol Cpl. Todd Johnson. "We've got the freezing rain and Salt Lake County has more crashes than troopers can keep up with."
Even troopers who were off-duty were called in to help with crashes Thursday morning and three troopers were hit while assisting motorists.
The first freeway accident that injured a trooper occurred just after 6 a.m. Thursday on southbound I-15 near 1000 South. The trooper was out of his vehicle at the time handling the crash when he and his vehicle were struck by a car that was "driving too fast for the icy conditions," said Johnson. The trooper's injuries did not appear to be life-threatening, though he did receive stitches for a cut on his hand.
The second crash occurred around 8:30 a.m. on northbound I-15 near 5300 South when a vehicle, also traveling too fast for conditions, hit the rear end of a trooper's vehicle while the trooper was inside. That trooper was transported to the hospital as as precaution, Johnson said.
The third crash involving a trooper was near Springville in Utah County at 9:10 a.m. where the officer was assisting a vehicle that had slid off of the road near the I-15 southbound off-ramp. The trooper was in an emergency lane with his lights activated when a vehicle exited too quickly and slid into the rear of his car, pushing it into a pickup truck that had also come to help. The trooper was inside the car and he received minor injuries to his back and neck, but was not transported to a hospital.
There were a total of 128 crashes causing damage that were reported in Salt Lake County and 25 causing injuries throughout the morning, with 21 more crashes in the evening commute. Utah County saw 25 total crashes with damage and two involving injuries. Davis County recorded an additional 70 crashes.
Friday should bring warmer temperatures and an end to the rain.
Jordan School District delayed buses transporting elementary school age children by as much as an hour Thursday morning, spokesman Steve Dunham said. High school and middle school students had already been dropped off when the decision was made by school officials working,

with input from local municipalities, to delay transportation for younger children around 8:30 a.m.

Dunham said parents were notified via Facebook, Twitter and the district's sky alert system so they could retrieve any waiting children from bus stops. By 9:15 a.m., the district reported that buses were back out and all tardy students Thursday morning would be excused.

The Utah Department of Transportation even urged those who work in Salt Lake City to delay their morning commutes by at least an hour due to the road conditions. UDOT spokeswoman Lisa Miller said plow crews were "out in full force."

"Make sure that if you see a plow, you slow down around them and give them room to work so they can clear the road," Miller said, noting that plows would be using a liquid chemical spray treatment for roads that are more effective on ice.

For those involved in some sort of crash on the freeways, UHP asked drivers to take the next exit if possible.

"If there are no injuries in that crash, please move off to the next exit, dial 911 and a trooper will meet you there at that exit," spokesman Dwayne Baird said. "We just want to avoid secondary crashes or having people get injured as they get out of vehicles on those icy roadways."

Salt Lake City Mayor Ralph Becker and the city's Public Services Department also urged city residents to limit driving. All 45 of the city's plows were on the roads with sanders to apply salt to main roads and steep residential streets.

Utah Transit Authority spokesman Gerry Carpenter said that while their buses struggled with delays like most other motorists, Thursday was a good day to take public transportation. The number of riders was so high that an additional FrontRunner route was added to both Ogden and Provo.

"If there was ever a day to ride the train, this was it," Carpenter said. "Those who rode the train got to work faster than everybody else."

How could the 3rd law of motion have helped these drivers? Drivers following by the principle that if they brake and apply an action, an equal and opposite reaction will happen. The result of this reaction would be to stop. Paramount to this successful reaction, however, involves knowing exactly how much braking force to apply and what will happen when you apply it, that is where this law of motion comes into play. Winter storm conditions on the road means you are brushing up against ice, which provides very little friction force resulting in the reaction that followed braking, sliding. Humans have a tendency to slam on their brakes and lock up when they start to slide, which makes the event even worse, thereby causing an even greater reaction to happen. Realizing quickly that you are sliding and remembering to take your foot of the brake and pump them to momentarily gain traction and begin to slow down would have helped these commuters.

Friction force is the reacting force that allows us to slow down in virtually all means of transportation. Whether we are biking, roller skating, or driving a car, friction is what allows us to move forward and to stop moving all together. In winter conditions however this friction force can be interrupted or changed, degraded to a much lower force and prevent cars from being able to stop in the allotted time necessary to avoid accidents. The freezing rain caused a .08-inch layer of ice to form covering the road, which prevented drivers from being able to grip the asphalt and

slow down correctly. Taking the steps of pumping their brakes and leaving enough space between them and other cars could have prevented some of these accidents.

Leaving enough space between cars would have been a huge help, but nothing can replace the time it takes to stop. Acceleration or as some people refer to it deceleration is a crucial principle to remaining accident free. Every object requires a certain amount of force to accelerate, either in forwards or backwards. It requires time in a vehicle to come to a complete stop and it only gets worse as you lose friction force. Failing to remember this results in accidents due to neglect and lack of spatial reasoning.

Inertia is our last principle of discussion. Inertia is the property of all matter that gives it resistance to change. An object in motion will want to stay in motion unless something acts on our object. The bigger the object the greater resistance to change it has. A vehicle for example will want to continue in motion, unless we apply the brakes and cause an acceleration change. Since we have a bigger object like a car travelling at higher speeds it becomes more difficult to have it come to a stop. Now if you apply ice to the roads that are used to grip and use friction to stop, the end result is an object that doesn't want to stop and won't stop because the friction force isn't great enough to bring the object to a stop.

The underlying problem in all of this is that cars and ice don't play nice and sometimes there isn't anything a person can do to stop the impending doom of a crash. Thermodynamics and its laws will cause the roads to freeze whatever moisture is there if the weather permits. To add the cherry on top include rain that is so cold it freezes the second it touches something and you've got a terribly bad situation, in which it becomes dangerous to even walk on the road at a slow pace. Add a vehicle travelling at high speeds plus all of the laws of physics listed above and you've got a recipe for disaster. Conditions such as these make it nearly impossible to not get in an accident and maybe it's out of our hands at times.

Clearly there are a few key things to always remember. One, if you're driving your car in the middle of a snowstorm or an ice storm always be sure to give yourself enough distance between you and other cars. Following this rule will ensure you have enough time to apply your brakes and stop before contacting another vehicle. Number two, be sure to remain calm and apply your brakes in such a way that they grip as much as possible to provide you with the stopping power you need to avoid a collision. Nothing feels worse in that moment when you're sliding and can't do a thing about it. Our third thing to remember is this, never be in a hurry when the conditions are terrible. Being in a rush is a sure way to forget steps one and two and wind up with a costly repair bill. Bottom line is be safe and cautious while driving in unsavory road conditions and be smart while doing so.