Nestled in Mother Nature's benevolence, Saji

Take a good long look at Saji. You still find wondrous outdoors that calm and nurture the heart. We are literally nestled in Mother Nature's benevolence. And, She has given the town yet another wonder – astronomy.

Japan's best starry skies

Saji is known all across Japan as having the most beautiful star-lit skies. But, to see the stars clearly at night, the air must be clean and the view little affected by light from the Earth. Because of its lush natural environment, Saji meets those conditions.

Saji Observatory
Address: 1071-1 Takayama, Sajicho, Tottori City, Tottori Prefecture
Latitude: 134˚7'11" East
Longitude: 35˚20'30" North
Elevation: 397.4 m (WGS) … **Learning about Earth in Saji**

Now tracking shooting stars!

There is a slightly surprising way to track shooting stars. In fact, it's the same technology used for FM radio broadcasts. It is called "radio observation". Here's how it works.

Shortwave broadcasts bounce off the ionosphere, which is why you can listen to broadcasts from the other side of the world. In contrast, the signals used in FM broadcasting normally pass through the ionosphere, so, unlike shortwave programs, they do not carry great distances. However, when a shooting star appears, the ionosphere thickens for a brief moment just in that spot and reflects all radio signals, so even broadcasts that normally would not be picked up can be. So, as long as radio signals are being broadcast from a station on Earth, this principle can be used to detect them, therefore shooting stars can be tracked even if it is cloudy or during daylight hours.

This radio observation application uses amateur wireless signals instead of a typical FM station. **When shooting stars appear, they are tracked on the computer screen as red and yellow dots and lines, and audibly reported by a series of acoustic tones.**

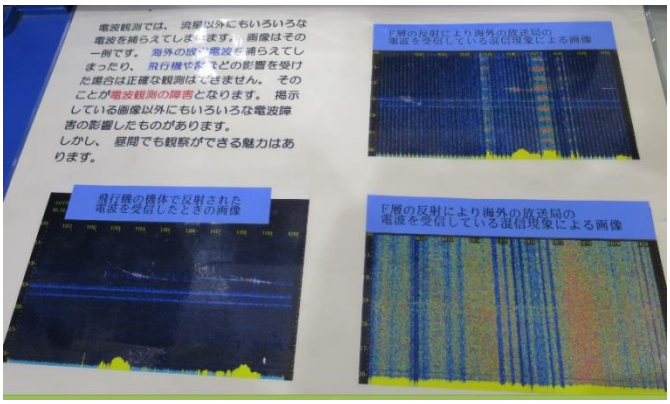
Radio observation of shooting stars

This monitor displays the signatures left by shooting stars. They appear as dots and lines. You can see lots of signatures during meteor showers.
However, radio observation picks up all sorts of signals besides shooting stars. This is an example of that. Observations can pick up overseas broadcasts and become cluttered with signatures from airplanes and lightning. This is referred to as “interference” and there are many other causes of interference than indicated here. Nevertheless, the beauty of radio observation is that it works during the daytime, too.

Listen for shooting stars!

This speaker usually makes a shushing sound, but every now and then you hear a short beep or a pop. These are the sounds of shooting stars. **But, they do not come from the shooting stars themselves. What you are hearing are the sounds of radio signals emitted from a relay station bouncing off the shooting stars.** Most are shorter than 1 second, though some seem longer because the shooting stars leave behind what is known as a “meteor trail”. Just like when looking up at the sky, you never know when a shooting star might appear. So, be patient! During a “meteor shower”, you will hear more beeps and pops than usual.

• Other noise picked up during radio observation -- Airplanes



Airplanes produce beeps and pops just like shooting stars do. But, the sound is drawn out. **It gradually gets louder, peaks and then slowly peters out like hiking over a mountain.** In longer cases, the echo can last from 1 to 2 minutes.

• Other noise picked up during radio observation – Overseas TV and radio transmissions

Sometimes, you can **hear voices or music. This is audio from TV and radio transmissions**, but none of the TV and radio stations in Japan broadcast over the frequency used here for radio observation. The sound is coming from overseas (mainly Southeast Asia) and can be heard because of the effects of the ionosphere. These broadcasts not only cause audio interference but visual interference as well, as signatures appear on the monitor. When this happens, it is not a good time to track shooting stars. (Interference cannot be distinguished from shooting stars.)

Local resources Saji is passing down to future generations

"5 Treasures"

Activities are underway in Saji to pass down "stars", "washi paper", "Asian pears", "stones" and "folklore" to future generations as prized resources of the local area.

Star gazing … Saji Astro Park

"Starry skies" are a core component of efforts to define and articulate the local pride and identity. Saji Astro Park provides the amenities for observing the heavens in a planetarium with a 6.5 m-wide dome, reflecting telescope of the largest class in Japan, 5-channel refracting telescope for solar observations and more. Moreover, since star-gazing is done at night, there are lodging facilities on the grounds in the Cosmos House pension, which is perfect for large groups, and cottages complete with private telescopes for crawl-out-of-bed observing.

Inshu Washi … Coming Saji washi atelier

You are looking at the Coming Saji washi atelier where you can try making *Inshu Washi* paper, a traditional handicraft from Saji. Postcards and stationary made from washi paper work magic on the hearts of senders and recipients alike with their beautiful colors and warm texture. And, as delicate as it may seem, washi paper is surprisingly strong.

Inshu Washi from Saji has a proud history that dates back over 1,000 years and is the most produced washi paper amongst those designated as traditional handicrafts of Japan. A large share of the rice paper produced in Japan for ink painting and calligraphy is made in Saji.

Nijuseiki Asian pears … Fruits and processed products

A group of women with great ideas and a lot of drive got together and put their strengths into a local variety of Asian pear. Not only do they sell the fruit but they have also crafted and marketed sherbet, candy and other products made from it. Their business activities have expanded widely ever since they registered their "Nashi Sherbet" trademark in September 2000, and have been reported in local newspapers and on TV.

Polished stones from the Saji River … Prized all over Japan

The stones polished by the pristine waters of the Saji River continue to captivate collectors as one of the top-three prized stones in Japan, the other two being the stones from Kamuikotan, Hokkaido and the Seta River in Shiga Prefecture. The Saji River has been designated a wilderness conservation area in order to protect the workings of Mother Nature that give the

stones their alluring appearance.

Local folklore … Efforts to preserve and share fireside stories

Many amusing tales have been passed down by word of mouth in Saji since long ago. They are fondly known across a wider area of outlying communities as heart-warming stories of the olden days. Because of strong interest and debate both within and from outside of the town, the Saji Minwakai was launched in autumn of 2000 to accurately record these stories and share their warmth with future generations. Ever since, members have continued their activities by gathering around the hearth of the thatched-roof "Minwa-no-yakata" once or twice a month. Passionate about their endeavor, the group arranged to have Fujio Tokita, an actor known for his voice-overs for animated Japanese tales, narrate a few of the stories for a live nationwide radio broadcast in November 1999. In 2002, they hosted a creative crossover of Noh comedy and music with kyogen actor Sennojo Shigeyama reciting the local tales to music by the Kyoto Philharmonic Chamber Orchestra. Later that same year, the storytelling component they organized for Yume Festa Tottori was a hit on the culture and heritage festival circuit. The Saji Minwakai has continued its efforts with vim and vigor, including CD recordings and performances both in and out of town. What began as a tripartite grassroots activity of a few individuals, a small community and its government was recognized in October 2004 with the Chairman's Award from the Federation for Promoting Autonomy in Sparsely Populated Areas of Rural Japan for the way they turned a "dark past" into "community pride".

Stars, washi paper, stones, Asian pears and amusing folktales. In Saji, they are called the "5 Treasures". Saji is colorful, lucent and nostalgic in a way that will make you think like you've been here before.

Earth

Covered by a wondrous natural environment

Lit by the sun, the Earth is a beautiful blue ball floating in the vastness of space. It is the only planet in our solar system – as far as we know -- to support life and is covered by a wondrous natural environment that has no political borders.

Night view of Earth seen from space

This is what the Earth looks like when viewed from space at night. Light from human activity radiates from industrially advanced countries and big cities. In the Middle East, it comes from burning oil, while, in Africa and Southeast Asia, the light is from torched fields. The light captured off the coast of Japan is from fishing.

Night view of Earth seen from space

Remote Sensing Technology Center of Japan (Yasunori Nakayama and Sotaro Tanaka)
Faculty of Environmental Studies, Hiroshima Institute of Technology (Yuzo Suga)

What meteorites tell us

Meteorites crash into Earth from space out of the blue. Like the Earth, meteorites revolve around the sun, only they are a lot smaller. However, small as they are, objects like these hold the key to unraveling the enigma of how the planet we live on and the universe were born. Seeing and touching them can help you ponder all of that.

This particular meteorite is known as a “siderolite” or “pallasite”. When meteorites reach a certain size, their iron component, which is heavy, concentrates at the core, while lighter stone materials aggregate towards the outside. Medium sized, this meteorite contains an unusual mixture of heavy iron and medium-weight olivine not found on Earth.

Martian meteorite … Fell in Zagami. Nigeria in 1962

You are looking at a very rare find – a meteorite from Mars. Compared to Earth, Mars has a considerably lower gravitational pull, which we know by calculating the weight of things on Mars. So, when a meteorite from space smacks into the planet, rocks and debris from the surface are hurled high into the sky and, in some cases, tossed into outer space. One of those rocks reached Earth, hence you are looking at a meteorite from Mars. It is also special because it is made of fine grain side. The fragment on display was broken off a larger piece that weighed 39.7 g. What you see at the tip of the test tube weighs 0.02 g.

Neat things about meteorites

If you look closely at where the meteorite has been cut, you will notice some striations. These striations are peculiar to meteoric iron, which you find with meteorites composed predominantly of iron. They are actually nickel crystals that cooled very slowly at a temperature of a few degrees Celsius over one million years ago. They are called “Widmanstätten Figures” after the Austrian scientist Alois von Widmanstätten who discovered them in 1808.

This particular meteorite is covered in something black. That black stuff is char. While traveling through the atmosphere, meteorites heat up to several thousand degrees Celsius, which causes the surface to melt and burn.

Because meteorites melt on the outside, temperature on the inside does not rise. This is curiously important since adenine, guanine and other DNA building blocks have been discovered inside of stony meteorites that consists mainly of silicates. It begs the question of whether meteorites carried life to planet Earth.

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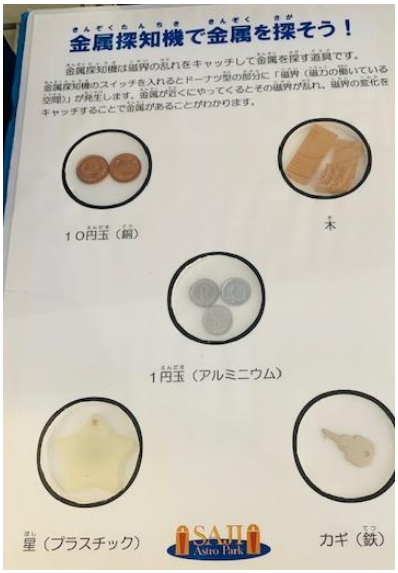
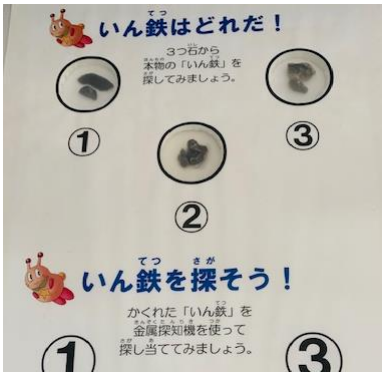


Probing for metals

A metal detector is a tool for searching for metals. It works by picking up disturbances in a magnetic field (area where there is magnetism) it projects from the doughnut-looking end when the device is switched on. If something metallic is within range, it disrupts the magnetic field. The detector picks up those changes to let the user know that something metallic is in the area.

- 10-yen coin
- Wood
- 1-yen coin (Aluminum)
- Star (Plastic)
- Key (Steel)



Which of these 3 stones is meteoritic iron?

Look for the real meteoritic iron.

Can you find the meteoritic iron?

Use the metal detector to find the hidden meteoritic iron.

Space MEDAKA

Space MEDAKA literally means “space rice fish”. It is what people are calling a local species of rice fish that was born onboard the Space Shuttle in July 1994 and the offspring that were born after the mission returned to Earth. They were the product of the first attempt (IML-2) ever to reproduce a vertebrate in a zero-gravity environment. The Space MEDAKA that are being raised at Saji Astro Park were a gift to the Saji Chapter of the Young Astronauts Club, Japan that is based out of the park. Having the fish here brings visitors a little bit closer to the vast frontier of outer space.

Saji Astro Park observes the following rules in raising the Space MEDAKA.

- Not to sell or use the Space MEDAKA for commercial purposes.
- Not to breed the Space MEDAKA with other species of rice fish.
- Not to release the Space MEDAKA into the wild.

In July of 1994, Japan’s first woman astronaut, Chiaki Mukai, flew into outer space aboard the Space Shuttle Columbia, custodian of the Space MEDAKA experiment. The experiment served to see whether or not a local species of rice fish, said *medaka* in Japanese, could lay eggs and those eggs could properly develop and hatch in space. Mukai and the fish spent 15 days aboard the Space Shuttle, during which time they orbited the Earth 236 times and the babies hatched without a problem. Four fish flew into space and the offspring born from Cosmo (male) and Miki (female) were given to Saji Astro Park in November of 1994. The rice fish currently being raised at the park are the descendants of the Space MEDAKA that flew in space.


宇宙飛行をした4匹のメダカ


スペースシャトルの中で実験キットを手に持つ向井宇宙飛行士


宇宙へと向かうスペースシャトル


上のメダカが雄(オス)、下のメダカが雌(メス)です。よく観察すると違いが分かります。

スペースシャトルの船内で活動する向井宇宙飛行士

The speed of light

Light travels about 300,000 km per second. That means a flash of light circles the Earth 7 ½ times in just 1 second. Pretty fast! The distance that light travels in a year is called a "light-year". Because the universe is so vast, it is described in units of light-years.

1 light-second = 300,000 km
1 light-minute = 18,000,000 km
1 light-hour = 1,000,000,000 km
1 light-day = 26,000,000,000 km
1 light-year = 10,000,000,000,000 km

Star brightness

The stars we can see with the naked eye are classified into Magnitudes 1 through 6 by brightness. Magnitude 6 is the darkest, while brightness increases about 2.5 times with every magnitude above that. However, this classification is based on the *apparent brightness* seen from Earth, which means stars closer to Earth will look brighter and those farther away darker. Therefore, to compare the actual brightness of stars, what is known as the "Absolute Magnitude", which calculates star brightness at a point 32.6 light-years from Earth, is used.

Moon … 1.3 sec
Sun … 499 sec … Mag. -26.8 → Mag.+4.8
Antares (Scorpius Constellation) 500 light-years … Mag. +0.9 ~ Mag. +1.8 → Mag. -5.4 ~ Mag. -4.5
North Star (Urus Minor Constellation) 400 light-years … Mag. +2.5 → Mag. -4.5
Sirius (Canis Major Constellation) 8.6 light-years … Mag. -1.5 → Mag. +1.4
Spica (Virgo Constellation) 350 light-years … Mag. +1.0 → Mag. -3.2
Deneb (Cygnus constellation) 1,800 light-years … Mag. +1.3 → Mag. -7.0

Galaxies … Billions of stars in clusters of differing color and shape

What we call a "galaxy" is a cluster of some 100 billion to 1 trillion fixed stars and the dust between them spanning the night sky. Size-wise, galaxies range from several thousand to several tens of thousand light-years in diameter. They vary in shape, too. Younger galaxies that are dynamically active and full of gases are irregularly shaped and bluish-white in color, whereas galaxies that are populated by old stars are oval in shape and whitish.

Our galaxy

Our galaxy is a bluish-white spiral some 100,000 light-years across. Our solar system is found in an area of the galaxy referred to as the “Orion Arm”.

Asteroids discovered at Saji Astro Park

* What are asteroids?

Asteroids are small celestial bodies in our solar system composed mostly of rock and metal. A good portion of them are found in a strip of space between Mars and Jupiter we call an “asteroid belt”. Most asteroids are small, measuring less than several tens of kilometers across, but the biggest is Ceres at about 1,000 km in diameter. Just counting the number of asteroids whose orbit we know, there are tens of thousands.

* Who names asteroids?

Anyone who discovers an asteroid can propose a name for it. But, naming an asteroid requires that you know its precise orbit. That typically takes anywhere from 4 to 6 years of observation.

Certificate and medal from the NPO Oriental Astronomical Association for discovering the asteroid “Saji”

Time seen with the eye

Viewing time through a telescope

Observing the stars through a telescope has little by little taught us about the vastness of space. At the same time, telescopes have allowed us to look back in time at how the universe and Earth were born. That is, when we observe a star several hundred million light-years away, we are actually looking light that it emitted several hundred million years ago, which tells us what happened to that star at that time. With a telescope, we are not only looking at the vastness of space but also at time itself.

Viewing time through the telescopes in Saji

The telescopes in Saji can observe light 340 million light-years away. 340 million years ago, Earth was in a Carboniferous Period that spawned reptiles and was teeming with amphibians. With telescopes that can look back in time like this, what do you think the universe looked like?

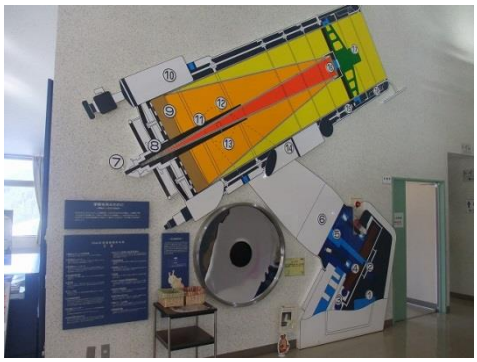
Fossils beds of Tatsumitoge Pass

On the way through Tatsumitoge Pass to Okayama Prefecture are found numerous fossils of diverse species of plants and insects. This fossil bed dates back to the late Tertiary Miocene Epoch (about 10 million ~ 5 million years ago) and, because the fossils are preserved in good condition, leaves and insects can be readily identified from their shape and size. To date, 158 species of plants from 93 genera and 45 families, and insects of 40 families and 11 orders have been verified (as of September 1992).

So we can look to the stars … Telescopes in Saji

The Cassegrain telescope at the Saji Observatory is a reflecting telescope that uses a concave mirror with a 103 m aperture and convex mirror. It is the largest class of telescope open for use to the general public. Let us show you how this marvelous telescope is configured and works.

Names of parts … Legend



①Barrel air supplier

Supplies dry air to the lens barrel.

②Right-ascension encoder

Detects the right-ascension coordinates. Employs toothed gears to prevent rattling in the mount and ultimately to accurately detect coordinates.

③Right-ascension worm gear

Large toothed gear installed on the right-ascension axis. Slows the motor revolutions transmitted to the right-ascension axis from the right-ascension driver. Very high precision.

④Right-ascension driver

Precision toothed gear. Slows and transmits the right-ascension motor revolutions to the worm gear.

⑤Right-ascension axis

Also called the “polar axis”. Star movements can be accurately tracked by facing this axis due north and turning with the natural rotation of the Earth.

⑥Fork

Supports the barrel. The fork is made of a material that dampens the vibrations of the drivers so that they do not propagate to the telescope.

⑦Main eyepiece

This is the focal point of light collected from the primary mirror. Since a large quantity of light is collected, observations can be conducted in several ways. For example, using various attachments like a dual eyepiece, two people can look through the telescope at the same time, or, with a moon projection plate, a group of people can simultaneously observe the full image

of the moon.

⑧Viewfinder

This is a smaller telescope with a 5 cm aperture for pinpointing where to look when observing a wide area of space. It is designed so that the point viewed in space is close to where the eyepiece is looking.

⑨Primary mirror (103 cm effective aperture)

Light from the stars first strikes this mirror and is reflected. The wider this mirror is, the more light is collected. The primary mirror of this telescope is 103 cm in diameter, so it collects a lot of light.

⑩20 cm guide telescope (With automatic tracking unit)

Used to more accurately track objects during observations with the main telescope. Because unintended stars can be tracked, it comes with a unit for fine-tuning into tracking targets.

⑪Declination driver

Precision toothed gear. Slows and transmits the declination motor revolutions to the declination axis.

⑫Declination encoder

Detects the declination coordinates. Employs toothed gears to prevent rattling in the mount and ultimately to accurately detect coordinates.

⑬Declination axis

Perpendicular to the right-ascension axis. The coordinates plotted from the right-ascension and declination axes are called “equatorial coordinates”.

⑭15 cm sub telescope (With cover opening/closing mechanism)

This is a 15 cm refracting telescope. Because of the good contrast they produce, refracting telescopes are suited for looking at planets, etc. The telescope’s cover can be electrically opened and closed.

⑮Temperature offset unit

Keeps the distance between the primary and secondary mirrors constant even if the barrel expands and contracts because of temperature swings.

⑯Secondary mirror (30 cm effective aperture)

Star light reflected off the primary mirror reflects off this mirror, too, before converging on the eyepiece. Stars are viewed by enlarging images from the eyepiece.

⑰Motorized focusing unit

Brings viewed objects into focus. Focusing with this telescope is done by moving the secondary mirror. The secondary mirror is designed not to slip out of place to the side.

⑱Barrel cover opening/closing unit

Opens/Closes the cover to the main telescope. The mechanism is designed so the telescope does not lose its balance when the cover opens or closes.