

The Equivalence Principle under a *MICROSCOPE*

A cartoon illustrates results from the *MICROSCOPE* satellite mission, which has measured with astronomical sensitivity the falling rate of different objects under gravity.

Matthew R. Francis is a physicist
and freelance science writer based in Virginia.

—Maki Naro is a science illustrator based in New York.

THE EQUIVALENCE PRINCIPLE UNDER A MICROSCOPE

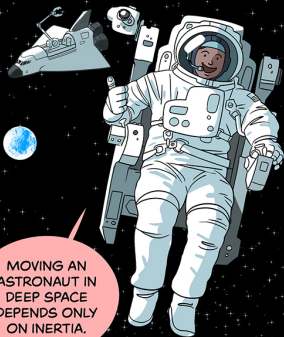
FOR TWO AND A HALF YEARS, A SMALL FRENCH SATELLITE NAMED **MICROSCOPE*** FLEW OVER THE NORTH POLE EVERY 99 MINUTES.

ITS JOB: TO TEST THE WEAK EQUIVALENCE PRINCIPLE (WEP), ONE OF THE FOUNDATIONS OF EINSTEIN'S THEORY OF GRAVITY.

**MICRO-SATELLITE À TRAÎNÉE COMPENSÉE POUR L'OBSERVATION DU PRINCIPE D'EQUIVALENCE*

PHYSICS HAS TWO KINDS OF MASS:

INERTIAL MASS, THE MEASURE OF AN OBJECT'S RESISTANCE TO BEING MOVED...



MOVING AN ASTRONAUT IN DEEP SPACE DEPENDS ONLY ON INERTIA.

...AND **GRAVITATIONAL MASS**, WHICH DETERMINES HOW MUCH GRAVITY A BODY FEELS.



GRAVITY PULLS BOTH THE AIRPLANE AND THE PERSON DOWN.

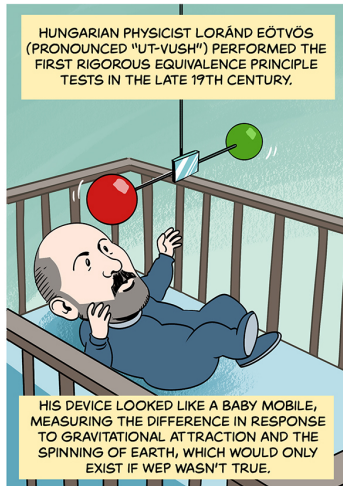
WEP SAYS THESE TWO TYPES OF MASS ARE EQUIVALENT--A RADICAL IDEA, SINCE IT IMPLIES A SPECIAL RELATION BETWEEN GRAVITY AND MASS THAT OTHER FORCES DON'T HAVE.

WEP DATES BACK TO THE 16TH CENTURY WHEN GALILEO REALIZED AIR RESISTANCE, NOT WEIGHT, WAS RESPONSIBLE FOR DIFFERENCES IN THE WAY OBJECTS FALL. WITHOUT AIR, EVERYTHING ACCELERATES THE SAME WAY.



DROPPING SCIENCE LIKE GALILEO DROPPED THE ORANGE!

HUNGARIAN PHYSICIST LORÁND EÖTVÖS (PRONOUNCED "UT-VUSH") PERFORMED THE FIRST RIGOROUS EQUIVALENCE PRINCIPLE TESTS IN THE LATE 19TH CENTURY.



HIS DEVICE LOOKED LIKE A BABY MOBILE, MEASURING THE DIFFERENCE IN RESPONSE TO GRAVITATIONAL ATTRACTION AND THE SPINNING OF EARTH, WHICH WOULD ONLY EXIST IF WEP WASN'T TRUE.

ALBERT EINSTEIN BUILT HIS THEORY OF GENERAL RELATIVITY ON WEP IN 1915, IMAGINING A SCENARIO FROM

BECAUSE FOR AN OBSERVER IN FREE FALL FROM THE ROOF OF A

ANY EXPERIMENT PERFORMED DURING FREE FALL WILL BEHAVE LIKE IT WOULD IN A SITUATION WITH NO GRAVITATIONAL FORCES ACTING ON IT AT ALL!