

天文教育の未来予想図

-日本からの世界貢献とは？-

縣 秀彦（国立天文台）

1. 文化（趣味?）と教養（モラル?）

趣味としての「天文」

- ・（昭和時代）オタク文化、ネクラ文化、マイナー、サブカル？
- ・（平成時代）裾野拡大？ 宙ガール、宙フェス、宙ツーリズム
- ・（将来・希望） 音楽やスポーツと並ぶメジャー文化に？

教養としての「天文」

- ・（～20世紀中盤） 大学における必須の教養？
- ・（現在）リベラルアーツ（論理・文法・修辞学・天文学・算術・幾何学・音楽）は、いったい、どこへ？
- ・（将来・希望） 知識階級のみならず万人が持つべきモラルに

教養とは = 学習にて修得？

「私にとって教養という言葉の持っているぎりぎりのもの
というのは、人間としてのモラルです。

教養という言葉が揶揄するときの常套句に『理性と教養が邪魔をして』というのがありますね。

でも、慎みを忘れそうになったときに、『理性』と『教養』
とが邪魔をしてくれなければ、それは人間じゃない、とさえ
言えるのです」

(村上陽一郎、『あらためて教養とは』(新潮文庫)より引用)

「教養」・・・今では万人が持つべきもの？・・・ 教育の目的の一つ

天文文化 (?) VS 天文教養 (?)

個人の文脈としての「天文」 (文化)

VS

社会の文脈としての「天文」 (教育)

個人の幸福実現のためのツール (趣味)

VS

社会の幸福実現のためのツール (教養)

2. SDGS達成への道のり

SUSTAINABLE DEVELOPMENT GOALS

世界を変えるための17の目標



持続可能な開発目標
(Sustainable Development Goals: SDGs) の169項目ある達成基準の一つは、

「宇宙の中の地球というユニバーサルな視点の獲得」 (教養)

わたしたちの星地球

わたしたちの星(地球)



ペイル・ブルー・ドット

(クレジット:NASA)

(1990年、約60億km彼方から撮影された地球)

3. IAUの次期10年計画

IAU STRATEGIC PLAN 2020-2030

<https://www.iau.org/static/education/strategicplan-2020-2030.pdf>

IAU STRATEGIC GOALS 2020-2030

Goal 1

The IAU leads the worldwide coordination of astronomy and the fostering of communication and dissemination of astronomical knowledge among astronomers.

研究者の活動・交流

100年前

一般社団法人日本天文教育普及研究会
＋
国立天文台天文情報センター
で、
翻訳中（近日中に日本天文教育普及研究会ウェブに公開予定）



IAUの次期 10年計画

IAU STRATEGIC PLAN 2020-2030

現在

IAU STRATEGIC GOALS 2020-2030

Goal 1

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研究者の活動・交流

Goal 2

The IAU promotes the inclusive advancement of astronomy.

天文学のインクルーシブな発展

Goal 3

The IAU promotes the use of astronomy as a tool for societal development.

社会発展のための天文学利用

Goal 4

The IAU engages the public in astronomy through access to astronomical information and communication.

一般の人に天文学を

Goal 5

The IAU stimulates the use of astronomy for teaching and education at school level.

初等中等教育に天文学を



International Astronomical Union

新戦略の目玉

教養
平和



知識・
後継者
育成

文化
対話

発展
平和

4. 日本学術会議の取り組み（高等教育）

報告

大学教育の分野別質保証のための
教育課程編成上の参照基準
物理学・天文学分野



平成28年（2016年）10月3日

日本学術会議

物理学委員会

物理学分野の参照基準検討分科会

天文学分野の学士としての質保証
基準を2016年10月に発表

提案：

英文化し、特に日本の
大学院への進学を希望する
学生が参照できるように。

5. 日本天文学会の取り組み

「大学学部教養としての天文学」ガイドラインの作成 WG
..... 草案ほぼ完成 ただし 未完

提案：早期の完成、発表を（英文も含め）

6. 日本から世界へ（キラードコンテンツなど）

天文学辞典
公益社団法人 日本天文学会

用語名で探す 調べたい用語名の全部または一部を入力してください。
検索

この辞典について
日本天文学会について

新規・更新用語

新規・更新	用語名	よみ方	英語	学習レベル	最終更新日
更新	プロミネンス	ぶろみねんす	prominence	小	2019年3月13日
更新	連星パルサー	れんせいばさー	binary pulsar		2019年3月6日
更新	リュウグウ	りゅうぐう	Ryugu	小	2019年3月5日
更新	Wukong衛星	うこんえいせい	Wukong satellite		2019年3月5日
更新	COMPTTEL検出器	こんぶてるけんしゅつぎ	COMPTTEL detector		2019年3月5日

[もっと見る](#)

学習レベルで探す
小中高
小学生
中学生
高校生

五十音で探す
あ い う え お
か き く け こ
さ し す せ そ
た ち つ て と
な に ぬ ね の
は ひ ふ へ ほ
ま み む め も

カテゴリで探す
太陽
太陽系
太陽系外惑星
恒星
星間物質と星形成
銀河・銀河団
宇宙の進化
高エネルギー現象
原子・分子過程
理論
観測天文学
観測技術
時と暦
装置・施設・データベース
天文学史

画像を見る
はやぶさ2探査機
暗黒星雲
バルマー系列

動画を見る
はやぶさ2探査機
国際単位系
キロノバ
火星

用語は大切

提案：
諸外国でも用語集の整備・
公開が可能になるよう
ASJが支援しては？

Multi language

Mitaka
File Land/Takeoff Target Viewing Target Preset Scale View Time Setting Help

Japanese
English
French
Spanish
Italian
Indonesian
Portuguese
Thai
Chinese

Coming Soon:
Arabic
Korean
German

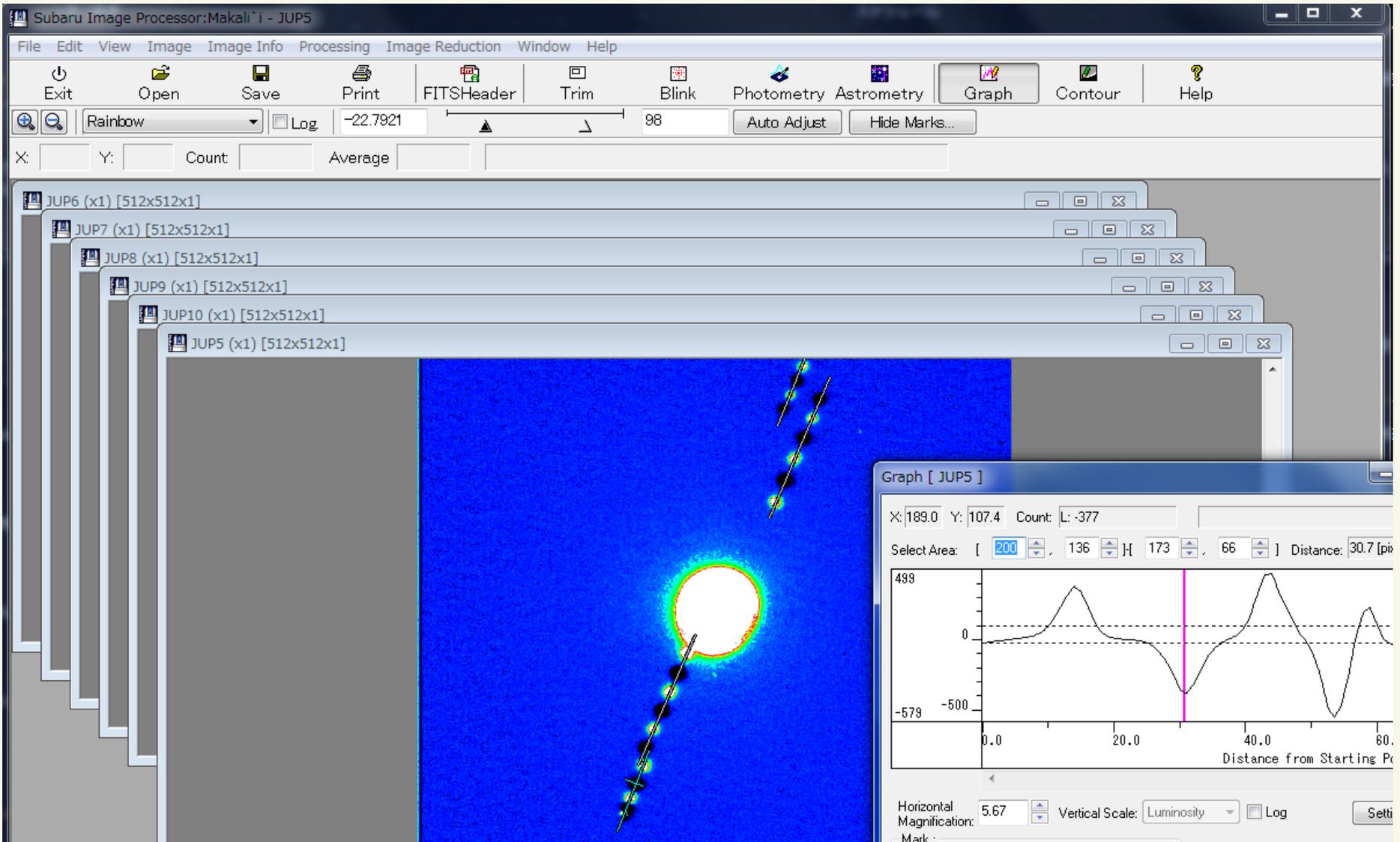


Earth

Language

- English
- Japanese
- Japanese with Kana Reading
- Spanish
- French
- Indonesian
- Italian
- Portuguese
- Thai
- Chinese (Simplified)
- Chinese (Traditional)

March 15, 2019 08:50



SUBARU Image Processor: **Makali`i**
<http://makalii.mtk.nao.ac.jp/index.html.en>

What is the Universe?

The Universe is the breadth of time and space that includes all physical entities. Humans, the landscapes that we see, the planets, stars, galaxies, and the Milky Way, which spreads its path lighting among the stars, and galaxies far away that they can only be seen with a huge telescope. All these things are part of the Universe as well. The Universe encompasses all the things that exist, and everything beyond.

How to use this diagram
Experience the Universe using four rules:
This diagram maintains the Universe based on the latest research and observations, with humans at the center. The vertical represents the passage of time, from the age of humans back to the birth of the Universe. The horizontal represents the breadth of space that is the Universe. From an overall inverted cone shape, we can see that the Universe has been expanding continually ever since it first came into existence. The diagram is a guide that will take you on a journey through time and space. Keep these four rules in mind as you uncover the secrets of the Universe with your own eyes.

Rule 1

Looking into the Universe means looking into the past

The strange thing is that when we look at the Universe from the Earth, what we see is not as it was in the present but as it was in the past. For example, when we look at the Sun, we are actually seeing what it looked like eight minutes ago. Light from the star takes eight minutes to reach Earth. What we are actually seeing is what the star looked like about 400 years ago. Why does this happen? We see stars and galaxies because the light they emit travels toward us. By the time that light gets here, the stars that emitted that light have moved on. This is the only part of the Universe that we can see. What we see is what lies behind our ability to observe.

Rule 2
There is a "Noisy" Universe that is larger than the one we see

The "Current Universe" spreads out on all sides of the human being pictured at the center of the diagram, but are unable to see it. The Universe really looks like a noisy, expanding cone. This is the only part of the Universe that we can see. The diagram to the left shows the cone that we can see with the naked eye or through telescopes, we find a spherical shape that is the cone shown in the center of the diagram. This is the only part of the Universe that we can see, and even those selected images from a different era, thousands, millions, or even billions of years ago.

In our Universe, Elements were born

The diagram is based on the composition of the Universe. The elements are shown in the diagram. The elements are shown in the diagram. The elements are shown in the diagram.

Rule 3
In space, distances are not always what they seem to be

When we talk about the distance to celestial bodies, we talk about "the path that light has traveled to reach us". For example, light from the farthest point in the observable Universe has traveled for 13.7 billion years, a distance that we see as an 13.7 billion light years. During that time, however, the Universe has continued to expand, so the path that light takes has grown increasingly longer than the time journey began, and the starting point is moved farther away. By the time the light reaches us, that starting point is estimated to be as far as 47 billion light years away.

Rule 4
The Universe becomes visible through the Eyes of Science

The observable Universe is the teardrop-shaped image at the center of the diagram's gold ring in the border compared to the vast expanse of the actual Universe. Through the "Eyes of Science", however, we have learned a great deal about the nature of the observable Universe. How the observable Universe expanded from the beginning of the inverted cone. And we have explored the outer limits of this cone. This diagram contains the results of many such scientific discoveries. The Universe is waiting for you to unravel its mysteries.

Diagram of our Universe

Humans were born from the Stars, and then, Science was born.

Looking for life on the planets of our Solar System

Does life exist somewhere in the Universe, aside from on the planet Earth? First, let's look at the possibilities in our own Solar System. Our Solar System is composed of several celestial bodies of various sizes and environments. Our Solar System includes: The Sun, eight planets, asteroids and comets (including trans-Neptunian objects and dwarf planets like Pluto), and satellites.

Mercury Venus Earth Mars Jupiter Saturn Uranus Neptune Pluto

Trans-Neptunian objects: Eris, Haumea, Makemake, Sedna

Interplanetary space: Asteroids, Comets, Meteoroids, Meteorites, Space Debris

Development of life on Earth

Development of life on Earth

Development of life on Earth

Looking for life on the planets of our Solar System

Development in space exploration technologies have enabled new scientific research aimed at seeking out life on other planets. We can now send probes directly to other planets in our Solar System to look for traces of life. Among the main targets for these probes are Mars, where liquid water was thought to exist on the planet's surface, and Europa, where an ocean is believed to be hidden under a thick layer of ice. There is little likelihood of finding intelligent life or advanced life forms there, but one day, we may discover microorganisms on these celestial bodies similar to those found on Earth.

Looking for "Another Earth"

Does life exist in the vast expanse of the Universe outside of our Solar System? In 1995, for the first time, we discovered an exoplanet, or "another Earth". Since then, astronomers have discovered more than 800 planets outside of our Solar System. These planets vary in size, composition, and distance from their stars. Some are similar to Earth, while others are completely different. The discovery of exoplanets has opened up a new field of research. We are now looking for planets that are similar to Earth, where life might exist. This is a very exciting time in the history of astronomy.

How did our Universe come into existence?

This vast Universe we can observe was once so small that it could not be seen. Modern science is closing in on the secrets of the Universe, and is gradually gaining an understanding of the astounding origin behind the formation of the Universe itself. Let's look back at the history of the Universe, starting from the moment of its formation some 13.7 billion years ago.

WHAT IS THE MATERIALS' ORIGIN OF THE HUMANS?

The human body, which could be compared to a small "Universe", is composed materials called elements. Modern science has determined that these elements originated in the stars, and were scattered through space eons ago. Let's go back in time to unravel the mysteries of human beings and the Universe.

The presumed cradle of the Universe

Countless stars shining in the darkness

This is the state of the Universe as brought to light by recent observations. More than 70% of the Universe's "dark energy," a mysterious form of energy that accelerates the expansion of the Universe. More than 20% is an undifferentiated sea of "dark matter," a mysterious substance that makes up most of the mass of the Universe. The Universe has a diverse layered structure comprising of galaxies with one or more billions of stars, galaxy clusters that contain hundreds or even thousands of galaxies, and a vast field of individual galaxies that are spread out across hundreds of millions of light years.

The mesh of the Universe

Dark matter and large-scale structures

Why are galaxies distributed in the form of a mesh? The answer is "dark matter", a substance that remains undetected, and which cannot be directly observed. It is believed that an invisible, undetectable dark matter, gravity is caused even more dark matter to gather and create "large-scale structures" in the form of three-dimensional mesh, normal matter forms collapsed into the other various forms of dark matter, eventually forming galaxies embedded in these large-scale structures.

The first star brings light to the Universe

The birth of stars and galaxies

13 billion years ago, that we don't know exactly when the first stars were born. We believe that our first star had about 40 times more mass than our Sun. A variety of elements were created inside this giant star. These elements were scattered by a supernova explosion and they became seeds of new generations of stars.

Atoms appear, and the fog of the Universe lifts

Electrons combine with atomic nuclei

About 380,000 years after the birth of the Universe, "the fog of the Universe lifted". Up until that time, the Universe was a seething, opaque "fog" of light and particles. These electrons combined with protons, forming light atoms in a steady line, and making the entire Universe opaque. When the temperature of the Universe dropped to about 3,000K, however, electrons decoupled with atomic nuclei to form neutral atoms. This allowed light to travel freely through the Universe. The fog lifted, and the Universe became transparent. This is the beginning of the "cosmic dark ages".

The three minutes in which everything was created

The starting point in the creation of matter

About three minutes after the birth of the Universe, the time took to create matter in the Universe arrived. During these three minutes, the superheated Universe cooked off as if expanded at an incredible rate. Quarks, another elementary particle and a building block of matter, gathered to form protons and neutrons. These three protons and neutrons came together to form the atomic nuclei of hydrogen and helium, the lightest of all the elements. About 90% of all the atomic nuclei created at this time were hydrogen, and the remaining 10% were helium. Now, it's like a clockwork of the instant in which the Universe was born.

The Universe as a superheated fireball

The beginning of the Big Bang

Immediately after its formation, the Universe was a superheated, uncompressible fluid, heated by radiation. This is the state of the Universe at the beginning of the Big Bang. During this time, the Universe was so hot that it was opaque to light. The photons were scattered by the free electrons, and the Universe was a seething, opaque "fog" of light and particles. This is the state of the Universe at the beginning of the Big Bang. The Universe was a seething, opaque "fog" of light and particles.

The beginning of space and time

"Inflation": The rapid expansion of the Universe

In the incredible heat of the Big Bang, the energy that had pervaded the Universe up to that time was transformed into heat. In the very first moments, the Universe expanded at an incredible rate. This is the state of the Universe at the beginning of the Big Bang. The Universe was a seething, opaque "fog" of light and particles.

Fluctuations in the Nothingness?

Fluctuations in the Nothingness?

Fluctuations in the Nothingness?

Types of elementary particles

Quark	Lepton	Photon	W boson	Z boson	Gluon	Higgs particle
Up, Down, Strange, Charm, Bottom, Top	Electron, Muon, Tau, Neutrinos	Photon	W boson	Z boson	Gluon	Higgs particle

The beginning of the Big Bang

Fluctuations in the Nothingness?

Center of the diagram

The diagram depicts the entire Universe, a global representation of the expansion of the Universe. At the center of the diagram is the Earth, where we stand and observe the Universe. The center of the Universe is not a point, but a region. The Universe is not a sphere, but a teardrop shape. The Universe is expanding, and the expansion is accelerating.

Space: About 47 billion light years - the current radius of the Universe as we see it today

Time: From the beginning of the Universe to the present

Speed of light: The speed of light is constant in all directions.

Acceleration: The expansion of the Universe is accelerating.

Planetary rubble with various shapes

Planetary rubble with various shapes

Planetary rubble with various shapes

Old stars are element factories

Stars immediately before the end of their lives

Old stars are element factories

Stars mature and shine in space

Nuclear fusion reactions and the life of a star

Stars mature and shine in space

The birth and growth of stars

Protostars emit jets of gas

The birth and growth of stars

Elements in the constantly changing Universe

Molecular clouds: the birthplace of stars

Elements in the constantly changing Universe

Fluctuations in the Nothingness?

Fluctuations in the Nothingness?

Fluctuations in the Nothingness?

Inflation

Inflation

Inflation

The birth of the Universe

The birth of the Universe

The birth of the Universe

7. すでに始まっている国際協力の事例



650名を超える海外ボランティア

<https://translation.iau.org/en/>



Inspiring every child with our wonderful cosmos



Search

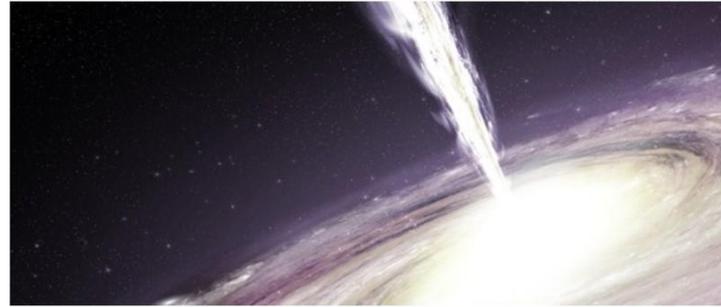
News

Updates

Space Scoop

Press releases

Find Us Online At



The Big Rip is Coming, Look Busy!

1 February 2019

[Read more](#)

Space Scoop



Here you can read the latest *Space Scoop*, our astronomy news service for children aged 8 and above. The idea behind *Space Scoop* is to change the way science is often perceived by young children as an outdated and dull subject. By sharing exciting new astronomical discoveries with them, we can inspire children to develop an interest in science and technology. *Space Scoop* makes a wonderful tool that can be used in the [classroom](#) to teach and discuss the latest astronomy news.

Visit our brand new *Space Scoop* website for children: www.spacescoop.org

Now you can read *Space Scoop* on your [Android device](#) here.

Space Scoop is available in the following languages:

English, Dutch, Italian, German, Spanish, Polish, Albanian, Arabic, Bengali, Bulgarian, Chinese, Czech, Danish, Farsi, French, Greek, Gujarati, Hebrew, Hindi, Hungarian, Icelandic, Indonesian, Japanese, Korean, Maltese, Norwegian, Portuguese, K'iche', Romanian, Russian, Sinhalese, Slovenian, Swahili, Tamil, Tetum, Turkish, Tz'utujil, Ukrainian, Vietnamese, Welsh



The Big Rip is Coming, Look Busy!

1 February 2019:

[Read more](#)



Project We Love

Ada's Adventures in Science

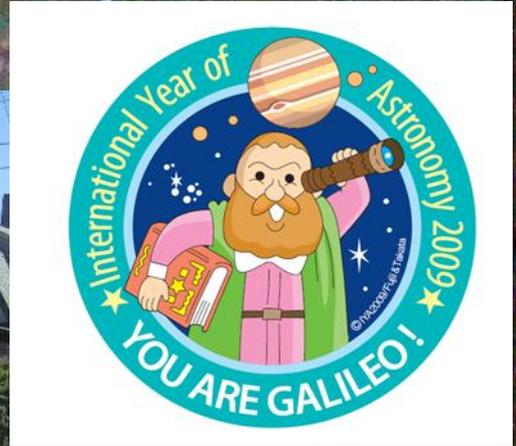
Inspire children and adults around the world with a special edition, 24 page science comic book and education resources. Thanks to our



Space Scoop is supported by:



“You are Galileo !”



とは言え、、、

足元が揺らぐ、国内の天文教育事情

8. 初等中等教育段階での天文教育の課題

- ・ 小学校：
 - ・ 実験・観察の不足
 - ・ 学校知・日常知
 - ・ 天動説に基づく説明（地球が丸いことを前提に扱わない）
- ・ 中学校：
 - ・ 理振法では、生徒4名に対し1台配置を奨励している
天体望遠鏡の配備実態
 - ・ 自転・公転（季節変化）中心の天文単元（天文学＝暦？）
- ・ 高等学校
 - ・ 理科総合科目設置の是非（学術会議からの提案を無視？）
 - ・ 地学科目の極めて低い履修率、物理も低い
 - ・ 新学習指導要領「地学基礎」での天文分野の大幅な縮小

おわりに

ブダペスト
世界科学会議
(1999年)

(吉川弘之議長)

「科学と科学的知識の利用に
関する世界宣言」

1. 知識のための科学
(進歩のための知識)
2. 平和のための科学
3. 開発のための科学
4. 社会における科学と
社会のための科学

ブダペスト会議 (1999) SDGS (2015-2030) IAU STRATEGIC PLAN (2020-2030)

IAU STRATEGIC GOALS 2020-2030

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初等中等教育に天文学を

知識

社会

開発・
平和

文化

教養

「科学と科学的知識の利用に
関する世界宣言」

1. 知識のための科学
(進歩のための知識)
2. 平和のための科学
3. 開発のための科学
4. 社会における科学と
社会のための科学