ASTRA NEWS

03/25/2022

10th issue

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Enjoy the 10th issue!

The cover for the tenth issue was designed by Leonid Vishnevskiy

THE REPUBLIC OF MARS

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ABOUT THE REPUBLIC OF MARS

If you dream of us, humans, to become a multi - planetary species and see Mars as our chance to build a better world for humankind, this project is for you. Please, see the beginning of this project in issues No. 1, 3, 6, 8 and 9.

In this issue

While the last time that man has stepped on the Moon was 50 years ago, the exploration of space has nonetheless never stopped. If you do not have a clear understanding of the modern stage of it, then you need a guide to unravel this large volume of information and not get lost. Alexander Buick is that guide! He knows all about this.

Alexander's article is a summary of important future space exploration missions, with links that are essential for those who want to dig further.

On the picture

Max read this article too and was touched by the mission named after pioneering scientist Rosalind Franklin, who died at a young age before she could be nominated for and receive the Nobel Prize. It seems as it has never been the right time for her.

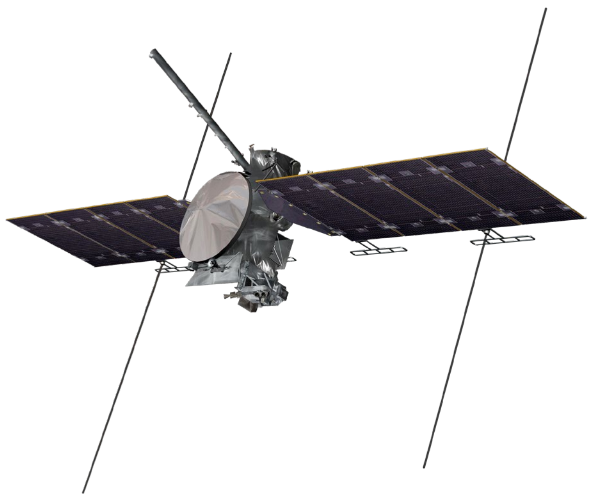
Together with Max we did for Rosalind Franklin what was in our power. And she is bringing the olive branch for all of us.

Max and Leonid

Future Space Exploration Missions

By Alexander Buick

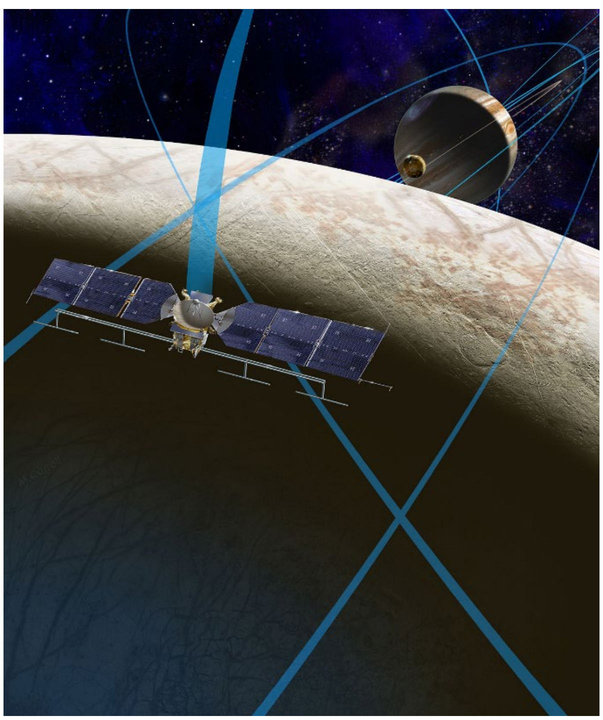
Europa Clipper



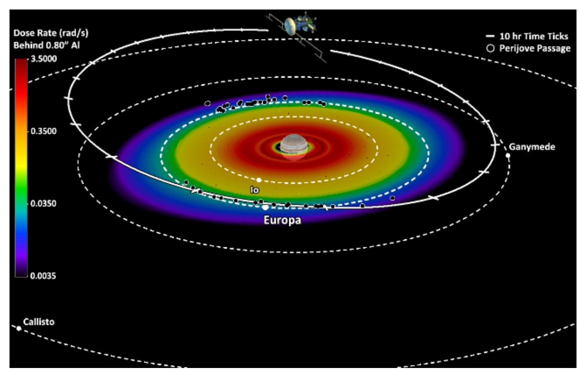
Transparent background version of [the Europa Clipper spacecraft]

Europa Clipper will launch on top of a Falcon Heavy rocket in October of 2024 to begin its five and a half year journey to Jupiter . Once at Jupiter over four years, it will make 44 close flybys of Europa to collect valuable science data. The reason for not putting it in orbit around Europa was due to the impacts of Jupiter's Magnetosphere's radiation in the region it was decided it would be safer not to.

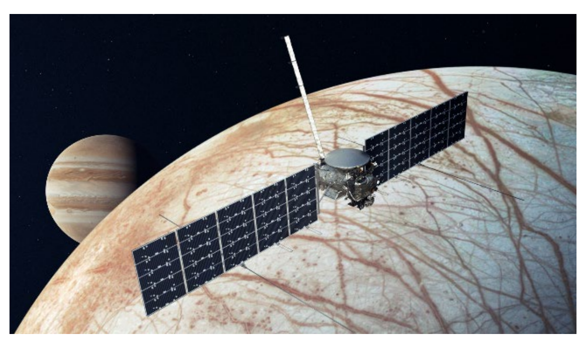
You can read more about Europa Clipper here: https://europa.nasa.gov/



This artist's rendering shows a concept for a future NASA mission to Europa in which a spacecraft would make multiple close flybys of the icy Jovian moon, thought to contain a global subsurface ocean. *NASA/JPL-Caltech*

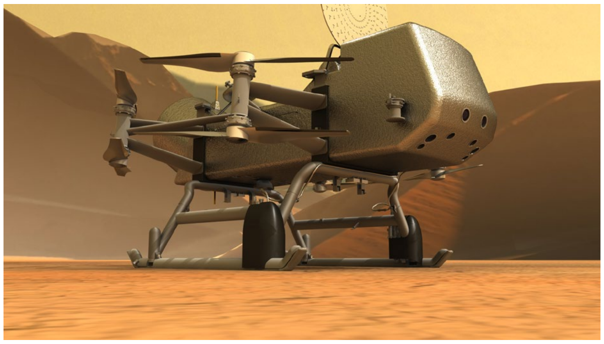


Harsh radiation fields surrounding Jupiter. *NASA/JPL-Caltech*



Europa Clipper Artist's Concept. NASA's Europa Clipper spacecraft will assess whether Jupiter's moon Europa could support life. *NASA/JPL-Caltech*

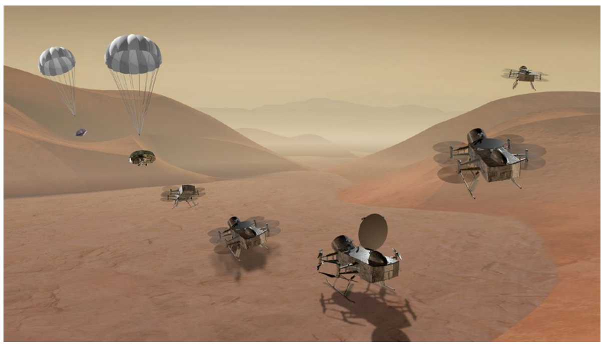
Dragonfly



[Dragonfly spacecraft](#).
Image credit: Johns Hopkins APL

Dragonfly is a drone expected to launch in June of 2027 to begin its 7-year journey to Saturn's moon Titan. It will study its chemistry and collect valuable information on Titan's microbial habitability. Titan is ideal for a drone since its gravity is less than Earth's moon, and its atmosphere is significantly larger than Earth's.

You can read more about this fantastic mission here: https://dragonfly.jhuapl.edu/



NASA graphic showing Dragonfly mission arriving on Saturn's moon Titan, and flying in its atmosphere.
From NASA press release 17-101

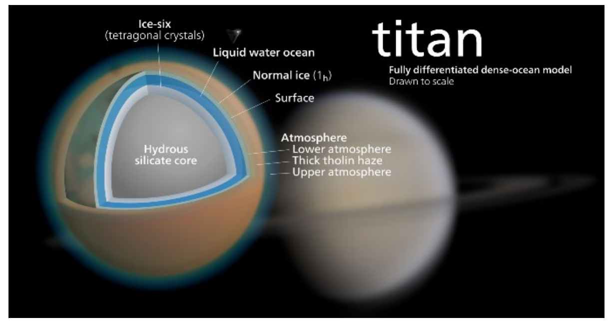


Diagram of the internal structure of Titan according to the fully differentiated dense-ocean model.
By Kelvinsong - Own work, CC BY 3.0.

Rosalind Franklin Rover

The Rosalind Franklin Rover is named after pioneering female scientist Rosalind Franklin. It is an astonishing astrobiology mission. The rover was built in collaboration with the ESA (European Space Agency) and Roscosmos (The Russian Space Agency) and will contain a variety of scientific instruments. The most exciting tool onboard will be a 2 meter! (6ft 7in) long drill for comparison, the current record for deepest drilled on Mars is 7cm (2.8inches). The rover will be drilling where we believe was an ancient Martian ocean, so we hope to find organics beneath the surface there and make remarkable discoveries.

The Rosalind Franklin Rover was planned to launch this September however that is unlikely due to the Russian-Ukraine conflict. It wouldn't be the first time it would've missed its launch window since in 2018 it missed its launch window due to a parachute issue and again in 2020 due to Covid-19 restrictions. You can read more about this astonishing rover here:

- Rosalind Franklin (rover)
- ESA's Mars rover has a name

ExoMars Rosalind Franklin rover
By ESA/Mlabspace

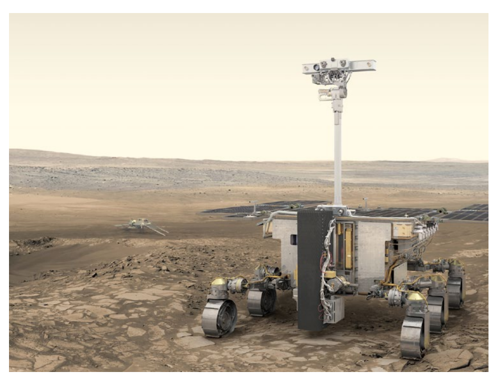


Image source

JUICE

[In the artist's impression](), which is not to scale, Ganymede is shown in the foreground, Callisto to the far right, and Europa centre-right. *spacecraft: ESA/ATG medialab; Jupiter: NASA/ESA/J. Nichols (University of Leicester); Ganymede: NASA/JPL; Io: NASA/JPL/University of Arizona; Callisto and Europa: NASA/JPL/DLR*

JUICE (Jupiter Icy Moons Explorer) is going to begin its 8 year-long journey to the gas giant in April of 2023. Once there, it will conduct multiple flybys of Europa, Ganymede, and Callisto. It will go into orbit around Ganymede during the final years of its science phase. It will become the first spacecraft to do so. It will provide us with a vast quantity of data about Ganymede.

You can read more about it here:
Jupiter Icy Moons Explorer

MMX

MMX (Martian Moons eXploration) built by JAXA (Japan's Space Agency) will have instruments provided by NASA, ESA, and CNES. Its journey to the Martian moons Phobos and Deimos will begin in September of 2024. It will land a rover on Phobos and return Phobos regolith samples to Earth by 2029. The mission hopes to find if the moons resulted from an impact with Mars or if they are captured asteroids.

You can read more about this amazing mission here: Martian Moons eXploration (MMX)

Artist's concept of Japan's Mars Moons eXploration (MMX) spacecraft, carrying a NASA instrument to study the Martian moons Phobos and Deimos. *From Nasa press release 17-090* Credits: JAXA/NASA

BepiColombo

By NASA - Published source': "Spacecraft Icons" at NASA ScienceDirect source: Image hosted by smd-prod.s3.amazonaws.com., Public Domain, wikimedia

BepiColombo launched in 2018 is expected to reach Mercury in 2025. BepiColombo is a joint mission between the ESA and JAXA. Once at Mercury the spacecraft will separate into two different spacecraft. The new spacecrafts will be the Mercury planetary orbiter built by the ESA and the Mercury Magnetospheric orbiter built by JAXA.

You can read more about it here:
BepiColombo

DAVINCI+

DAVINCI (Deep Atmospheric Venus Investigation of Noble gasses, Chemistry, and Imaging) is planned to launch in 2029-2030 and will consist of an orbiter and a Venus descent probe. We hope to understand better the formation of the Venusian atmosphere from this mission and if Venus had a past ocean and a variety of other things.

You can read more about this mission here:
DAVINCI+

Artist's conception of DAVINCI probe.
Caption: During its 63-minute descent, DAVINCI would collect and return measurements of Venus. atmospheric composition

By NASA's Goddard Space Flight Center - http://science.gsfc.nasa.gov/690/photos.html , Public Domain, https://commons.wikimedia.org/w/index.php?curid=47317725

Artist's conception of DAVINCI probe descent stages.
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Mars Sample Return

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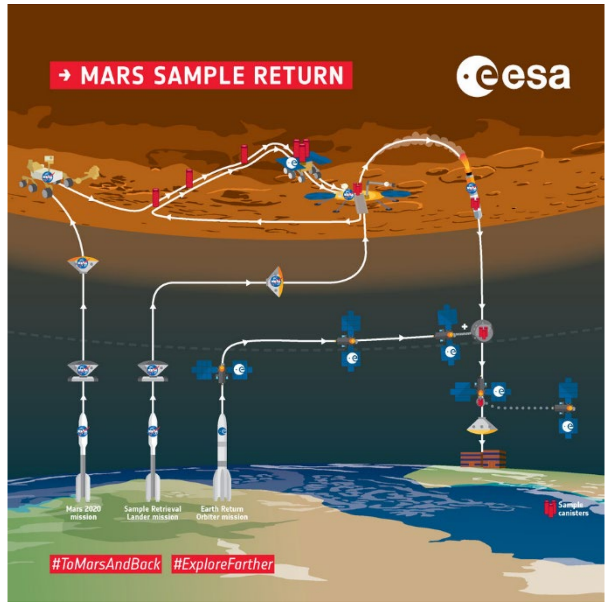
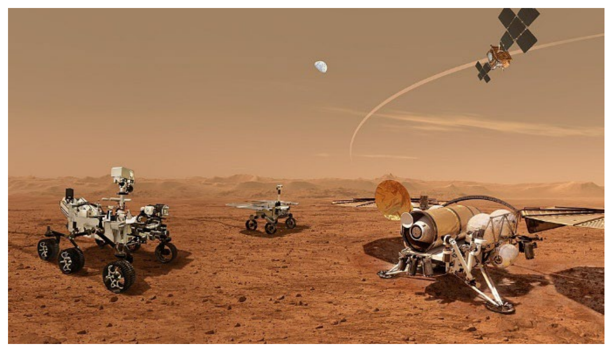


Overview of the Mars Sample Return mission.
ESA–K. Oldenburg

Mars sample return is a 4 part mission consisting of the Perseverance rover to collect the samples. Then a smaller rover will launch with the MAV (Mars Ascent Vehicle) in 2026. Once at Mars, the rover will pick up the samples taken by Perseverance and load them onto the MAV. The final part of the mission, ERO (Earth Return Orbiter) will be launched in 2026 to take the sample back from Mars. In 2029 the MAV is scheduled to launch the samples into low Mars orbit, where the samples will be intercepted by ERO and brought back to Earth.

You can read more about this incredible mission here: Mars sample-return mission, Mars sample return (ESA), Mars sample return (NASA)

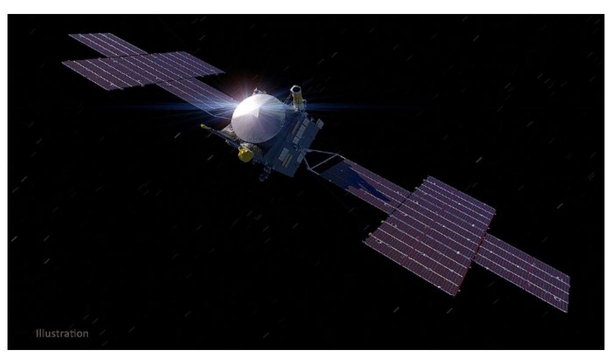


This illustration shows a concept for a set of future robots working together to ferry back samples from the surface of Mars collected by NASA's Mars Perseverance rover. *NASA/ESA/JPL-Caltech*

Psyche

Psyche is a mission to the asteroid Psyche and will launch this August. This mission will not only study this unique asteroid, but it will be one of the first NASA missions to test deep-space laser communication. Laser communication is between 10-100 times more efficient than standard forms of communicating with objects in deep space, so we hope it will pave the way for future deep-space laser communication technology.

You can read more about Psyche here: Psyche (spacecraft) and The Psyche Mission (NASA)



By NASA - *https://www.nasa.gov/sites/default/files/thumbnails/image/pia24473-psyche-spacecraft-16.jpg*
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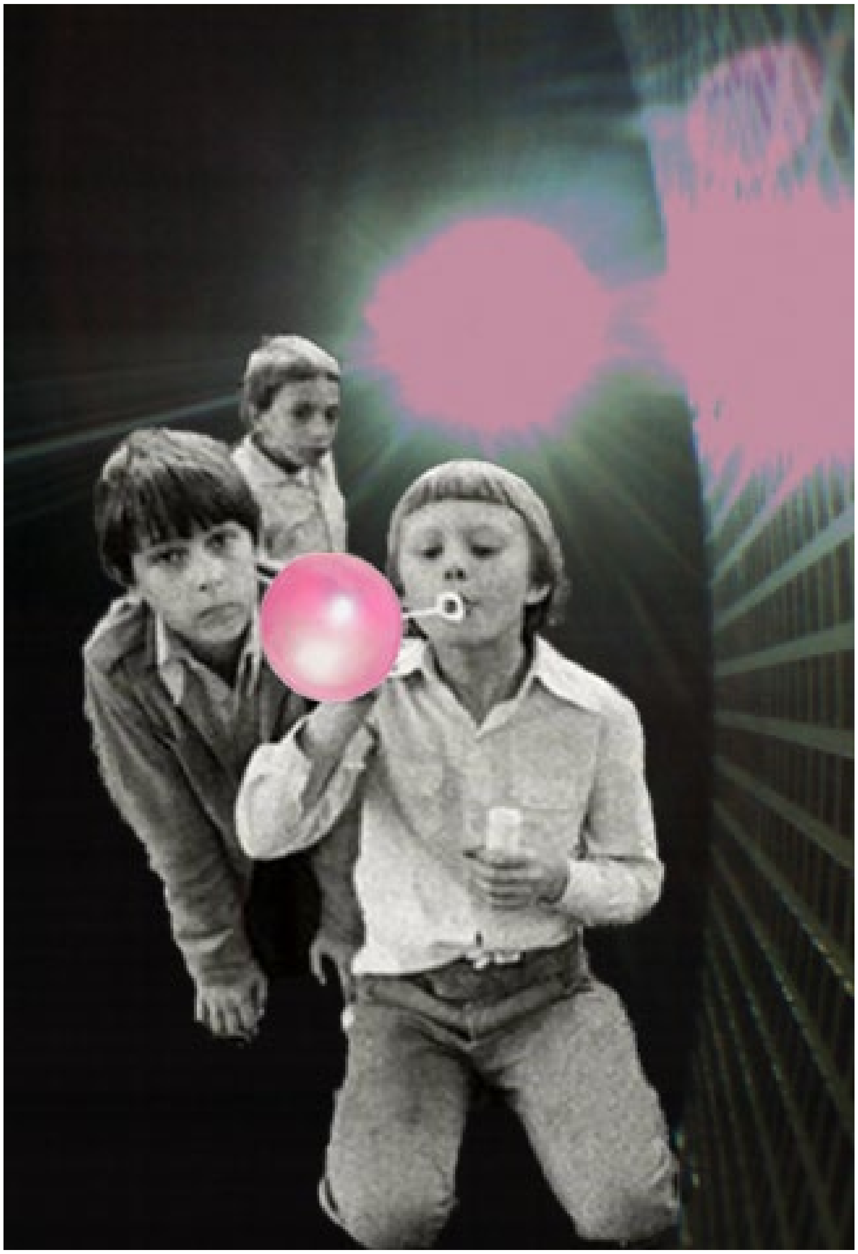


NONFICTION

Pages 8 - 10

ABOUT NONFICTION

Never stop questioning and experimenting. That's what defines nonfiction within *Astra News*.

In this issue

You all know the story of the three little pigs. Let's send them on a different adventure.

This was an assignment in the Art Criticism Class at Astra Nova School, which was turned into retelling this very well-known fairy tale. The assignment's idea was to use works of any one photographer to make a story from them.

We would love to see your stories in the next issue!

On the picture

It's a collage I made, for the background of which a NASA image Away from Mars, With Sunburst was used.

Leonid

The Three Little Pigs

retold by Leonid Vishnevskiy based on the works of [Henri Cartier-Bresson][i]

Once upon a time there was a mother pig who had three little pigs.

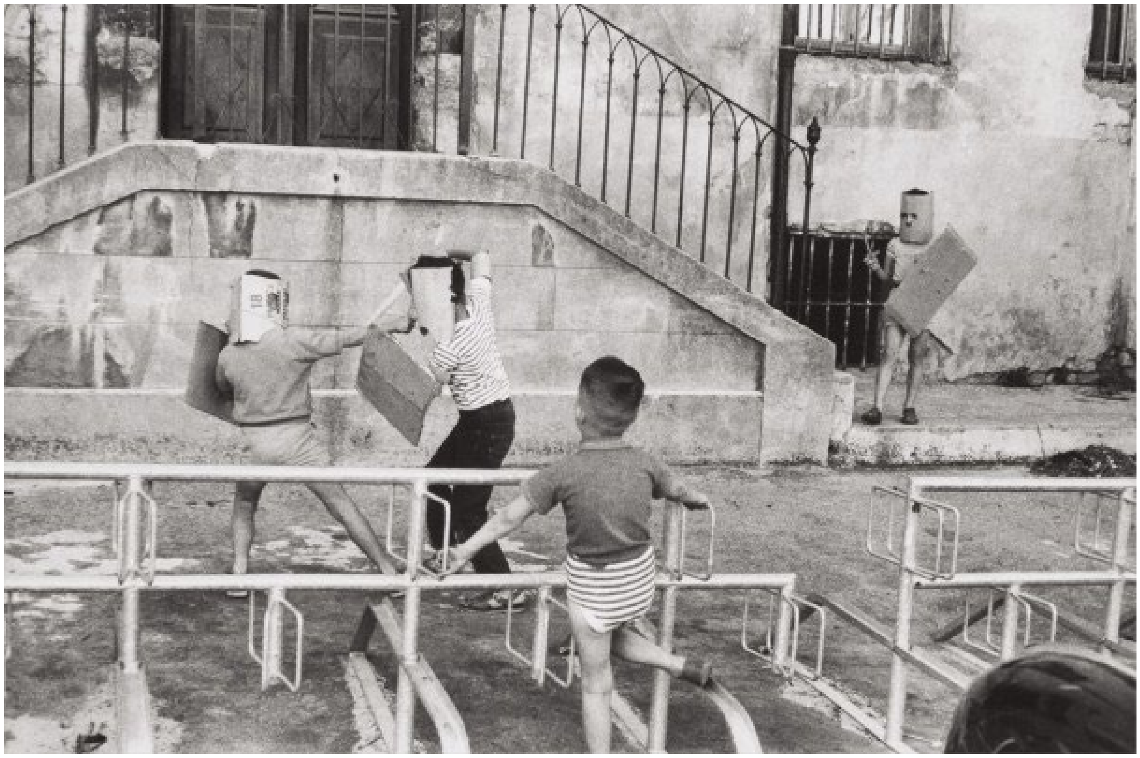
When they were old enough, she sent them out into the world to seek their fortunes.

On the first day the three little pigs saw people covering land with fabric rivers. One of the pigs thought that this is where the water ends in the world and so he rushed back home. Because how could you be without water?

That must have been a very funny little pig.

On the second day the remaining two little pigs saw little boys fighting. One of the pigs figured that they were sent out into the world to seek their fortunes too. He rushed back home as fast as his short legs could carry him, because he was scared to become their fortune.

That must have been too thoughtful of a little pig.



So, there was only one little pig left. He traveled and traveled the world in search for fortune and nothing quite suited him. That must have been a very adventurous little pig. And one day he saw this. A man running from a wolf!

The little pig rushed back home faster than his short legs could carry him, because before he knew it, he was back home.

There he came to his mother and brothers, and they all lived happily ever after.

This is how three little pigs found their fortune.

The End

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[i] *Works of Henri Cartier-Bresson in the order that they appear:*

Holland, 1953
Ahmedabad, India, 1966
Tarascon, France, 1959
Behind the Gare Saint-Lazare, Paris, France, 1932

SCIENTISTS WATCH MOVIES

Pages 11 - 18

ABOUT SCIENTISTS WATCH MOVIES

Create a science problem(s) based on your favorite movie or on a cult movie. In one magazine issue define the problem, and in the next issue publish the solution. It can be any science-related problem, not only physics. The first such problem can be found in the 5th issue of Astra News, under the name "When Light Leaves Us in the Darkness" and then in the 8th issue.

You can also write an article discussing movie bloopers that aren't correct from the science perspective.

In this issue

In this issue there is a physics problem that you can solve, dedicated to the movie "2001: A Space Odyssey" (1968). In the 11th issue, coming out on April 29, I will publish the solution. You don't need to send the answers, however, if you have questions, email me.

Also in this issue are the answers to the three problems that were published in the 8th issue of *Astra News.*

On the picture

This is a movie still from "2001: A Space Odyssey" in which two astronauts are making a terrible mistake and only because they underestimated someone's ability to analyze well while simply watching.

Physic Problem Solving

based on the movie "2001: A Space Odyssey"

by Leonid Vishnevskiy

A problem on kinematics.

Level of difficulty: easy

In the beginning of the film, we see the iconic scene where an ape throws a bone into the air that never lands. My problem is based on this.

An Ape and a Bone

An ape threw a bone into the air and it reached its peak height from the ape in 5.15 seconds.

- What is the velocity at which the ape threw the bone?
- What is that peak height?

Answers to the physics problems published in the 8th issue

“Back to the Future”. Two problems to solve on kinematics and dynamics

Problem 1. “If my calculations are correct…” Dr. Emmett Brown

The DMC DeLorean time machine was going down the wet Twin Pines Mall parking lot at a constant velocity of 88 miles per hour. The coefficient of kinetic friction between the rubber wheels and the wet asphalt parking lot can be said to be 0.4. The mass of the car is 1230.1 kilograms.

- What is the force of kinetic friction on the car (f)?
- What is the kinetic energy of the car (K.E.)?
- What is the force of the engine of the car (F)?

Solution:

Let’s assume that $g = 10\ m/s^2$. We can use the equation to find the friction force

$$f = \mu n \qquad (1)$$

Let’s input what we know into the equation.

$$f = \mu n = \mu m g = 0.4*1230.1*10 = 4920.4N$$

We can use the equation to find the kinetic energy

$$K.E. = ½*m*v^2 \qquad (2)$$

First, we need to convert the speed into meters per second.

$$(88*1.6) = 140.8km/h$$

$$(140.8*1000)/3600 = 39.1m/s$$

Let’s input what we know into the equation.

$$K.E. = ½*m*v^2 = ½*1230.1*(39.1)^2 = 940294.59J$$

Because the car is travelling at a constant velocity, we can say that the force is equal to the force of friction.

$$F = f$$

$$F = 4920.4N$$

Problem 2. Peeping Tom

George McFly was lying on a tree, looking through his binoculars. His mass is 82.7 kg. Suddenly, he loses grip and vertically falls onto the road after 0.7 seconds (happily, he makes it out fine). Neglect air resistance.

- With what velocity did he reach the ground (V)?
- What was the height at which George fell from (h)?
- How much work did the force of gravity do (W)?

Solution:

We can use an equation for velocity with constant acceleration. The positive axis is directed downwards.

$$V = V_0 + gt \tag{1}$$

Let's input what we know into the equation.

$$V = 0 + 10*0.7 = 7m/s$$

We can use the equation for distance (distance can be thought of as height)

$$h = V_0*t + \frac{1}{2}*g*t^2 \tag{2}$$

Let's input what we know into the equation.

$$h = 0*0.7 + \frac{1}{2}*10*0.7^2 = 2.45m$$

We can use the equation for work here:

$$W = F*d \tag{3}$$

Let's input what we know into the equation. We know the distance, only we wrote it down as "h", that is height.

$$W = F*h = 82.7*10*2.45 = 2026.15J$$

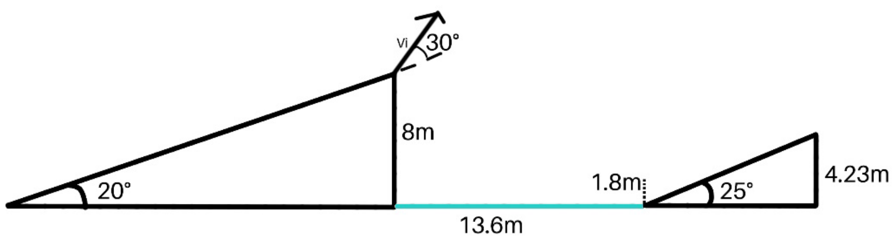
“The Red Balloon”. Physics problem solving on kinematics dedicated to the movie and called “Two Boys and the Ball”

Problem. Two boys and the ball

The first boy is running up a hill to the shore of a river. The path is 20° to the horizontal. He throws a ball at an angle of 30° to the path. The height of the cliff is 8 meters above the river, the width of the river is 13.6 meters. The second boy is standing on the other side of the river. The angle of the second bay is 25° to the horizontal (it’s a hill). The boy starts from a height of 4.23 meters above the river. That same boy catches the ball with his hands raised at the bottom of the hill, which gives a height of 1.8m above the river. (Figure 1)

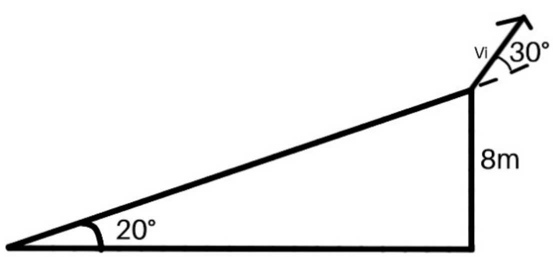
For how long was the ball in the air? With what velocity was the ball thrown? What distance does the second boy need to run for? With what acceleration does he need to run at to catch the ball? Find the value and direction of the final velocity of the ball. (Assume that $g = 10m/s^2$)

Figure 1.



Solution:

The first boy (Figure 2).



The path that the boy is running on is 20° to the horizontal. The angle that the ball is thrown at is 30° to the path. So, the angle between the initial velocity of the ball to the horizontal is equal to 20°+30°, which is equal to 50°.

Let’s find the horizontal and vertical component of the initial velocity of the ball.

$$V_x = V_i * \cos 50°$$

$$V_{iy} = V_i * \sin 50°$$

The x-component of the velocity is constant, because in the horizontal direction there is no applied force (we ignore air resistance), so $F_x = 0$, and thus the acceleration $a_x = 0$.

The y-component of the velocity will change, because in the vertical direction, there is the acceleration of gravity, g.

The range of the projectile (ball) is found as the distance of uniform motion:

$$R = V_x*t \qquad (1)$$

Since we have the height from which the ball was thrown (H = 8m), and the height over which it was caught (h = 1.8m), we have the vertical displacement of the ball.

$$\Delta y = h-H = 1.8-8 = -6.2m$$

The origin of the coordinate system, x = 0, y = 0, we will place in the point where the ball was thrown. Then:

$$\Delta y = V_{iy}*t - ½*g*t^2 \qquad (2)$$

In this equation above there are two unknowns: V_{iy} and t. We cannot solve it like this. We need to write one more equation with these two unknowns and then we will have a solvable system of equations.

For this we can use equation (1). Then the system of equations will look like this:

$$R = (V_i*\cos 50°)*t$$

$$\Delta y = (V_i*\sin 50°)*t - ½*g*t^2$$

From the first equation above, we can find V_i.

$$V_i = R/(t*\cos 50°)$$

And we can put this into equation (2).

$$\Delta y = (R*\sin 50°*t)/(*\cos 50°*t) - ½*g*t^2$$

Or

$$\Delta y = R*\tan 50° - ½*g*t^2$$

In this equation there is only one unknown, t, and we can solve for it. Let's substitute in the values that we already know.

$$-6.2 = 13.6*\tan 50° - ½*g*t^2$$

Or

$$-6.2 = 13.6*1.19 - ½*10*t^2$$

Or

$$t = (4.4768)^{1/2} = \pm 2.12s$$

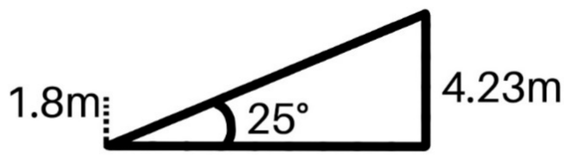
Since a negative time isn't appliable in this situation, we will take the positive time.

$$t = 2.12s$$

Knowing the time of flight of the ball, we can put it into equations (1) or (2) to find the initial velocity of the ball. We'll put it into equation (1). Then:

$$V_i = R/(t*\cos50°) = 10m/s$$

The second boy (Figure 3).



Now we need to find with which acceleration the second boy needs to run at to catch the ball at the height of raised hands which is equal to 1.8 meters.

We know the height of the hill (H_2 = 4.23m) that he is running down, and we know its angle to the horizon (Θ = 25°).

To find the acceleration that he is supposed to be running at, let's first find the distance that he needs to run. From a right triangle, the distance d can be found this way:

$$d = H_2/\sin25° = 4.32/0.42 = 10.3m$$

We know that he needs to run during t = 2.12s.

Since he was at rest on the top of the hill, his initial velocity V_{i2} = 0. Then:

$$d = V_{i2}*t + ½*a*t^2 = ½*a*t^2$$

The acceleration from this would be:

$$a = (2d)/(t^2) = 20.6/4.49 = 4.59m/s^2$$

The projectile (ball) moves on a parabolic path. The x-component of its velocity will be constant, the y-component will be changing. Let's find the x-component of the velocity.

$$V_{ix} = 10*\cos50° = 6.43m/s$$

The initial y-component of the velocity can be calculated as:

$$V_{iy} = 10*\sin50° = 7.66m/s$$

We found that the time of flight of the ball would be 2.12 seconds. Let's calculate the final y-component of the velocity.

$$V_y = V_{iy} – gt \tag{3}$$

$$V_y = 7.66 – 10*2.12 = -13.54m/s$$

Now we can find the value of the final velocity of the ball.

$$V = (V_y^2 + V_x^2)^{1/2} = ((-13.54)^2 + 6.43^2)^{1/2} = 15m/s$$

And finally, the angle between the direction of the final velocity to the horizon we can find as:

$$\tan\Theta = V_y/V_x = 2.11$$

$$\Theta = \tan^{-1}(2.11) = 64.64°$$

<u>Answers:</u>

$t = 2.12s$
$V_i = 10m/s$
$d = 10.3m$
$a = 4.6m/s^2$
$V = 15m/s$
$\Theta = 64.64°$