

# **ALBERT EINSTEIN SINGS THE GREAT AMERICAN SONGBOOK**

**A Musical Revue Featuring His Secrets of  
Happiness, Relativity, White Holes, Black Holes,  
Gravitation, Dark Energy, and Cosmic Vice**

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**SCENE:**

An attractive Female Astrophysicist **LECTURER** stands behind a podium. She is giving a witty ‘public-understanding-of-science’ talk entitled “Albert Einstein: Rock Star” about his life and work. The theater audience, eavesdropping, is also the audience for the talk. The slides that accompany her talk appear behind her on a large screen, and she uses a laser pointer.

**Stage Left** is an elderly, somewhat disheveled, version of Albert Einstein a few years before his death. He wears no socks. When he speaks or sings, a spotlight illuminates him.

**Stage Right** is a youthful, somewhat formal, version of Albert Einstein in his forties. When he speaks or sings he is illuminated by a spot.

**ELDERLY EINSTEIN** and **YOUTHFUL EINSTEIN** comment on the **LECTURER’S** talking points, correct her when necessary, and approve of her shapely good looks. Sometimes she responds to their comments, sometimes she ignores them. The two **EINSTEINS** address each other and ignore her occasionally.

Theme music (FAÇADE, A POPULAR SONG, by Sir William Walton, 2:13) plays over and under the **LECTURER’S** opening words.

**LECTURER:**

THANK YOU FOR THAT LOVELY INTRODUCTION. AS LYNDON JOHNSON SAID, “MY FATHER WOULD HAVE LOVED IT, AND MY MOTHER WOULD HAVE BELIEVED IT.”

THANKS TO OUR SPONSORS [insert name(s) of local institution(s)].

PLEASE NOTICE **SLIDE 1**, WHICH REVEALS A FEW MODERN INVENTIONS... THE WHEEL, AIR CONDITIONING... LET ME ASK THE AUDIENCE: WHAT DO YOU THINK WAS THE GREATEST INVENTION OF ALL TIMES? [PAUSE] MEL BROOKS SAID IT WAS SARAN WRAP. SOME JOKER SAID IT WAS THE THERMOS JUG, BECAUSE ‘WHEN YOU PUT HOT STUFF IN, IT SAYS HOT; WHEN YOU PUT COLD STUFF IN IT STAYS COLD— AND WHAT’S MORE IT KNOWS WHEN TO DO WHAT’. MY FRIEND SAID ‘VENETIAN BLINDS, BECAUSE WITHOUT THEM IT’D BE CURTAINS FOR ALL OF US’.

**SLIDE 2:** HERE’S ALBERT EINSTEIN’S ANSWER...

“*COMPOUND INTEREST!*” MAYBE THAT’S WHY HE’S SMILING.

{OH! I ALMOST FORGOT. MY TWO GUESTS. ON MY LEFT, ALBERT EINSTEIN, THE ELDER. ON MY RIGHT, ALBERT EINSTEIN, THE YOUNGER. THEY KNOW EACH OTHER. }

WHAT ARE WE TO MAKE OF A MAN WHO SAYS THAT IF HIS THEORY IS WRONG, HE FEELS SORRY FOR THE DEAR LORD? IS THAT CONFIDENCE, ARROGANCE,...OR GENIUS? A MAN WHO SAYS: “TO PUNISH ME FOR MY CONTEMPT FOR AUTHORITY, THE FATES MADE ME AN AUTHORITY?” WHAT ARE WE TO MAKE OF A MAN WHO SAYS: “ONCE YOU KNOW

THE UNIVERSE IS MATTER EXPANDING INTO NOTHINGNESS,  
WEARING PLAID WITH STRIPES BECOMES EASY”?

**ELDERLY EINSTEIN:**

I SAID THAT? I DON'T REMEMBER!

**YOUNG EINSTEIN:**

OF COURSE YOU SAID THAT...WHEN YOU WERE MY AGE!  
YOU'RE REALLY GETTING RUSTY. YOU USED TO HAVE SOME  
BITE IN YOUR APHORISMS. I, ON THE OTHER HAND...

**LECTURER:**

GENTLEMEN! PLEASE!

THERE ARE TWO KINDS OF GENIUS: THE ORDINARY KIND,  
LIKE YOU AND ME, ONLY A LOT SMARTER...AND THEN  
THERE'S THE MOZARTS AND EINSTEINS...AS IF THEY CAME  
FROM ANOTHER PLANET. MOZART COULD COMPOSE A  
SYMPHONY WHILE PLAYING A GAME OF BILLIARDS.  
EINSTEIN WROTE FOUR PAPERS IN ONE YEAR, 1905, EACH OF  
WHICH WAS WORTHY OF A NOBEL.

**ELDERLY EINSTEIN:**

I AM NOT REALLY A GENIUS. NOT SMARTER THAN  
EVERYONE ELSE. I JUST STAYED WORKING ON A PROBLEM  
LONGER.

**YOUNG EINSTEIN:**

YES! WHY SHOULD I BE HONORED SO MUCH FOR ONLY  
DOING WHAT CAME NATURALLY TO ME. FAME AND GENIUS!  
WHAT A LIABILITY.

**LECTURER:**

HERE, ON **SLIDE 3**, YOU SEE HOW CELEBRITY CAME TO EINSTEIN. IN 1919, SIR ARTHUR EDDINGTON, BRITISH ASTRONOMER, MOUNTED AN EXPEDITION WHICH CONFIRMED A PREDICTION EINSTEIN MADE IN 1915, THAT STARLIGHT SHOULD BE BENT BY THE GRAVITATIONAL FIELD OF OUR SUN. THIS RESULT HAS BEEN CONFIRMED MANY TIMES. THE ANGLE OF BENDING YOU SEE IN THE LOWER LEFT CORNER OF THE SLIDE [**LASER POINTER INDICATES**] IS THE ANGLE MADE BY A QUARTER SEEN FROM A DISTANCE OF FOUR MILES.

**YOUNG EINSTEIN SINGS*****“GRAVITY’S TUG” (“It Was Just One Of Those Things”)***

(1) It was **just** gra/vi/ty’s **tug**//Ac/tual/ly, not ev/en a **hug**

A **bend** in the beam //Of **star**/light a/**bove**

Just **gra**/vi/ty’s **tug**

(2) So small, like an **inch**//At four miles a/**way**, not a **cinch**

Ce/**le**/brity came, to **Al** from that sight

Pub/li/ci/ty, fam/ous/ly **right**.

(3) I’m Sir **Ar**/thur Ed/ding/**ton**

Un/der/**stood** rel/a/**tiv**/i/ty then

It was such fun//It was **just** one of those **things**.####

**LECTURER:**

THANK YOU. BRAVO!

HERE, IN **SLIDE 4**, YOU SEE THE HEADLINES FROM THE NEW YORK TIMES, FOLLOWING EDDINGTON'S CONFIRMATION, IN NOVEMBER, 1919. THIS IS HOW A QUIET, HUMBLE MAN BECAME A CELEBRITY. IN 1921, EINSTEIN COMES TO AMERICA.

**YOUNG EINSTEIN SINGS**

“RELATIVITY'S TRUE” (“If This Isnt Love)

Rel/a/**tiv**/i/ty's true// Or I'll **eat** my **hat** for **din**/ner

Space is **ac**/tual/ly **curved**//Or I'm **just** a be/**gin**/ner

Star-light's **ben**/ding's a proof //That I'm really a **win**/ner

I'm a **shoe**-in for the **No**/bel//And the **theo**/ry's going **glo**/bal

It's cor/**rect**! It's cor/**rect**! It's cor/**rect**!####

**LECTURER:**

JOURNALISTS ARE ENCHANTED, BEWITCHED, CHARMED, AND AWED BY HIS QUOTE “STRAIGHTFORWARD SIMPLICITY, KINDLINESS, PATIENCE, GENUINE MODESTY, AND NAÏVE HUMOR, WHICH ALMOST MADE ONE LOSE SIGHT OF HIS *TRANSCENDENT MENTAL POWER*”. UNQUOTE. THEY COULD NOT GET ENOUGH OF HIM. HERO WORSHIP ENVELOPED HIM. HIS VISIT WAS A PUBLIC RELATIONS BONANZA, A HOME RUN. HE WAS OVERWHELMED.

## **LECTURER SINGS**

“**STAR STRUCK**” (“The Physician”, Cole Porter)

(1) On **Ein**/stein **fate** had **played** a strange **trick**

De/**flec**/ted **star**/light wowed ev’ry/**one**

Sud/den/**ly** as/**tron**/o/my showered ce/**le**/bri/ty

He ac/**cep**/ted it re/**luc**/tant/**ly**

(2) Es/sen/tial/**ly** a **sim**/ple man, **he**

All he **wan**/ted was pri/va/**cy**

He sought some **peace** and **qui**/et

But the **pub**/lic would/n’t **buy** it

A **star** had **made** him into a **star**!#####

## **LECTURER:**

[SHE BOWS. SMILES]

MY DEFINITION OF A ROCK STAR: A PERSON WHO INSPIRES INTENSE ADMIRATION. IF YOU GOOGLE “ALBERT EINSTEIN” OR “THE BEATLES” YOU GET OVER 100MM HITS.

IN **SLIDE 7**, YOU SEE HIM BEING TREATED LIKE ROYALTY. GIVEN THE KEYS TO NEW YORK CITY IN 1921. HE’S A SUPER-STAR. TODAY, WE’D SAY ROCK-STAR.

EINSTEIN WAS MY CHILDHOOD HERO. {I BECAME A PHYSICIST BECAUSE OF HIS BEGUILING IDEAS.}

## **ELDERLY EINSTEIN:**

I HAD A STRANGE KIND OF MIDAS TOUCH... EVERYTHING I SAID TURNED MAGICALLY INTO PRINT. HISTORIAN STUDS

TURKLE SAID “YOU CAN’T GO WRONG QUOTING EINSTEIN”...ON ANY TOPIC! PAPAL INFALLIBITY? FOR A JEW?

**LECTURER:**

IN **SLIDE 10** YOU SEE YOUNG EINSTEIN IN 1931 WITH SUPER-STAR CHARLIE CHAPLIN, AT A GALA CELEBRITY OPENING OF CHAPLIN’S MOVIE “CITY LIGHTS”.

**ELDERLY EINSTEIN:**

I REMEMBER! CHAPLIN SAID TO ME, “THE CROWDS ARE CHEERING ME BECAUSE THEY UNDERSTAND ME. THEY ARE CHEERING YOU BECAUSE THEY DO NOT UNDERSTAND YOU”. SO I ASKED HIM “WHAT DOES ALL THIS ADULATION MEAN?” HE ANSWERED, “ABSOLUTLY NOTHING”.

**LECTURER:**

MANY YEAR LATER, WHEN J. ROBERT OPPENHEIMER LEFT THE MANHATTAN PROJECT AND WAS HEAD OF THE INSTITUTE FOR ADVANCED STUDY WHERE EINSTEIN WORKED, OPPENHEIMER WROTE THST EINSTEIN WAS “FRIENDLY, LONELY, STRANGE, AND HAD A LUMINOUS MIND.”

**ELDERLY EINSTEIN:**

WELL, I LIKED OPPIE ANYWAY. VERY HIGH-STRUNG MAN. {SMOKED AND DRANK A LOT. TOO BAD HE LOST HIS SECRET CLEARANCE. }



**LECTURER:**

EINSTEIN OFTEN COMPLAINED ABOUT BEING ACCOSTED BY REPORTERS WANTING TO INTERVIEW HIM. IN 1927, HE WROTE THIS POEM, ACTUALLY DITTY, ORIGINALLY IN GERMAN. **SLIDE 14**

**YOUNG EINSTEIN SINGS**

**“EINSTEIN’S LAMENT”**

(1) Wher/**ev**/er I **go**, and wher/**ev**/er I **stay**//

There’s **al**/ways a **pic**/ture of me on dis/**play**//

On **top** of the desk, or **out** in the **hall**//

**Tied** round my **neck**, or **hung** on the **wall**//

(2) Some/times, sur/round/ed by all this good cheer//

I’m puzz/led by some of the things that I hear//

And won/der, my mind for a mo/ment, not hazy//

If I, and not they, could really be cra/zy.####

**YOUNG EINSTEIN: [ANGRILY]**

THANK YOU. THOSE REPORTERS! THEY ALL WANTED MY BLOOD FOR THEIR INK! ONE STOPPED ME AND ASKED IF HE COULD INTERVIEW ME. I SAID “I’M NOT EINSTEIN.” HE SAID, “YES YOU ARE! I’VE SEEN YOUR PICTURES IN ALL THE NEWSPAPERS.” SO I SAID TO HIM, “WHO SHOULD KNOW BETTER—YOU OR ME!” LATER, I LEARNED TO LIE: “SOME PEOPLE SAY I RESEMBLE HIM.”

**LECTURER:**

I LEARNED RELATIVITY FROM THIS MAN **SLIDE 15**  
 PROFESSOR BANESH HOFFMANN, EINSTEIN'S COLLEAGUE,  
 FRIEND, AND CO-AUTHOR. HE TOLD ME THAT WHEN HE  
 AND EINSTEIN WORKED TOGETHER ON THE COMPLICATED  
 EQUATIONS OF GENERAL RELATIVITY, EVEN EINSTEIN  
 WOULD HAVE DIFFICULTIES. WHEN THEY CAME TO A  
 MATHEMATICAL IMPASSE, BANESH SAID EINSTEIN WOULD  
 GET UP, PACE THE FLOOR, TWIST HIS LONG HAIR, SAYING, "I  
 VEEL A LEETLE THEENK". AFTER A FEW MINUTES OF  
 TWIRLING AND PACING, HE WOULD FIGURE OUT WHAT TO  
 DO. BANESH SAID THAT AFTER EINSTEIN DIED, WHEN HE  
 WAS WORKING ON THE SAME EQUATIONS AND GOT STUCK,  
 HE WOULD TRY TWIRLING AND PACING. BUT, HE SAID, "IT  
 NEVER WORKED!" OBVIOUSLY, GENIUS IS EASY IF YOU'RE  
 BORN WITH IT, BUT IT'S NOT TRANSFERABLE.

**YOUNG EINSTEIN:**

LIKE THAT WORN OUT OLD MAN SAID [POINTS ACROSS THE  
 STAGE TO ELDERLY EINSTEIN] WE'RE *NOT* GENIUSES! WE  
 SIMPLY PERSIST!

**LECTURER:**

{GOOD 'TAKE-AWAY' LESSON FOR YOU YOUNG PEOPLE IN  
 THE AUDIENCE. I MEAN, LECTURE HALL} OF COURSE, ONLY  
 GENIUSES WOULD SAY THEY WEREN'T GENIUSES.

**ELDERLY EINSTEIN:**

YOU KNOW, YOUNG PEOPLE. [STEPS FORWARD. SPEAKS  
 WITH GREAT PASSION] YOU SHOULD PAY ATTENTION!

THIS YOUNG GUY [**POINTS**] IS TELLING YOU SOMETHING TRULY IMPORTANT. STAY WITH A PROBLEM UNTIL YOU CRACK IT OPEN. {YOUNG PEOPLE NOWADAYS ARE LAZY, ADDICTED TO ENTERTAINMENT. I'M TALKING TO A WALL}

**LECTURER:**

LOOK AT **SLIDE 16!** THESE ARE THE *FOUR* NOBEL-WORTHY PAPERS EINSTEIN PUBLISHED IN ONE “MIRACLE YEAR”, 1905. I’LL DISCUSS THESE AT THE END OF MY TALK...FOR THOSE INTERESTED.

REMEMBER STUDYING PLANE GEOMETRY BACK IN HIGH SCHOOL? EUCLID? HE BEGAN WITH BUILDING BLOCKS, LIKE LEGOS, TINKER TOYS, ERECTOR SETS...WHICH HE CALLED AXIOMS, POSTULATES, OR ASSUMPTIONS. NEWTON DID THE SAME WITH HIS THREE LAWS: “OBJECTS AT REST TEND TO STAY AT REST,  $F=MA$ , TO EVERY ACTION THERE IS AN EQUAL BUT OPPOSITE REACTION”. (OR, MY POLITICALLY INCORRECT VERSION: “TO EVERY PHD THERE IS AN EQUAL AND OPPOSITE PHD”.)

WELL, EINSTEIN DID THE SAME. HE SUMMARIZED RELATIVITY IN THREE COMPACT AXIOMS. **SLIDE 18** IMAGINE A CAR COLLISION AT NOON, EASTERN STANDARD TIME AT BROADWAY AND 42<sup>ND</sup> STREET. I CAN ALSO DESCRIBE THE SAME COLLISION BY SAYING IT OCCURRED AT 40 DEGREES NORTH LATITUDE, 70 DEGREES WEST LONGITUDE, GREENWICH MEAN TIME. THE PHYSICS OF THE COLLISION IS THE SAME -- NO MATTER WHAT COORDINATES WE USE TO DESCRIBE THE EVENT. EINSTEIN CALLS THIS

THE LAW OF INVARIANCE: THE LAWS OF NATURE ARE THE SAME FOR ALL SPACE-TIME COORDINATES!

**ELDERLY EINSTEIN:**

SHE'S VERY CHARMING. I WISH I WAS YOUNGER.

**YOUNG EINSTEIN:**

I AM YOUNGER. SHE'S STILL VERY CHARMING. MAYBE AFTER HER TALK, SHE AND I COULD HAVE A TEENY TETE-A-TETE IN THE GREEN ROOM BACK-STAGE.

**ELDERLY EINSTEIN:**

GOOD LUCK! LET ME KNOW HOW IT TURNS OUT. I HOPE TIME TRAVEL IS NOT RULED OUT BY PHYSICS. THEN I COULD JOIN YOU AND HER IN A TETE-A-TETE-A-TETE!

**LECTURER:**

GENTLEMEN! YOUR ATTENTIONS ARE VERY FLATTERING. BUT I HAVE A BOYFRIEND. NAME OF STEPHEN HAWKING. HE FORMULATED THE SO-CALLED "CHRONOLOGY PROTECTION CONJECTURE" WHICH SAYS THE LAWS OF PHYSICS PREVENT THE CEATION OF TIME MACHINES. SO SORRY: NO BACKWARD TIME TRAVEL IS POSSIBLE.

LET'S MOVE ALONG. IN 1887, MICHELSON AND MORLEY'S EPIC EXPERIMENT DISCLOSED THE TRULY *STARTLING* RESULT THAT THE SPEED OF LIGHT IS INDEPENDENT OF THE SPEED OF THE SOURCE OF THE LIGHT AND INDEPENDENT OF THE SPEED OF THE RECIPENT OR THE OBSERVER OF THE LIGHT. **SLIDE 19** THIS IS EINSTEIN'S SECOND POSTULATE, AND IT'S RESPONSIBLE FOR CHALLENGING HOW WE VIEW

TIME, LENGTH, MASS, AND ENERGY. YOU KNOW HOW FAST THE SPEED OF LIGHT IS? ONE LIGHT-YEAR PER YEAR!

EINSTEIN'S THIRD POSTULATE **SLIDE 20**, HIS EQUIVALENCE PRINCIPLE, SAYS THAT GRAVITATION IS A PROFOUND FORM OF GEOMETRY, AS I WILL SHOW SHORTLY IN A SIMPLE THOUGHT EXPERIMENT AND AN ACTUAL DEMONSTRATION.

**YOUNG EINSTEIN SINGS**

**“PHYSICS IS HARD”** (“It Had To Be You”)

(1) I'm **twis/ting** my **hair//**

A **prob/lem's** just **there**

Life at the **brink**

Trying to **think**

Think hard, just **think**.

(2) It's not about **me**

It's ab/out **it**

**Grav/i/ty's rough**

**Phys/ics is tough**

For all phys/i/**cists**

We **huff** and we **puff**

**Phys/ics is tough!####**

**LECTURER:**

YOU SEE? EVEN *HE* THINKS IT'S HARD. LET ME SHOW YOU. SPECIAL RELATIVITY IS HARD TO WRAP YOUR MIND AROUND.

CHECK OUT **SLIDE 21**. THIS IS HOW EINSTEIN EXPLAINS WHY TIME APPEARS TO SLOW DOWN, DEPENDING ON WHO IS LOOKING. IN THE LEFT PART OF THE SLIDE [**USES LASER POINTER**] YOU SEE WHAT AN OBSERVER ON A TRAIN WOULD SEE IF HE MADE A LIGHT BEAM MOVE FROM THE FLOOR OF THE MOVING TRAIN TO A MIRROR ON THE CEILING OF THE MOVING TRAIN. THIS EVENT, A LIGHT BEAM BOUNCING UP AND DOWN ONCE, COULD BE CONSIDERED THE TICK OF A CLOCK. THE WOMAN OBSERVER ON THE TRAIN STATION SEES WHAT YOU SEE ON THE RIGHT HAND OF THE SLIDE [**LASER POINTER POINTS AT IT**]. SHE WOULD NOTICE THAT THE LIGHT BEAM WOULD MOVE IN A SLANTED BUT LONGER PATH *AT THE SAME CONSTANT SPEED OF LIGHT THAT THE MAN IN THE TRAIN WOULD MEASURE*, SO SHE WOULD OBSERVE THAT THE SAME LIGHT BEAM WOULD TAKE LONGER TO TRAVEL AS SEEN FROM THE PLATFORM THAN HE OBSERVED. THUS HER CLOCK-TICK AND HER TIME WILL BE SLOWER FROM HER VANTAGE!

**YOUNG EINSTEIN:**

NOT BAD!

**ELDERLY EINSTEIN:**

ARE YOU TALKING ABOUT HER EXPLANATION?... OR HER?

**LECTURER:**

TIME APPEARS TO A STATIONARY OBSERVER TO SLOW IN MOVING SYSTEMS (LIKE THE TRAIN). BUT ALSO TO AN OBJECT IN A STRONG GRAVITATIONAL FIELD. IN **SLIDE 22** LIGHT TAKES LONGER TO TRAVEL “C” TO “D” ALONG THE BOTTOM CURVED LINE [**LASER POINTER**] BECAUSE, REMEMBER, GRAVITY BENDS LIGHT. SO THESE TWO

DIFFERENT TIME DILATIONS, ONE FROM SPECIAL RELATIVITY AND ANOTHER ARISING FROM GENERAL RELATIVITY, MAKE GLOBAL POSITION SATELLITES POSSIBLE! IF THE GPS IN YOUR POCKET IS NOT CORRECTED FOR BOTH OF THESE EFFECTS, IT'S USELESS. EVERYWHERE YOU TAKE YOUR SMART PHONE, EINSTEIN'S WITH YOU... TO ETERNITY! {WOODY ALLEN SAID "ETERNITY IS A VERY LONG TIME—ESPECIALLY NEAR THE END!}

**YOUNG EINSTEIN:**

IMAGINE THAT!

**ELDERLY EINSTEIN:**

WE'RE IN HER POCKET!

**LECTURER:**

HERE'S ANOTHER STRANGE FEATURE OF RELATIVE MOTION... SIMULTANEOUS EVENTS LOOK DIFFERENT, DEPENDING ON WHO IS DOING THE OBSERVING. LOOK AT **SLIDE 23**. THE UPPER OBSERVER INSIDE THE TRAIN SEES THE LIGHT BEAM ORIGINATING IN ITS CENTER STRIKE THE FRONT AND BACK OF THE TRAIN "SIMULTANEOUSLY", BUT THE PLATFORM OBSERVER LOWER PART OF DIAGRAM [LASER POINTER] DOES NOT.

**YOUNG EINSTEIN:**

THAT IS WHY I ASKED A TRAIN CONDUCTOR, "DOES OXFORD STOP AT THIS TRAIN?"

**ELDERLY EINSTEIN:**

YOU WERE ALWAYS MAKING FUN, EVEN OF YOUR TEACHERS. THAT'S WHY THEY EXPELLED YOU FROM SCHOOL.

**LECTURER:**

I CANNOT EASILY PROVE  $E=MC^2$  FOR YOU BRIEFLY, BUT HERE IT IS ON THE CARRIER OF THE FIRST NUCLEAR-POWERED AIRCRAFT CARRIER, THE ENTERPRISE!

NOW, LET'S LOOK AT EINSTEIN'S WORK IN COSMOLOGY. BUT FIRST...

**SLIDE 25** BACK IN THE 2<sup>ND</sup> -3<sup>RD</sup> CENTURY, PTOLEMY THOUGHT THAT THE STARS AND PLANETS ARE ATTACHED TO GLASS SPHERES THAT REVOLVE AROUND THE EARTH AS THE CENTER OF THE UNIVERSE.

JUMPING AHEAD TO THE 18<sup>TH</sup> CENTURY, HEINRICH OLBERS ASKED 'WHY ISNT THE NIGHT SKY BRIGHT?' HE REASONED THAT IF THE UNIVERSE IS INFINITE AND IF THERE'S AN INFINITE NUMBER OF STARS, THEN EVERY SIGHT-LINE FROM OUR EYES SHOULD TERMINATE ON A STAR, WHETHER NEAR OR FAR, AS IN **SLIDE 25**. {IMAGINE BEING IN A DENSE FOREST AND ALL YOU CAN SEE ARE TREES IN EVERY DIRECTION ALL THE WAY OUT TO INFINITY}. SO WHAT'S WRONG WITH THIS PICTURE? [**PAUSE**] THE UNIVERSE IS *NOT* INFINITE; IT'S ABOUT 40 BILLION LIGHT-YEARS IN SIZE. AND THERE ARE *NOT* AN INFINITE NUMBER OF STARS; ONLY ABOUT A HUNDRED MILLION STARS IN OUR MILKY WAY GALAXY, AND ABOUT A HUNDRED MILLION GALAXIES.



## YOUNG EINSTEIN AND ELDERLY EINSTEIN:

WE DID NOT KNOW THAT! A LOT HAPPENED SINCE WE DEPARTED IN 1955!

### LECTURER:

HERE'S AN ARTIST'S VERSION OF THE BIG BANG, THE CURRENT VIEW OF OUR COSMOS IN **SLIDE 27**. AT THE LEFT [**LASER POINTER**] YOU SEE WHAT WE CALL A "WHITE HOLE", THE OPPOSITE OF A BLACK HOLE. ABOUT 14 MILLION YEARS AGO, MATTER IS CREATED OUT OF NOTHING, COAGULATES GRAVITATIONALLY INTO STARS; NUCLEAR FUSION EVOLVES THE STARS, WHICH CONGREGATE INTO GALAXIES; AND THEY ACCELERATE, EXPANDING THE VISIBLE UNIVERSE INTO NOTHINGNESS. STEPHEN HAWKING SAID THAT ASKING WHAT HAPPENED BEFORE THE BIG BANG IS LIKE ASKING "WHAT IS SOUTH OF THE SOUTH POLE?"

### STEPHEN HAWKING SINGS

"THERE'S NO SOUTH" ("Stormy Weather")

A

There's no **South**

Un/der/**neath** the cold South **Pole**

That's an **im**/age

Of **what** came a/**head**

Of the **Big** Bang

That sug/**gests**, there was **no**/thing be/**fore** it.

A

Sor/ry **folks**, that **is** just what it **is**

No pre/**ten**/ding

Does/n't look **good** for Re/li/gion

Who **knows** what the **truth** is now/ow

Keeps happening all the **ti-i-me**

B

Since the Big Bang **came**, and went a/**way**

**Four**/teen bil/lion years ...a/**go**... to/**day**

You know how time **flies** a/**way** a/**way**

**Some**/thing came from **no**/thing...**Hey!**

A

Gotta **go**

**Ev**/ry/thing that **sci**/ence knows changes **quick**/ly

Da/ta can be ve/ry **prick**/ly

Keeps chan/gin' all the time

Keeps chan/gin' all the time.#####

## **LECTURER:**

THANKS, SWEETHEART! [**SHE BLOWS HIM A KISS**] SEE YOU LATER... [**SEDUCTIVELY**] YOU KNOW WHERE.

CHECK OUT **SLIDE 28**. STARS EVOLVE INTO BLACK HOLES, NEUTRON STARS, AND SUPERNOVAE—CATAclysmic EXPLOSIONS THAT EJECT HIGHLY ENERGETIC NUCLEAR PARTICLES AND CHEMICAL ELEMENTS AND RADIATION. THEY PERMEATE THE UNIVERSE. THEY'RE CALLED COSMIC RAYS, DR. ROSEN'S SPECIALTY. SOME OF THEM FIND THEIR WAY TO US HERE ON EARTH, CREATING COSMIC RAY "SHOWERS" IN OUR ATMOSPHERE THAT SPREAD OUT OVER MILES... YOU MIGHT SAY THEY ARE AN ALPHABET FOR THE LANGUAGE THAT STARS USE TO COMMUNICATE WITH US.

NOW, PLEASE EXAMINE **SLIDE 29**. EINSTEIN SAID THIS IDEA, THAT THERE IS NO DIFFERENCE BETWEEN ACCELERTION OR

GRAVITATION. **[LASER POINTER TOGGLES BACK AND FORTH BETWEEN TWO ROCKET SHIPS.]** THERE IS NO EXPERIMENT THAT EITHER GUY CAN DO INSIDE EACH CAPSULE THAT WOULD REVEAL WHETHER THEY ARE ACCELERATING UPWARD, OR AT REST ON A PLANET. THIS IS THE THIRD EINSTEIN POSTULATE, THE PRINCIPLE OF EQUIVALENCE. NOTICE THE LIGHT BEAM ENTERING THE ACCELERATING ROCKET SHIP APPEARS TO DROP SLIGHTLY {BECAUSE THE SHIP MOVES UP IN THE SHORT TIME IT TAKES THE BEAM TO TRAVERSE THE SHIP} IMPLYING, BY EQUIVALENCE, THAT GRAVITY BENDS LIGHT! TA DA! {BRING ON THE TRUMPETS!}

I'M GOING TO LET DR. EINSTEIN DEMONSTRATE HIS EQUIVALENCE PRINCIPLE... **SLIDE 30...** USING A BIRTHDAY PRESENT GIVEN TO HIM SHORTLY BEFORE HE DIED. THE ORIGINAL IS ON THE LEFT **[LASER POINTER]**. YOU CAN SEE A WEIGHT IS HANGING BY A STRING ATTACHED TO A LONG SPRING INSIDE A LONG TUBE. ON THE RIGHT SIDE OF THE SCREEN **[LASER POINTER]** IS DR. ROSEN'S COPY {MADE IN HIS BASEMENT WORKSHOP OF YARD SALE MATERIALS...A FUNNEL, A PVC PIPE, AND SO ON}

### **ELDERLY EINSTEIN:**

“NOW I WILL LET THE TUBE DROP, AND ACCORDING TO THE EQUIVALENCE PRINCIPLE, THERE WILL BE NO GRAVITATIONAL FORCE [DURING IT'S FREE FALL] SO THE SPRING WILL NOW BE STRONG ENOUGH TO BRING THE WEIGHT INTO THE PLASTIC FUNNEL”

**[ELDERLY EINSTEIN DEMONSTRATES THE DEVICE, WHICH ERASES GRAVITY BRIEFLY, AND THE WEIGHTERUBBER DUCKY GET'S SUCKED INTO THE**

**FUNNEL WITH A LOUD PLOP! HE SMILES RADIANTLY AND GIVE THE AUDIENCE A SHY EUROPEAN BOW.]**

**LECTURER:**

[TO THE AUDIENCE/LECTURE HALL] SHALL WE GIVE DR. EINSTEIN A HAND? ANOTHER WAY TO EXPLAIN THIS IS TO SAY THAT THERE ARE TWO KINDS OF MASS... GRAVITATIONAL MASS, AND INERTIAL MASS.

**YOUNG EINSTEIN SINGS:**

“TWO KINDS OF MASS”

(“If This Isn’t Love”, Finian’s Rainbow, Burton Lane, Yip Harburg)

There are two kinds of mass//

One re/sists being shifted

In/er/tial mass is its name//

The other re/sists being lifted

Grav/i/ta/tion/al mass//

It’s what keeps us all ground/ed

Both of them are the same//

dif/fring on/ly in their name

Ein/stein proved, you’ll ap/prove//Check this out

{Here’s what he says...//Look at two rocket ships

{One’s on firm ter/ra fir/ma//

{Other’s ac/cele/rating up/wards

{Einstein says “From in/side//

{You can’t tell any dif/ference”}

{The two kinds of mass/Are the same/are the same

{Yes they are, CUE-EE DEE.}####

**LECTURER:**

THANK YOU! NOW I'M GOING TO SING A FRIVOLOUS SONG FOR YOU, IN THE SATIRIC STYLE OF TOM LEHRER. HOW MANY IN THE AUDIENCE REMEMBER HIM? [PAUSE] FROM LONG AGO?

**LECTURER SINGS:**

“WHY DO FOLKS FALL DOWN?”

(“Why Do I Love You?” from Showboat, Kern & Hammerstein)

(1) Why do folks fall down?

Why don't they fall up?

Ar/is/tot/le says, they want to go home

New/ton says it's grav/i/ta/tion

Ein/stein says it's space-time curv/ing

(2) Dar/win thinks a lot

About this ques/tion too

Ev/o/lu/tion is

His an/swer, that's true:

Peo/ple that fall up, up, up high”

“Do not re/pro/duce and that's why.”####

**LECTURER:**

THANK YOU!

**[DEEP BOW, SHOWING CLEAVAGE. BOTH EINSTEINS STARE]**

I MENTIONED SPACE-TIME CURVING. HOW DOES ONE MEASURE THE CURVATURE OF SPACE? IN **SLIDE 31**, ON THE LEFT SIDE OF THE SCREEN [**LASER POINTER POINTS**] IS A RIGHT TRIANGLE INSCRIBED ON A LATEX RUBBER GLOVE RESTING ON A FLAT PLANE SURFACE. [**HOLDS & SHOWS ACTUAL MODEL**] ON A FLAT SURFACE, A RIGHT TRIANGLE HAS THE SPECIAL PYTHAGOREAN PROPERTY THAT THE SUM OF THE SQUARES OF THE SIDES EQUALS THE SQUARE OF THE HYPOTENUSE. NINE PLUS SIXTEEN EQUALS TWENTY-FIVE.

ON THE RIGHT SIDE OF THIS SLIDE, AND ON THE MODEL I'M HOLDING, THE LATEX TRIANGLE IS STRETCHED ONTO A SPHERICAL SURFACE, THIS VOLLEYBALL. YOU CAN SEE THAT THE PYTHAGOREAN THEOREM DOES NOT WORK ON A SURFACE THAT IS CURVED PERPENDICULAR TO THE ORIGINAL FLAT PLANE OF THE GLOVE. SO THE AMOUNT OF DEPARTURE FROM "PYTHAGOREAN-ICITY" IS A MEASURE OF THE CURVATURE OF THE TWO-DIMENSIONAL SURFACE. THIS IS A METAPHOR, ANALOGY, SIMILE FOR WHAT HAPPENS IN FOUR DIMENSIONS WHERE TIME CANNOT BE IMAGINED AS PERPENDICULAR TO THE THREE DIMENSIONS OF SPACE. DO NOT WASTE YOUR TIME TRYING THIS AT HOME ALONE, TRYING TO VISUALIZE THIS IN FOUR DIMENSIONS. THE MATHEMATICS DOES THIS FOR US INSTEAD.

**YOUNG EINSTEIN:**

NOT BAD. THAT CURVATURE OF HER SPACE.

**ELDERLY EINSTEIN:**

GLAD YOU STILL FEEL THAT WAY ABOUT CURVES.

**LECTURER:**

HERE, IN **SLIDE 32**, IS HOW EINSTEIN'S SPACE CURVATURE EXTENDS OUR VIEW OF THE UNIVERSE, BY MAGNIFYING THE IMAGES OF DISTANT GALAXIES, USING LINE-OF-SIGHT GALAXIES AS GRAVIATATIONAL LENSES.

**YOUNG EINSTEIN SINGS**

“IDEAS ARE NO BIG DEAL” [“No Other Love Have I”]

(A) I/deas are **no** big deal//I/deas I deep/ly **feel**

I **did**/n't in/**vent** the wheel {*But I could have*}

**Phys**/ics is **al**/ways **real**

(A) **Em** see squared **e**/quals “**E**”// **En**/er/gy isn't **free**

In/**side** mass it's **froz**/en **E**

Not **ob**/vi/**ous** to **see**

(B) Wo/men like to **share** my name//Or they like to **share** my fame

Who knows, who knows// What wo/men **want**?

(B) But **i**/deas for **me** come **first**//From **in**/side my head they **burst**

My **wives** think that I am **cursed**//In **physics** I am **immersed**.

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**LECTURER:**

YOU DO NOT NEED TO READ MUSICS TO UNDERSTAND OR TO LOVE MUSIC. YOU DO NOT NEED TO UNDERSTAND MATHEMATICS TO UNDERSTAND THE IDEA INSIDE OF AN EQUATION. NEWTON'S LAW OF GRAVITATION "TELLS" YOU WHAT GRAVITATION "DOES". [LASER POINTS AT TOP EQUATION] EINSTEIN'S FIELD EQUATIONS [LASER POINTS AT SECOND EQUATION] "SHOWS" YOU WHAT GRAVITATION "IS".

DON'T "TELL" ME THE MOON IS SHINING. "SHOW" ME THE GLINTS OF SILVER ON THE SHARDS OF BROKEN GLASS. {CHECKOV ADVISED} NEWTON TELLS. EINSTEIN SHOWS.

NEWTON COULD NOT UNDERSTAND WHAT CONNECTED THE MOON TO THE EARTH. GRAVITY SEEMED INVISIBLE TO HIM... "ACTION AT A DISTANCE". EINSTEIN UNDERSTOOD IT IS CURVING SPACE-TIME ITSELF THAT ATTRACTS THE MOON TO THE EARTH.

THE RED CIRCLE [LASER POINTER] REFERS TO THE CELEBRATED "COSMOLOGICAL CONSTANT". EINSTEIN INVENTED THIS REPULSIVE GRAVITATIONAL FORCE TO COMPETE AGAINST ORDINARY EVERY DAY GRAVITATIONAL ATTRACTION TO ADJUST TO WHAT HE THEN THOUGHT WAS A STATIC UNIVERSE. {IF EVERYTHING WAS ATTRACTIVE, HE THOUGHT THE UNIVERSE WOULD COLLAPSE} HE LATER CALLED IT QUOTE "THE BIGGEST BLUNDER OF MY LIFE"UNQUOTE. BUT THE HUBBLE TELESCOPE NOW TELLS US THAT THE UNIVERSE IS EXPANDING AT AN ACCELERATING RATE, WHICH NOW MEANS THERE "IS" A REPULSIVE FORCE, NOW CALLED



“DARK ENERGY”. SO MAYBE IT’S LIKE SAYING “I WAS WRONG ONCE; ON THAT OCCASION I SAID I WAS WRONG, BUT I WAS REALLY RIGHT!”

**ELDERLY EINSTEIN:**

WELL, LOOKING BACK, I GUESS I MADE A FEW OTHER BLUNDERS... MY FIRST MARRIAGE. SIGNING THAT LETTER TO ROOSEVELT. PHILANDERING.

**YOUNG EINSTEIN:**

NOBODY’S PERFECT. REMIND YOURSELF: NEWTON “TOLD”. YOU “SHOWED”.

**LECTURER:**

**SLIDE 34** IS A COMPUTER SIMULATION OF A BINARY PAIR OF BLACK HOLES THAT MERGE AND EMIT GRAVITATIONAL WAVES THAT WERE PREDICTED A CENTURY AGO, AND DETECTED WITH A MONUMENTAL AND HEROIC EXPERIMENTAL EFFORT ON THE PART OF A THOUSAND SCIENTISTS AT A COST OF ABOUT A BILLION DOLLARS OVER A PERIOD OF SOME FORTY YEARS. LET’S WATCH THE ANIMATION.

**SLIDE 35** SHOWS HOW THE LASER INTERFEROMETER GRAVITATIONAL OBSERVATORY {LIGO} WORKS BY RE-COMBINING A SPLIT LASER BEAM IN TWO. EACH OF THE TWO SPLI BEAMS TRAVELS ALONG ARMS OF THE DEVICE THAT ARE PERPENDICULAR TO EACH OTHER. THE TWO BEAMS RE-COMBINE. AND REVEAL WHETHER ONE OF THE ARMS HAS CHANGED IN LENGTH BY ABOUT ONE THOUSANDTH OF THE DIAMETER OF A PROTON BECAUSE OF

THE DISTORTION OF SPACE TIME CAUSED BY THE GRAVITATIONAL WAVE FROM THE MERGER OF THE BINARY BLACK HOLE SYSTEM WE JUST VIEWED. THIS RESULT CONFIRMED EINSTEIN'S PREDICTION. SCIENCE ADVANCES, ONE CENTURY AT A TIME.

**ELDERLY EINSTEIN:**

RIGHT AGAIN! TOO BAD I DIDN'T LIVE LONG ENOUGH TO SEE THIS! I DO NOT NEED ANOTHER NOBEL PRIZE.

**LECTURER:**

I'M GLAD THAT THE FELLOWS WHO CREATED LIGO {KIP THORNE, RAINER WEISS, BARRY BARISH} GOT THE NOBEL.

**YOUNG EINSTEIN:**

PHYSICS IS REALLY A YOUNG PERSON'S GAME. I DID MY BEST WORK IN MY TWENTIES AND THIRTIES. SO IS PULCHRITUDE AND REPRODUCTION.

**LECTURER:**

DR. ROSEN, THE AUTHOR OF THIS PARODY, [**PAUSES FOR APPLAUSE, WHICH DOES NOT COME**] WAS WITH THE SIX YEAR OLD TWINS IN HIS FAMILY WHEN THE NEWS BROKE. GRAVIATIONAL WAVES WERE DETECTED! AS YOU CAN SEE FROM **SLIDE 36**, HE IS TRYING TO EXPLAIN EINSTEIN TO THEM AT BED-TIME. THEY WERE NOT INTERESTED. SO HE WROTE A SONG TO ENTERTAIN THEM, WHICH INSPIRED THE WORK YOU ARE NOW SEEING. {INTERMISSION IS COMING SHORTLY}

BUT FIRST A JOKE. WHICH ONE OF YOU WANTS TO TELL THIS ONE?

**YOUNG EINSTEIN:**

[SPEAKS DIRECTLY TO ELDERLY EINSTEIN] IS IT TRUE, SIR, THAT ALL OF HUMAN WISDOM CAN BE SUMMARIZED IN THE GOLDEN RULE: “LOVE YOUR NEIGHBOR AS YOURSELF”?

**ELDERLY EINSTEIN:**

LET EM ANSWER THAT QUESTION WITH A QUESTION. IS IT TRUE THAT ALL OF ASTROPHYSICS, GENERAL AND SPECIAL RELATIVITY, COSMOLOGY, GALAXY FORMATION, AND STELLAR STRUCTURE, CAN BE SUMMARIZED BY SAYING “TWINKLE, TWINKLE, LITTLE STAR”?

**LECTURER:**

**SLIDE 37** IS THE SONG THAT STARTED EVERYTHING. PLEASE SING ALONG WITH US.

BEFORE THE INTERMISSION, YOU MAY KNOW THAT EINSTEIN HAD A ROVING EYE.

**ELDERLY EINSTEIN:**

I DID. I ALWAYS PREFERRED PRIVATE VICE TO PUBLIC VIRTUE.

**LECTURER:**

IN THIS NEW YORKER CARTOON, **SLIDE 38**, WE CAN ONLY IMAGINE WHAT TOOK PLACE A FEW MOMENTS BEFORE THIS SCENE. THE YOUNG WOMAN IS CLEARLY FROWNING,

UNHAPPY. THE CAPTION, WHICH IS EIINSTEIN SPEAKING, IS:  
“TO YOU IT WAS FAST!”

WHEN EINSTEIN DIED IN 1955, THIS CARTOON BY HERB  
BLOCK APPEARED.

“THERE WILL NEVER BE ANOTHER ONE LIKE HIM”

[“There Will Never Be Another You”, Mack Gordon, Harry Warren]

There’ll ne/ver be an/o/ther one like him

Who had great thoughts while oth/er’s sights were dim

His mo/des/ty, his pur/i/ty were ob/vi/ous for all to see

His ub/er genius was lum/i/nous and free

Has phys/ics got/ten small/er or have men?

Our Ein/stein seems much big/ger now than then

There’ll ne/ver ev/er be an/o/ther one like him

There’ll ne/ver ev/er be an/o/ther one like him

**ELDERLY EINSTEIN:**

AND THERE’LL NEVER BE ANOTHER ON LIKE **YOU**  
[POINTING AT THE LECTURER]

**YOUNG EINSTEIN:**

AND THERE’LL NEVER BE ANOTHER ONE LIKE **YOU**  
[POINTING AT THE AUDIENCE]

## ELDERLY EINSTEIN:

I REGRETTED SIGNING THE 1939 LETTER TO ROOSEVELT THAT INAUGURATED THE MANHATTAN PROJECT THAT ENDED A FEW HUNDRED THOUSAND LIVES IN JAPAN. BUT I DID IT BECAUSE I THOUGHT, INCORRECTLY AS IT TURNED OUT, AND AS MY FRIENDS SZILARD, WIGNER, AND TELLER TOLD ME, THAT THE GERMANS WERE AHEAD OF US IN WEAPONIZING NUCLEAR FISSION.

## YOUNG EINSTEIN SINGS

“SHOULD I SIGN THIS CURS/ED LETTER?” [“Just You Wait Henry Higgins”]

Should I **sign** this **cur**s/ed **let**/ter//Should I **sign**?

Such a **com**/plex moral **ges**/ture//Not be/nign?

If the **Cher**/mans get there soon/er//

With a chain **re**/ac/tion boomer

I vill //No I won't//I veel a leetle think//Ach du Lieber!

[Place-holder/dummy tune: theme from ‘The Godfather’]

**Long** hair//I have **ve**/ry **long** hair

When I pace the floor **here**

I twist my hair **just** so

And lo and be/hold though

My ideas just leap so

Where they come from I **don**'t know

A **mys**/te/ry, mysterious mystery#####

**LECTURER:**

EINSTEIN’S SECRET OF HAPPINESS: QUOTE “READ NO NEWSPAPERS; HAVE A FEW FRIENDS WHO THINK LIKE YOU; BEFRIENDS A FEW SMALL ANIMALS” UNQUOTE.

HE LED A LIFE OF ACTIVE DISCOVERY. HE CHARMED AND RENEWED US. HE INVIGORATED CIVILIZATION. AND HE EXPLODED PHYSICS.

HE HAD A BRILLIANT WHIMSICAL MIND, AND A FIRST-RATE TEMPERAMENT.

HERE’S HIS DISTINCTION BETWEEN THE WIRE TELEGRAPH—AND THE RADIO: QUOTE ”THE WIRE TELEGRAPH IS LIKE A VERY VERY LONG CAT, WHERE YOU PULL HIS TAIL IN NEW YORK AND HE MEOWS IN LOS ANGELES. THE WIRELESS RADIO IS EXACTLY THE SAME...EXCEPT THERE IS NO CAT.

**INTERMISSION(?)**