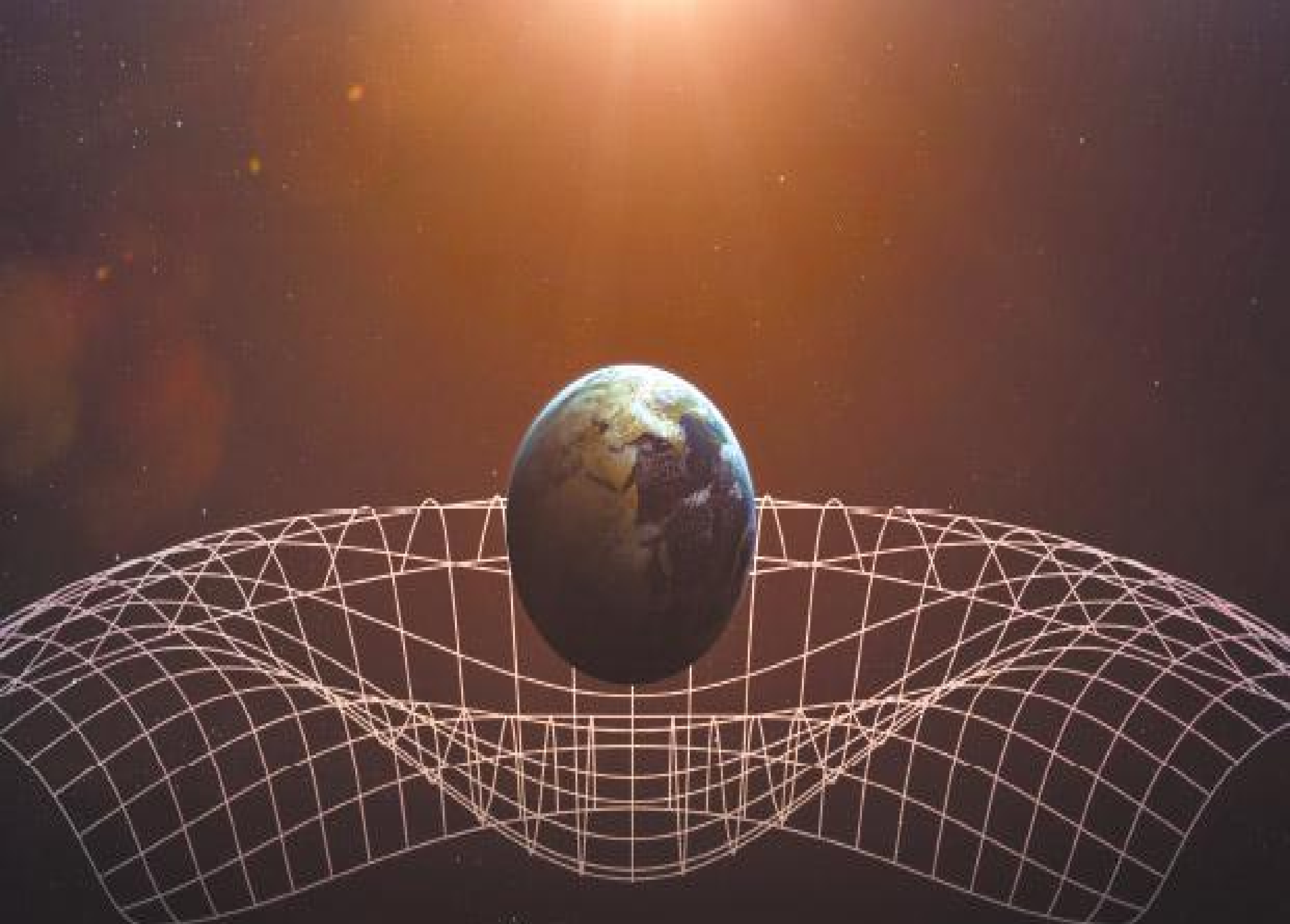

EINSTEIN'S THEORY OF RELATIVITY

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BABY PROFESSOR

EINSTEIN'
OF REL

Physics Reference
Children's Ph

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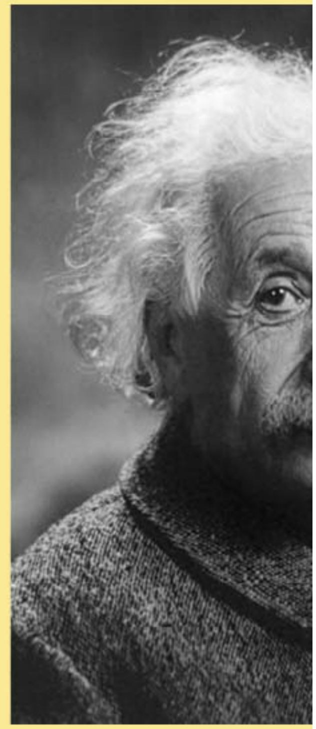
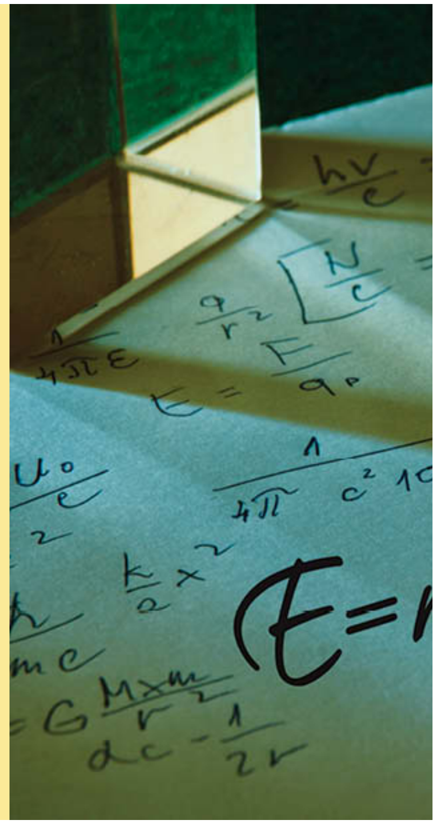
In this book, we
talk about Einste
relativity. So, let's

Albert Einstein was a famous physicist who was born in 1879. The theories he developed became the foundation for modern physics.



Einstein formulated the two theories of relativity in the early 1900s. They are called the theories of special relativity and general relativity. Einstein was a genius and these theories are very difficult to understand. However, the more you read about them, the better you'll understand them.



SPE

SPECIAL RELATIVITY

The laws that we know to
stay the same for people
relationship to each other.
frame." In this situation, t
at rest or at a velocity tha

One example would be if you are sitting on a bus with a group of other people. If someone stood up in the aisle and started to juggle three balls, the laws of physics about how balls react in this circumstance would remain the same. This would be true as long as the bus is either stopped or moving at a constant velocity.

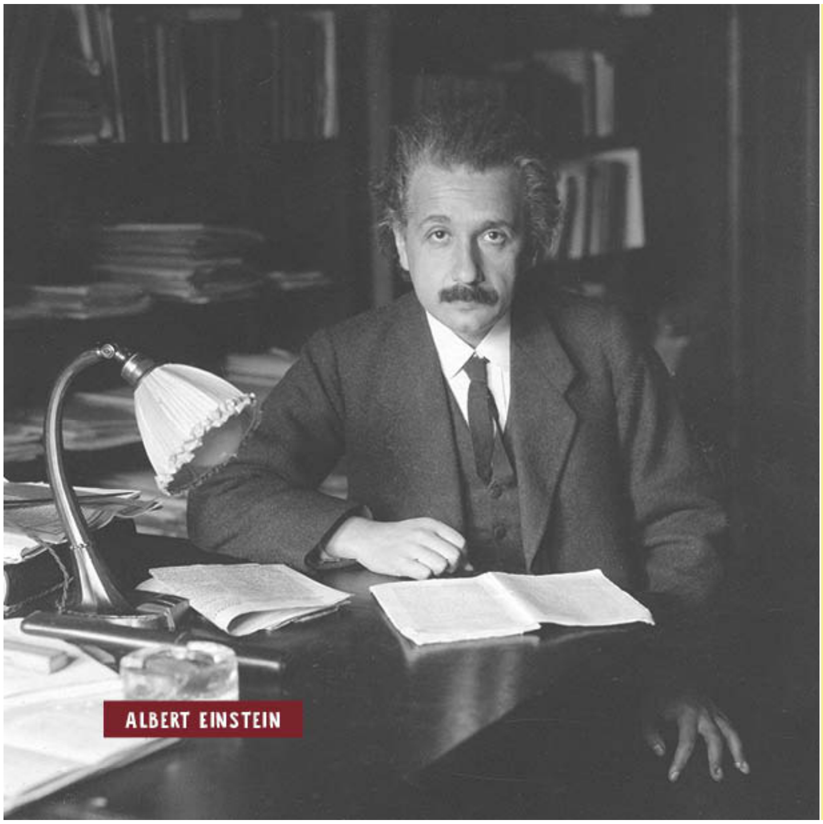
An inertial frame of
to understand if y
described in several c
situation where:

- the velocity is con
- there is no accele
- Newton's law of in
- Newton's laws of

If all of a sudden,
accelerate, then the
would be called a non

SPECIAL RELATIVITY: PART 2

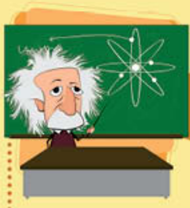
As long as light is in a vacuum, which is a space with no matter in it, it will travel at a constant speed, represented by **c**. It doesn't matter what the motion of the observers is or the motion of the light's source. The speed of light will always be the same in a vacuum. That speed is 186,282 miles per second or 299,792 kilometers per second.



ALBERT EINSTEIN

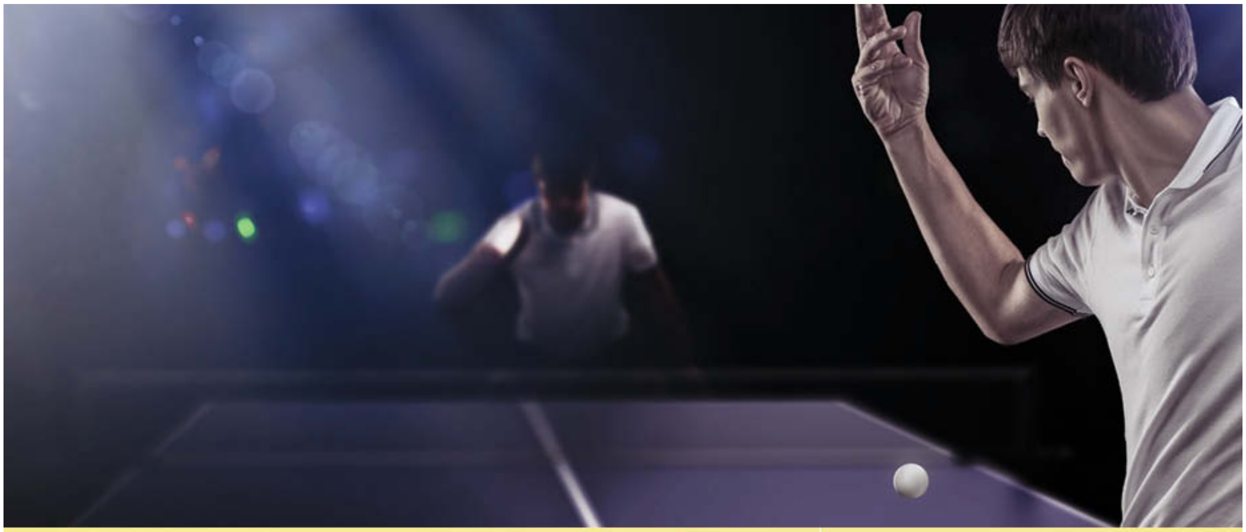
WHAT VELOCITY O

Before Einstein's theori when motion was me against a specific referen reference point the "ether. was no such thing as the that the measurement of the velocity that the obse the observer's position.



AN EXAMPLE OF RELATIVE MOTION

Let's look at a simple example. Suppose you are playing a table tennis game on a bus that is moving north at 22 meters per second, which is about 50 miles per hour. The center of the table is at right angles to the direction you are moving. You are the farthest away from the bus driver and you hit the ball over the net at a speed of 1 meter per second traveling north.



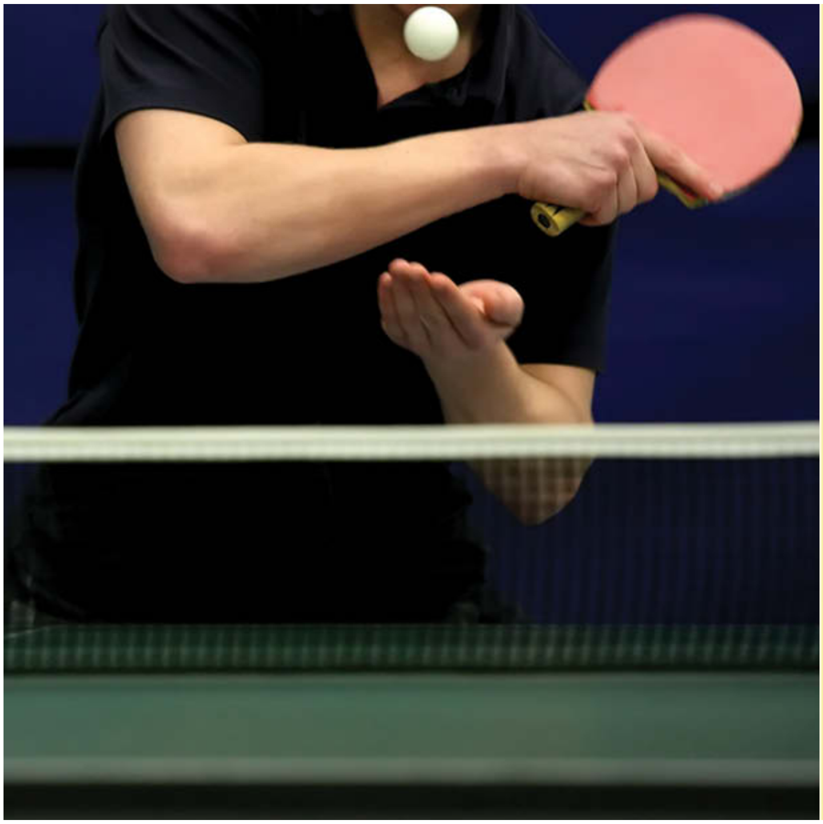
Then, the other player who is playing against you, hits it back at 1 meter per second traveling south. This is how you both would measure the speed and direction of the ball because your frame of reference is

inside the bus. You would
as 1 meter per second no
second south.

However, let's think about the way an observer would see the picture. The observer outside the bus is standing still and looking at the bus as you pass. You ask him to measure the speed and direction of the ball.

The center of the
traveling at 22 me
observer would say t
ball, it's traveling at 2
plus 1 meter per secor
per second traveling r

When the player opposite you hits the ball, it will be 22 meters per second minus 1 meter per second or 21 meters per second traveling north. At no time will that observer see the ball as traveling south since from his position relative to you, the bus is traveling in a northernly direction the entire time.

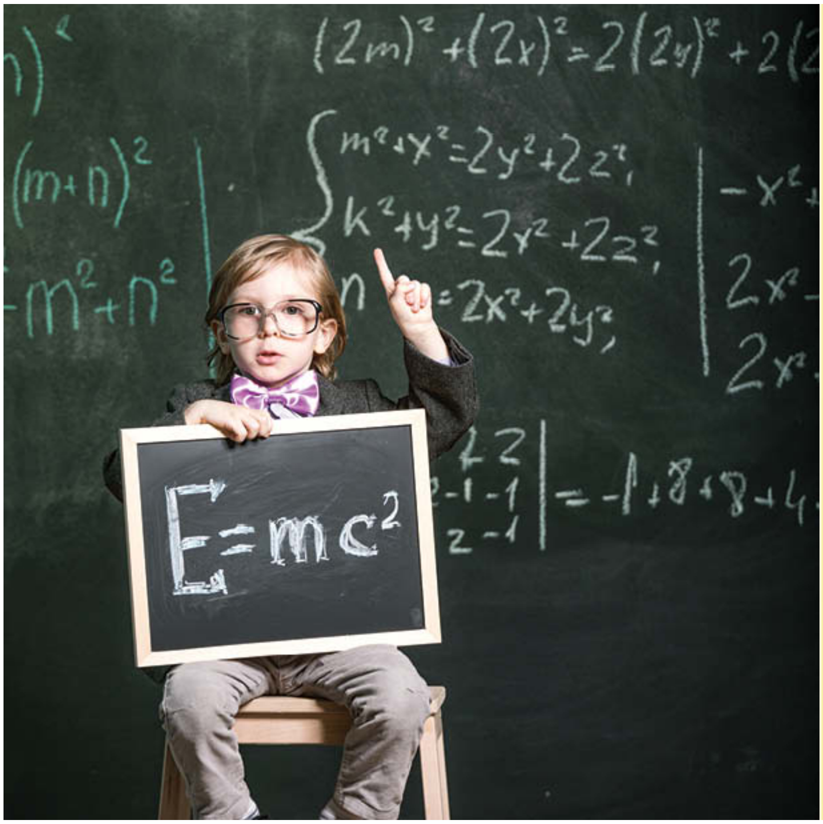


In summary, the spee
ball is relative to the
ball's speed and direct
be different for the play
an observer positioned

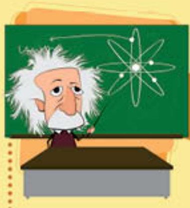
EINSTEIN'S FAMOUS EQUATION

One of the outcomes of Einstein's theories was his famous equation $E = mc^2$. The variables in this formula are simple to understand. The variable E stands for the quantity of energy an object has. The variable m stands for the object's mass and c stands for the speed of light to the second power.

ENERGY REPRESENTATION FORMULA

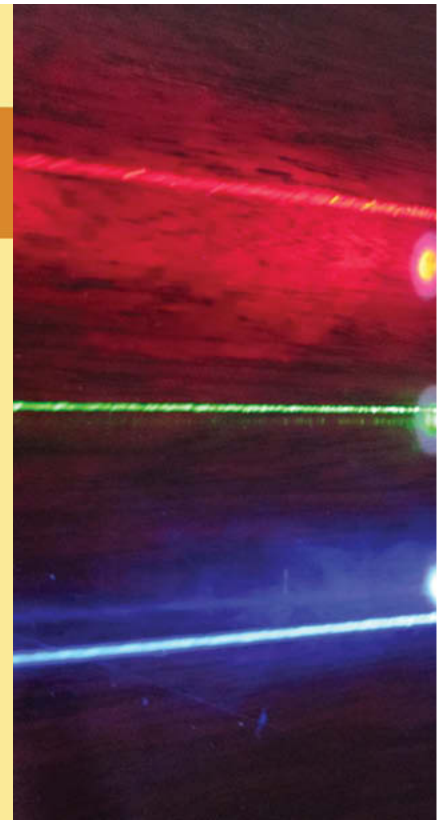


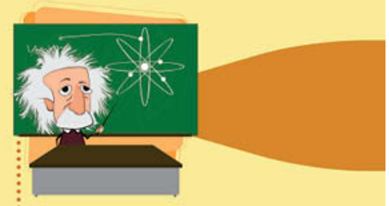
It means that if you ad
you also increase its m
mass, you also decrease
tremendous amount of e
of all matter. Einstein's e
the development of te
splitting the atom and cr



CONSEQUENCES OF THE SPEED OF LIGHT

There are some very strange consequences to the fact that the speed of light is a constant. Because we don't experience these effects in daily life, they are hard to imagine, but they have all been proven by different scientific experiments. Einstein discovered that Newton's laws weren't applicable when objects were getting close to the speed of light.

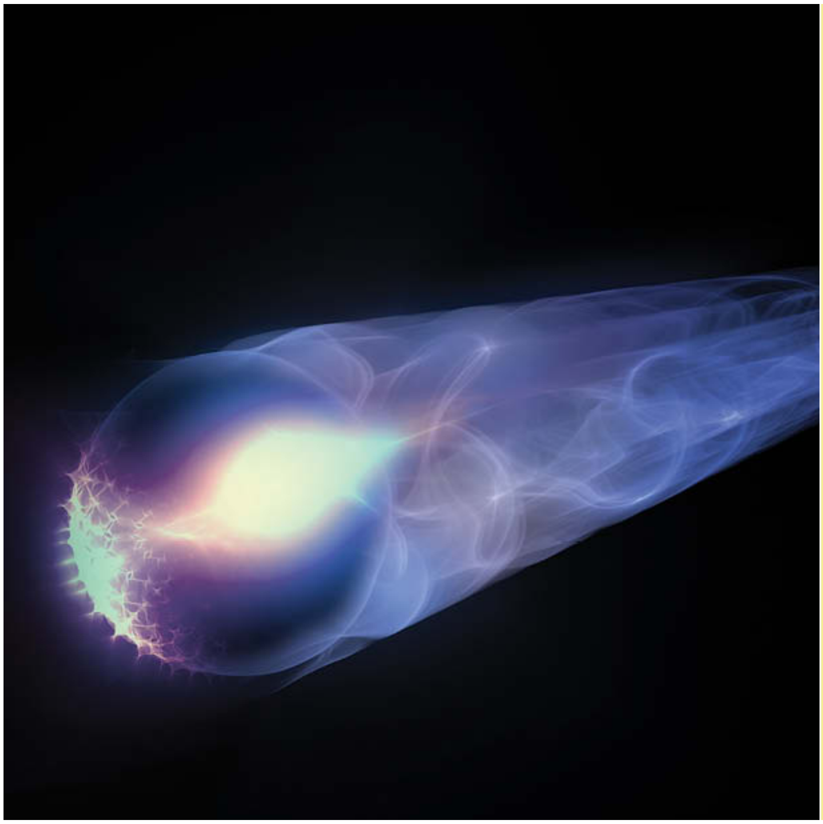




Einstein's equations and
that as you travel close
of light, time actually slo
time dilation. Suppose y
you take off on a trip in d

You have a new type of spacecraft that can travel 95% of light's speed. When you come back to Earth, your clock and calendar tell you that

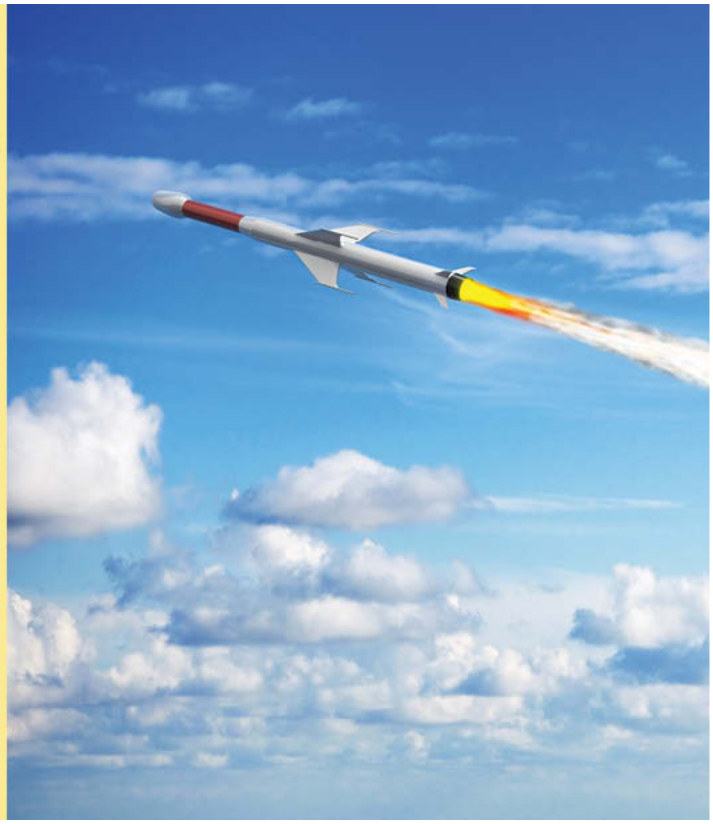
you've been gone for 10 y
you have aged. However,
have aged over three tim

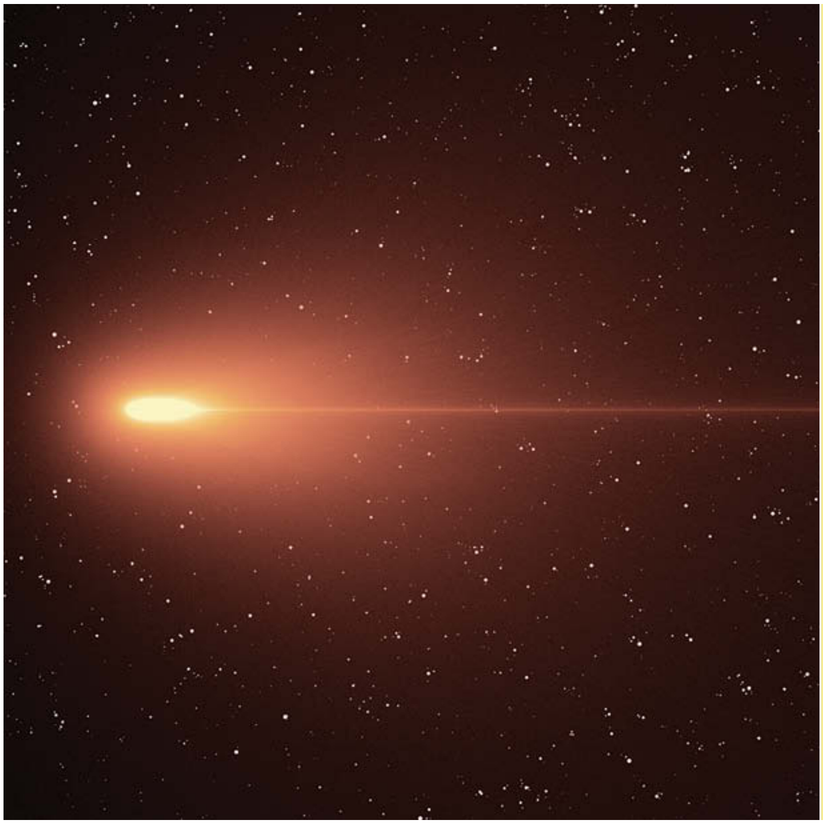


LENGT

Another strange result f
is that length contracts
faster an object is moving
is viewing, the shorter it w
Again, we don't witness th

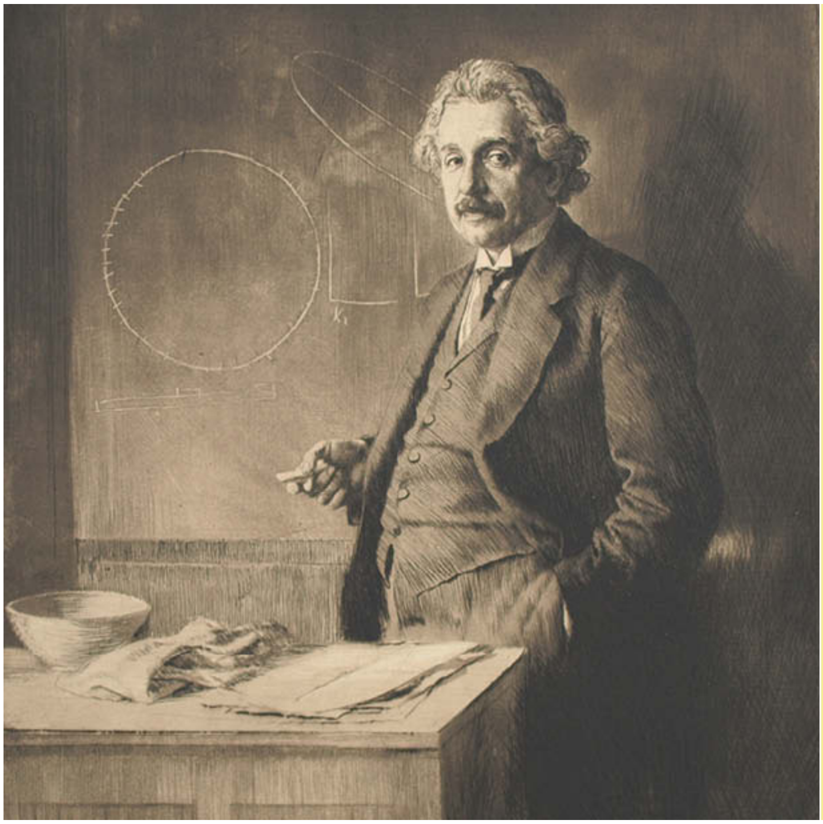
The situation required to observe the shortening of length only happens at extremely high speeds. If a missile measuring 100 feet in length was traveling past you at 50% of the speed of light, it would only seem to be about 87 feet long. If someone was inside the missile, he or she wouldn't perceive any difference in its length.





At this point in time it
ever travel as fast or
light. Even if we could g
there is a huge problem.
to the speed of light, the
would become. Suppose
a mass of 5 grams.

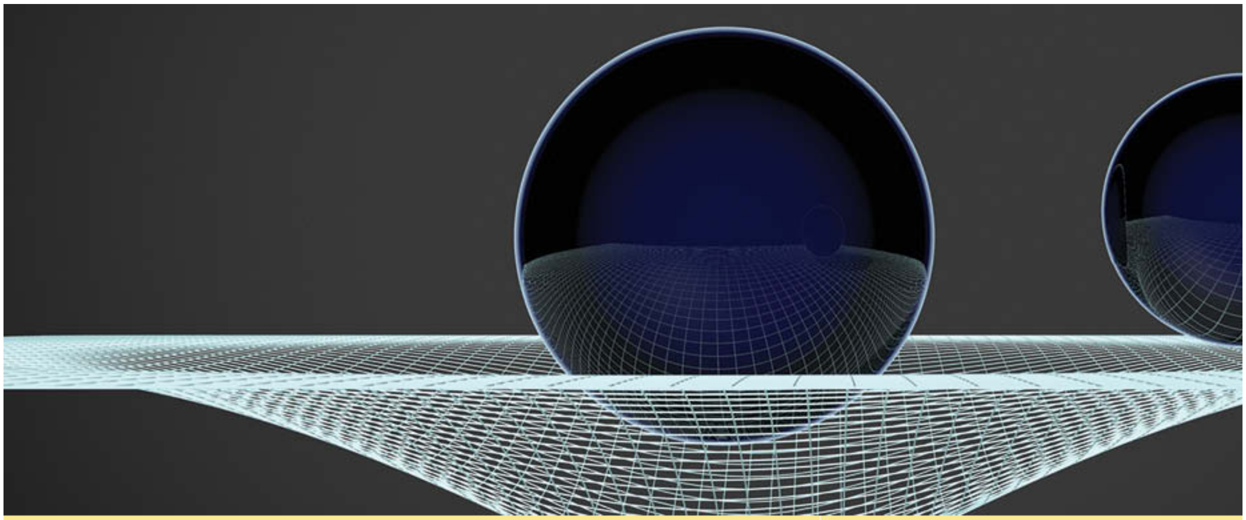
In the lab we're able to get it to travel at 95% of the speed of light. When we measure it, its mass would be 16 grams. That doesn't seem too bad, but the closer we get to the speed of light it increases dramatically. For example, at 99.999% the speed of light, that same 5 gram sample would be 500,000 grams!



GENE

Einstein published his th
These theories extend
theories to include situat
accelerating in relationsh
situations are non-inertial

- Special relativity applies to inertial frames of reference.
- General relativity applies to non-inertial frames of reference.



As Einstein continued to work with his theories, he realized that space and time were connected. He also discovered that the more massive an object was, the more it would bend the "fabric" of space.

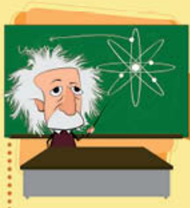
A good example is a
something really ma
trampoline, it bends the fa
in space cause this sam
planets have elliptical or

Einstein predicted that the space around planet Earth would be warped and also twisted by the rotation of Earth on its axis. In 2004, Gravity Probe B, called GP-B for short, was sent into space by NASA to see if Einstein's theory about Earth's gravitational field was correct. The satellite contained very sensitive gyroscopes that verified Einstein's findings.


GRAVITY PROBE B

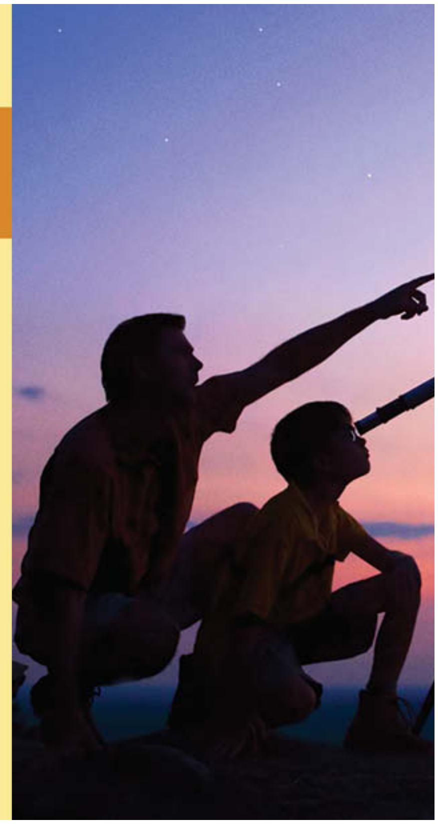
TIM

Einstein discovered th
heights. Earth's gravit
than at the top of Mount
faster if you lived at the
instead of at a sea-leve
amount of time is very
really notice it.

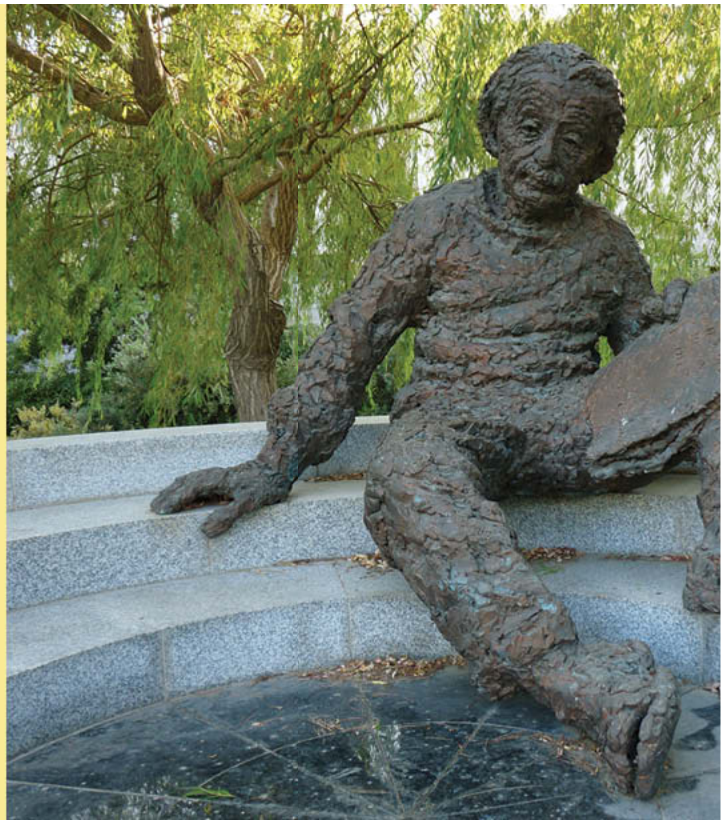


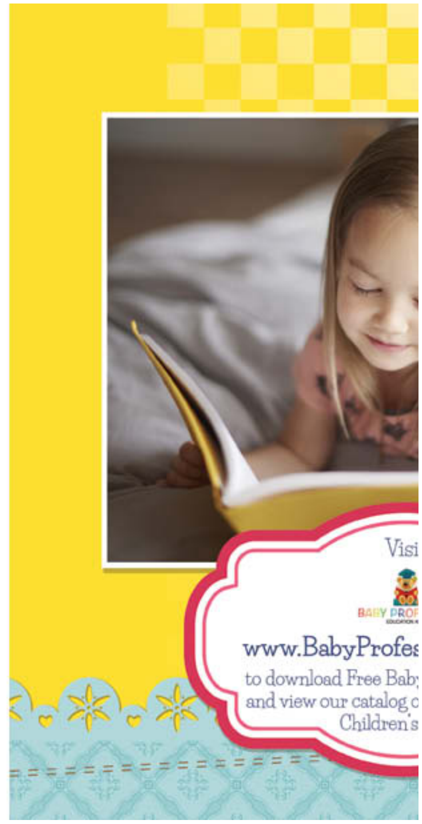
LIGHT AND GRAVITY

Another interesting finding from Einstein's work is that light bends as a result of strong gravitational fields. This is why astronomers have been able to see stars that are located just behind the sun from our viewpoint.



Awesome! Now you know more about Einstein's theory of relativity. You can find more Physics books from Baby Professor by searching the website of your favorite book retailer.





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