

2017 SPECIAL ENGLISH EDITION



A Magazine from Japan

Science Window

THE SCIENCE OF SPORTS

**SUPERHUMAN
SPORTS**

**PARALYMPICS
SPOTLIGHT**

OLYMPIC FACTS

**CHIMPANZEES:
Our Evolutionary
Neighbors**

**Guide to
CHERRY BLOSSOMS**

+ MUCH MORE



Special Feature

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SCIENCE WINDOW

A science education magazine that children and adults can read together

The sense of excitement that comes from learning something that leaves us amazed or wondering “Why?” plants the seeds that help our minds grow into ones with a spirit of inquiry toward the world of nature. The Japan Science and Technology Agency (JST) publishes the science education magazine *Science Window* with the aim of encouraging children and adults alike to ask questions about their world and indulge their curiosity. This publication is distributed to elementary, junior high, and high schools across Japan, and is also available free of charge on the JST website.

This is a special English edition featuring articles from recent Japanese language issues that introduce the science of sports and other fascinating topics. Japan’s contributions in the areas of science and technology are important for the creation of a sustainable global society. We hope that people around the world with an interest in this area, as well as in education, will enjoy reading this magazine.

Takahiro Shibata

Editor in Chief/Director, Center for Science Communication
Japan Science and Technology Agency

SYMBIOTIC RELATIONSHIPS: EXAMPLES FROM NATURE OF LIVING IN HARMONY

Treehoppers are small insects with body lengths that range from a mere few millimeters up to around two centimeters. The drawing to the right shows the remarkable appearance of the treehopper with what looks like a horn on its back. This is known as the pronotum, the back plate of the insect. This is just one of the interesting pronotum variations displayed by the treehopper, with approximately 3,100 types documented around the world so far. Treehoppers are classed in the same taxonomic order of Hemiptera as cicadas and aphids.

According to treehopper researcher Dr. Munetoshi Maruyama, “These insects lack the powerful defenses possessed by ants and bees. It is theorized that they evolved this way to camouflage themselves to avoid being eaten by other creatures.” This camouflage effect comes in many shapes and sizes. Some treehoppers have pronotum in the shape of thorns or plant shoots, some mimic dangerous insects like bees, while others resemble inedible substances like caterpillar droppings or discarded insect exoskeletons. Some even take on colorful and almost otherworldly shapes.

Treehoppers subsist on plant sap which they suck up using their hard, needle-like mouths. However, storing too much sugar in their bodies causes problems for treehoppers. They remove the sugar through the secretion of a substance known as honeydew.

The treehoppers’ sugary honeydew attracts ants, leading to a mutualistic relationship between the two insects. For example, in their larval stage, treehoppers have yet to grow wings and can barely move. Ants tap the bodies of treehopper larvae with their antennae to induce a sweet honeydew reward that is secreted from the larvae abdomens. In return, the ants benefit the treehopper larvae by protecting them from spiders and other insect predators. This is just one of the numerous aspects of the treehopper and ant mutualistic relationship.

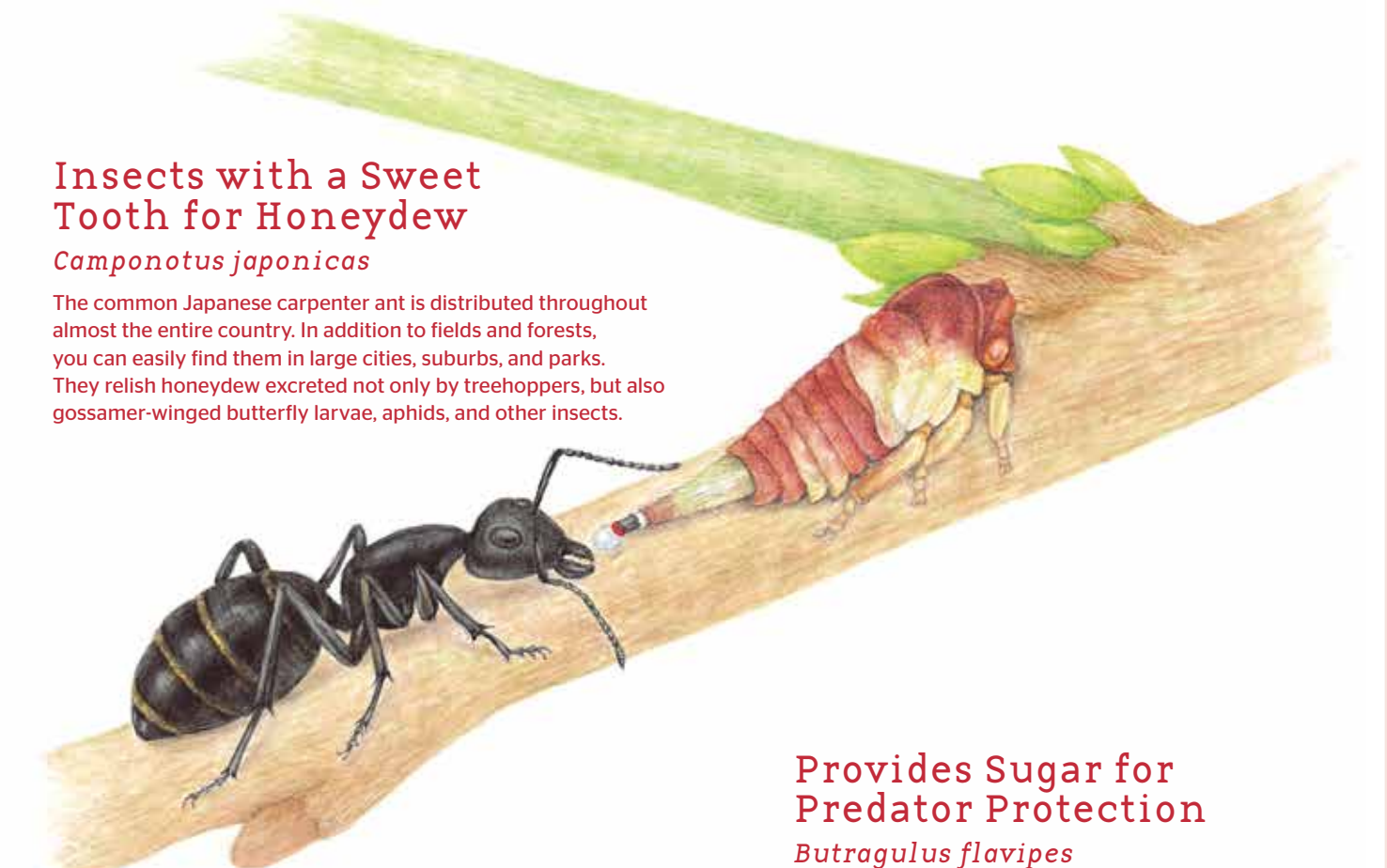
Dr. Maruyama’s interest in treehoppers grew when he studied abroad in Chicago about ten years ago. While in America, he was delighted to find assorted treehoppers he had never seen before on the undergrowth of forests in early spring. Since then, he has been researching treehoppers worldwide, focusing on the tropical forests of South America and South-east Asia.

You will probably be able to spot some treehoppers if you see ants coming and going on soft new shoots of plants. Dr. Maruyama concludes by saying, “There are more than ten treehopper species in Japan alone. I hope everyone can observe the beauty of their tiny world.” **sw**

Insects with a Sweet Tooth for Honeydew

Camponotus japonicas

The common Japanese carpenter ant is distributed throughout almost the entire country. In addition to fields and forests, you can easily find them in large cities, suburbs, and parks. They relish honeydew excreted not only by treehoppers, but also gossamer-winged butterfly larvae, aphids, and other insects.



Provides Sugar for Predator Protection

Butragulus flavipes

This species of treehopper is found in the mountain regions of Japan. Although shaped like adults, treehopper larvae have no wings and thus cannot fly, making ants a welcome protection from predators. They shed their exoskeletons five times before reaching adulthood.





Welcome to the World of Superhuman Sports

New Sports Made Possible by Technology

A new era of sports is dawning around the world. Technology is making artificial enhancement of athletic abilities a reality, enabling the development of entirely new kinds of sports. Innovation has also helped level the playing field and set fair handicaps, allowing everyone to enjoy these exciting sports.

Sports for our Digitized Society

The day when an 80-year-old woman can put on a robotic suit and run faster than Usain Bolt may not be far off. Japan's Superhuman Sports Society was founded to pioneer sports that use technology like this. Dr. Kouta Minamizawa, the Society's Director/General of the Secretariat and Associate Professor at the Keio University Graduate School of Media Design, filled us in on the Society's initiatives.

"The Superhuman Sports Society began with a gathering of specialists working on things like virtual reality, augmented reality, and robots. Technology has opened up a myriad of new possibilities for sports. It is possible to create new sports that anyone can enjoy, anywhere and anytime."

For example, robotic suits may make it possible for humans to someday com-

mand abilities far greater than those bestowed by Mother Nature, eliminating the barriers holding back humanity. Technology can also break down barriers between people by equalizing differences among competitors stemming from age and disability. Technology can help people overcome physical limitations, achieving new abilities through a unity with machines.

"During the age of agriculture-based societies, we saw a lot of sports created in the time between farm jobs. With the birth of industrial society, we began to see the creation of motor sports, such as F1 racing. Sports do not exist independently from industry or culture. I believe that superhuman sports are the sports of today. They are sports for our digitized society."

Sports that push the limits also push forward specific technologies, which

in turn leads to new products on the market. The efforts to test the limits on how fast cars could drive during F1 races led to the commercialization of turbo engines. Something similar might occur with superhuman sports technology. The devices developed for superhuman sports competitions are expected to drive efforts to make commercial products lighter and more battery-efficient in the future.

The Thrill of Designing New Sports

In July 2015, the Superhuman Sports Society held a "hackathon" (an event in which people compete with each other to develop the best ideas) to increase the number of people familiar with superhuman sports. It was a great success, drawing a crowd of over 100 engineers and creators for discussions on the creation of new sports.



Left-most photo: Bubble Jumper.

Left photo: HADO, developed by mealeap inc., uses motion sensing and AR technology to create a novel experience. Players wear a specialized device on their heads and compete for points in an expanded reality arena. Competitions are broadcast to spectators.

Photo: mealeap inc.

Bottom left photo: Carry Otto. It has been called "dog sledding with an engine" due to the need for delicate balance and coordination.

Bottom right photo: Hover Crosse.

"Normally hackathons are one-day affairs, but in this case over half of the participants are still working on their own superhuman sports. Many people who came to the First Superhuman Sports Expo in October were able to experience some of these new sports for themselves."

One sport born out of that hackathon was its grand prize winner, Bubble Jumper. For this sport, competitors wear giant, transparent vinyl bubbles, and shoes equipped with springs that are similar to stilts. To play, each participant attempts to launch his or herself at the opponent. Physical strength alone does not guarantee a win, as many people have trouble with the spring shoes, and in Bubble Jumper, if you fall, you lose. The risk of injury in this sport is very low thanks to the giant bubbles.

Another sport that has garnered atten-

tion is Carry Otto, a superhuman sport reminiscent of the chariot races of ancient Rome. For this sport, competitors sit on a platform attached to a large wheel that contains a motor. This wheel can be steered using reins. The team behind Carry Otto has funded the development of the sport through crowdfunding. It is clear that many people are looking forward to the fruits of their efforts.

"Creating new sports turned out to be

much more enticing than we ever imagined. Around ten new competitions have already been created. I think that going forward we will have to accelerate efforts on the competitions we hold and expand our horizons. We are now considering selecting five of the most popular superhuman sports to host a Superhuman Sports International Competition alongside the Tokyo Olympic Games in 2020." **sw**

DR. KOUTA MINAMIZAWA

Director/General of the Secretariat of the Superhuman Sports Society. Associate Professor at the Keio University Graduate School of Media Design. Specializes in haptics, virtual reality, embodied media, and embodied informatics.



Freedom of Mobility for All



Nakamura Brace Co., Ltd. of Ohda City, Shimane Prefecture is a leader in producing high-quality prosthetics for the global market. Their customers include Mei Ichinose, the Paralympic swimmer who represented Japan at the Rio Paralympics who uses a dual land and water use prosthetic from the company. We spoke with company president Toshihiro Nakamura and head of production Makoto Nasu about prosthetics.

Mr. Nakamura, what inspired you to enter this line of work?

Nakamura: I began working for a prosthetic limb manufacturer in Kyoto soon after high school. Our clients included the medical faculty of Kyoto University, and whenever I heard the professors speak I was inspired by the global impact of science. At the time, the market worldwide for prosthetics was still in its infancy, although its importance was recognized.

I decided that if I was to continue this work, I would go to the United States to see the top of the field. I saved up and went for a month at age 22. I didn't have any friends or connections there, but I was blessed with some truly wonderful encounters and my desire to learn was met with study opportunities. I was always impressed to see disabled and non-disabled people out and about and living so seamlessly together in the US. I

decided to dedicate myself to pioneering prosthetics in Japan.

Did you experience any difficulties creating the business after coming back to Japan?

Nakamura: After returning home I left my old job, and at 23 I flew again to the USA. But after half a year, I was involved in a hit and run accident. I remember waking up in a dark place that wasn't an operating room, surrounded by crying people. I had been bleeding from both ears and was carried to the morgue. Though I recovered at the house of an American friend without hospitalization, I knew I could collapse again at any time. I also knew I couldn't waste the experiences and kindness I had received in America.

I returned to my shrinking hometown of Omori (now Ohda City). There, I built

my business up from zero. In the first month I had just one customer. Worried about my health, my uncle ordered me a lower-back corset brace. My hard work helped me gain a good reputation in the town and my customers increased. Eventually, a hospital specializing in work-related injuries believed in me and placed stable orders. The business has grown from there.

How did you meet Ms. Ichinose, who went on to represent Japan in swimming at the 2016 Paralympics?

Nakamura: When I was working and aiming for the USA, I wanted to learn more and took a correspondence course at Kindai University. As such, I count as an alumnus and in May 2015 I was consulted about prosthetics for Ms. Ichinose, who had enrolled there a month before. She was born with a shorter right arm,



Top, left: The prosthetic training arm manufactured from a cast of Ms. Ichinose's arm. It helps overcome Ms. Ichinose's prior difficulties in balancing muscle strength by allowing strength training for both arms.

Above, left: Mei Ichinose, a sophomore at Kindai University and Japan's swimming representative at the Rio Paralympics. She participated in eight Paralympic events, improving on her own personal best in the 100-meter freestyle. As of May 2016, she holds the Japanese record for five swimming events. (Photo: Kindai Sports Editorial Department)

Above, center: The land/water-use prosthetic leg made of silicone rubber and carbon plates that is under development. Regular prosthetic limbs cannot enter the water directly because of the protective buffering material between the socket and skin and oil in the joints.

Above, right: Ms. Ichinose (right) and Mr. Nasu in charge of producing her prosthetic.

which hindered training her upper body muscles in balance. I met with Mr. Nasu and the managing director, and the three of us began making a prosthetic for her training.

Mr. Nasu, how did making a prosthetic for an athlete compare to your other work?

Nasu: The first thing that comes to mind was that Ms. Ichinose asked for a shape that did not actually resemble a hand.

Nakamura: Though we had imagined a more realistic artificial arm, Ms. Ichinose said, "My own arm is a part of me, and it would be strange to have one now that I didn't have before."

Nasu: She went on to say, "It may be extreme, but a design like an iron pipe would be good." She wanted it in blue. I then began conceptualizing the design from scratch, making it so that she could assemble and disassemble it herself. Any necessary part replacement could be bought at a hardware store. In addition, the whole limb was molded in silicon rubber to make it usable in water.

We made a cast of Ms. Ichinose's arm to make sure the limb could be attached precisely without gaps.

Is it possible her prosthetic arm will be refined in the future?

Nasu: Right now we are making parts that have the "pushing power" necessary for training such as bench pressing. We are also prototyping cylindrical parts that will allow the user to do four types of swimming strokes with one prosthetic.

Nakamura: We are now as a company considering an underwater-use prosthetic leg, based on this opportunity to create a land/water-use prosthetic arm. The prosthetic would not be aimed at competitive sports, but rather for disabled individuals to freely enjoy swimming in pools.

Looking at the prototype, it's surprising how incredibly simple the shape is.

Nakamura: I think that times are changing. For a prosthetic intended for competitive sports, it's now fine to leave the shape as is and not worry about trying

to hide the fact that it is artificial. People's feelings and impressions toward prosthetics have changed with better education and the Paralympics. In Japan, I think we have definitely become much more accepting. The land/water-use artificial leg is a step toward a new era, not only in terms of convenience but socially-speaking as well. Awareness about prosthetics will rise when people start seeing them more in places like pools.

It seems prosthetics development for athletes also helps create products for the wider market.

Nakamura: Indeed. In sports, we tend to focus on the top players, but there's definitely a market beyond them. Everyone has an innate desire to exercise. People in my field are here to empower people with disabilities by developing assistive technology. And at the same time, we are always aware of the support we receive daily from those around us. I want to listen to everyone's voices and give them the tools they need to thrive. **sw**



TOSHIRO NAKAMURA

Born in 1948, he traveled to Santa Monica, CA in the US in 1970-71 and then returned home to establish the Nakamura Brace company in 1974. He has been awarded a number of prizes, including the Special Prize for Japan Manufacturing, the Shibusawa Eiichi Award, the "Economics Grand Prize" Special Prize, and the International Mainichi Award. Author of *Letters of Thanks to a Prosthesis Maker in a Town with No Convenience Store* (Nihon Bungeisha, 2011)

Obinata competing in the women's giant slalom in the sitting category at the Vancouver X Paralympic Winter Games. (March 2010)
Photo: Isao Horikiri

The Thrill of Making the Impossible Possible

Confidence is the Accumulation of Small Victories

Kuniko Obinata was the first Japanese citizen to win a gold medal at the Winter Paralympics. She was involved in a traffic accident at the age of three that resulted in the amputation of her right leg and a permanent impairment in her left leg. Her first memory of walking was with the use of a prosthetic. But the undaunted Obinata is a dedicated athlete. Here, she speaks about the true meaning of sports.

My first experience riding a sit-ski came at 17 years old, about 10 years after its invention in the late 1970s. It was still a relatively new invention. I had always loved sports and was eager to try the sit-ski, so I dove in with a five-day, four-night introductory course.

To use the sit-ski, you sit on a seat suspended about 10 centimeters above a ski blade. The first time I tried it, I just could not get my balance. I fell countless times, but each time I got better and better at balancing. After two days, I was more or less able to glide down the slopes.

It is often said that technology makes everything easier, but that's not the case in sports. Humans must be the ones to control the tools created through technology. It is vital that we are diligent in training our ability to use these tools. And of course, when I say training I'm sure many people will associate that with physical training. But building physical strength is just one aspect of training. You won't be able to get anywhere unless you can successfully transfer your physical strength to whatever tool you are using. Through training,

you learn by facing yourself.

Sports help connect us socially and bring meaning to our lives. That is true for both disabled and non-disabled people. Quality of life also improves as we increase our physical capacity.

For disabled people, this is doubly true. For example, wheelchair users often experience difficulty going over even relatively minor bumps and uneven patches

in the road in their daily lives. This can lead them to want to shut themselves indoors. But building up your physical strength helps you discover your own power and transforms you. I think my experiences with sports have helped me discover the joy of life.

Sports represent an accumulation of small victories – the ability to do today what you couldn't do yesterday. If you tackle challenges with that strategy, you will surely reap the results as your victories pile up. Earning these victories will most likely take a good deal of time, and might seem trivial day by day. But by challenging yourself, you will open up a new road and learn to believe in your true potential.

I especially believe people with disabilities and impairments should tackle sports. I hope that many people enrich their lives through the joy of sports. **sw**

KUNIKO OBINATA

A Paralympic alpine skier who uses a sit-ski, Obinata competed in five Paralympic Games from 1994 to 2010 and won a total of ten medals in the Para-alpine Skiing division. She leverages her rich experience for diverse activities, including serving as a committee member of the Japanese Para-sports Association, Vice President of the Paralympians Association of Japan, a member of the Cabinet Office Commission on Policy for Persons with Disabilities, and Executive Director of the Japan Para-Ski Federation. She is the author of *Breaking Down Walls* (2006, NHK Publishing Co., Ltd.).



Olympic Facts



Q Why are marathons set at 42.195 kilometers?

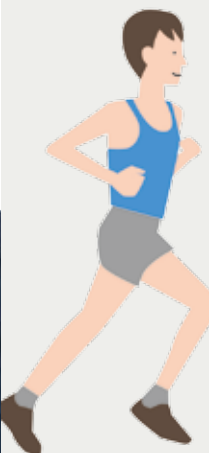
The distance of marathons was set as an homage to the Battle of Marathon in Greece, the originator of the Ancient Olympic Games. Legend has it that to deliver the news of Greece's defeat of the Persians in battle, the Greek messenger Phidippides ran a distance of about 40 kilometers from the Greek town of Marathon to Athens. The first modern Olympics was held in 1896 in Athens with the marathon course between Marathon and Athens. However, course lengths varied until the distance was standardized at 42.195 kilometers, the distance used at the 1908 London Olympics.

Q What are sports psychologists?

The emergence of sports psychologists has attracted attention in recent years in Japan and around the world. Although there is no set definition of the occupation, in Japan a certification for "Mental Training Consultant in Sport" is granted by the Japanese Society of Sport Psychology. The field involves guiding athletes on the psychological aspects of training and skills, in order to bring out the very best performance in the athlete.

Q What led to the ban on doping?

Doping is defined as enhancing athletic performance through the use of banned drugs and methods such as "blood doping" that involves boosting red blood cells through transfusions of the athlete's own blood. But what exactly led to the ban of these doping drugs and methods? In fact, athletic competitions in the early 20th century were rife with athletes who were doping due to a lack of set rules. However, with the 1960 death of an Olympic athlete who had ingested an amphetamine, efforts to enforce doping rules accelerated. Now, doping is globally banned based on the recognition that doping is dangerous to the health of athletes and is unsportsmanlike.



Q Are the Olympics a competition between countries?

The Olympic Charter states, "The Olympic Games are competitions between athletes in individual or team events and not between countries." For example, the songs and flags displayed are decided by each country's Olympic organizing committee and are not limited to national anthems and flags. The goal of the Olympics is to transcend differences of race, religion, and politics to deepen mutual understanding among all people through sports. Thus, a country-focused fixation is undesirable.



This article was compiled based on information from the Tokyo Organising Committee of the Olympic and Paralympic Games, the Japanese Olympic Committee, the Japanese Society of Sport Psychology, and the Japan Anti-Doping Agency.

SEE YOU IN TOKYO!

Key dates for the 2020 Tokyo Olympic and Paralympic Games:

Olympic Games: July 24 to August 9

Paralympic Games: August 25 to September 6

33 Sports at the Tokyo Olympics:

Aquatics / Archery / Athletics / Badminton / Baseball & Softball / Basketball / Boxing / Canoe-Kayak / Cycling / Equestrian / Fencing / Football / Golf / Gymnastics / Handball / Hockey / Judo / Karate / Modern Pentathlon / Rowing / Rugby / Sailing / Shooting / Skateboarding / Sport Climbing / Surfing / Table Tennis / Taekwondo / Tennis / Triathlon / Volleyball / Weightlifting / Wrestling

22 Sports at the Tokyo Paralympics:

Archery / Athletics / Badminton / Boccia / Canoe / Cycling / Equestrian / Football 5-a-side / Goalball / Judo / Powerlifting / Rowing / Shooting / Sitting Volleyball / Swimming / Table Tennis / Taekwondo / Triathlon / Wheelchair Basketball / Wheelchair Fencing / Wheelchair Rugby / Wheelchair Tennis

Improving Motor Skills

Although genetic factors influence physical capacity for areas such as running speed and muscular strength, with some effort this capacity can be greatly extended. The key lies in the motor control that helps move our bodies in the way that we want. In this article, leading sports scientist Dr. Kando Kobayashi outlines a scientific approach to strategic motor control improvement and specific training routines.

Many people believe that children are becoming increasingly poor at exercise and losing physical strength. For example, poor motor coordination and balance can cause children to lack the ability to run in a straight line. In fact, physical activity that would have been simple for a 4-year-old in the past is now often impossible for a 3rd grader. Elementary school teachers are reporting difficulties in teaching physical education because of this.

Why have the physical strength and exercise capacity of today's children decreased so much? The cause is believed to be poor conditions relating to motor control. Sometimes people blame their "bad reflexes" for their poor sports and exercise skills, but often our use of this term is scientifically dubious. It is important to develop a good understanding about the connections between exercise, the nerves, and the brain and how to improve physical functionality.

While there are also genetic influences on how good or bad one is at exercise, the impact of exercise experience as an infant is far greater. Children who have plenty of physical activity from birth until three or four years old can handle themselves much better as they develop their nervous system that controls movement from brain to body. In other words, their motor control is functioning well.

Thus, it is vital that children develop and train the basic motor skills necessary to control movement. Elementary schools are already



DR. KANDO KOBAYASHI



Born in 1943, he studied physical and health education at the Faculty of Education, University of Tokyo, and continued on to focus on physical education at the Graduate School of Education at the same university. He is now Professor Emeritus of the University of Tokyo, and has specialized in sports science, devised conscious motion training techniques and developed machines, and conducted physiological studies to improve youth fitness. He has released several books including *Science of Motor Neurons* -*Anyone Can Run Fast* (Kodansha Gendaishinsho) and *Rejuvenation through Walking: A Way to Walk that Will Make the Brain and Body 10 Years Younger* (Takarajima Shinsho).

incorporating key equipment like horizontal bars and mats as gauges of core physical ability. However, we should also go to an even more fundamental level: teaching the proper ways to stand and walk, which are shown in this article.

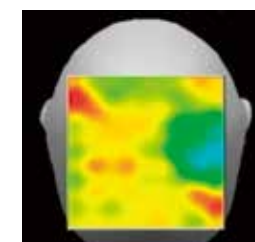
Improving "Quality of Motion"

In the medical world, we use the term "quality of life" (QOL) to describe one's ability to live well in a healthy manner. Building on this, I hope that children can develop what I call "quality of motion" (QOM). I believe that by improving motor control and QOM, a host of other areas outside physical strength can be improved as well.

When playing sports, a variety of abilities are necessary aside from muscle strength or stamina. Abilities held by top athletes such as spotting sudden danger, making predictions, tackling challenges with courage, and broadening their perspectives are all equally applicable to studying and all fields of work. Through my research into training for the motor neurons, I discovered the importance of fundamentals like posture and walking style. From this, I developed a variety of exercise methods to train the body and improve mental agility. [sw](#)

FUNDAMENTALS OF MOTOR CONTROL IMPROVEMENT

Having a thorough understanding of your body and movement are key to motor control. Once you master the fundamentals of posture and motion, you can aim to improve your motor control.



Stimulate Your Brain with Exercise

Movements that use the torso muscles and affect one's feeling of balance stimulate the brain through the primary motor cortex (Brodmann's area 4), the core of movement instructions. The image above shows a large amount of oxygen circulating within the brain.



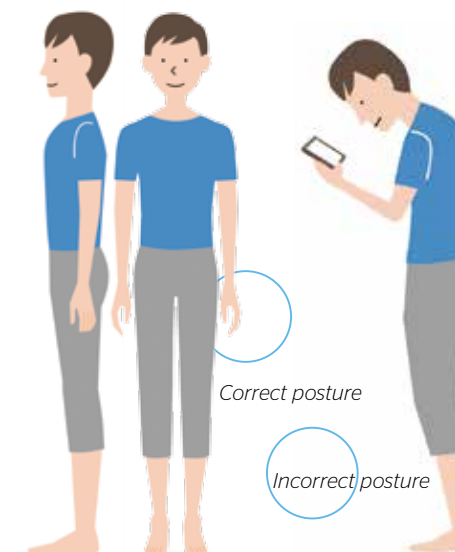
Core Torso Muscles Are Key

The core torso muscles (inner muscles) support the spine from the inside and perform numerous important functions aside from maintaining posture and motion. The image above shows the torso muscles captured in an MRI.



Understand Your Psoas Major Muscle

The psoas major muscle connecting the back and femur bones plays an important role in maintaining posture and walking. Top athletes are characterized by their thicker psoas major muscles and level of control over them. The red section is the psoas major muscle.



Stand Up Straight!

We use muscles in the back and torso to arch the back and stand straight. Incorrect posture and development of a slump arise if these muscles weaken. With deep muscle strength, one can stand relaxed without using the surface muscles.



Walk with Confidence!

When we think about walking with confidence, we often think of the phrase "Chest out, stomach in!" This might result in a comical posture in which we arch our backs to puff out the chest and stick out our rumps. However, to walk correctly, you should walk forward with the psoas major muscle rather than the leg. Imagine that the foot starts from directly below the pit of the stomach, and the hips are pushed out from the chest.

AMAZING
ANIMAL
SECRETS



Top photo: Tsutomu the chimp takes a flying leap.

Left photo: Tsutomu uses his makeshift tool.

Right photo: Tsutomu's female companion Maruko finds fruits and vegetables hidden inside a firehose.

Far right photo: Young Mamoru turns three this year and loves to cling to his mother's back and bother his father when he wants to take a nap.



Keeper Tomonori Hoshino

ALL ABOUT CHIMPS

About 187,000 chimpanzees call Africa home, spread across the continent's savannas to its tropical rainforests. Chimpanzees organize themselves within communities of over 20 males and females of all ages. They live for about 50 years, subsisting on leaves, fruits, nuts, berries, insects, and even small animals. Females tend to leave their home community for a new one upon maturation, and usually give birth for the first time at around 14 years old. Chimpanzees were long classified in the now obsolete Pongidae taxonomic family. However, research has shown that these animals possessing strikingly high intelligence have close links to humans and they are now classified with their kindred humans in the family Hominidae.



JAPAN MONKEY CENTRE MUSEUM AND ZOO FOR NONHUMAN PRIMATES

Located in Inuyama City, Aichi Prefecture, this is one of the world's leading monkey zoos. Inside you'll find 900 monkeys from over 60 species. The zoo's staff members know that learning about monkeys helps us make discoveries about our own human selves. They've accordingly created enlightening exhibits and educational activities that introduce all of the fascinating traits of monkeys. The zoo also collaborates with research institutions such as the Primate Research Institute, Kyoto University. For more, check out their website at the link below:
<http://www.japanmonkeycentre.org/index.html>

Chimpanzees

Our Highly Intelligent Evolutionary Neighbors

A chimpanzee sits in front of a bushy grove at the Japan Monkey Centre, swinging his body from side to side. Hair on end, he lets out a cry. Suddenly he stands up on his hind feet, clambers across the area's monkey bars and drops to the ground below while clapping his hands. His audience of riveted zoo visitors exclaims a collective "Wow!" Encouraged, the chimp makes another show of jumping from high up while clapping. Japan Monkey Centre breeding assistant Tomonori Hoshino is on hand to give an explanation of the chimpanzee's strange behavior. "This is all a display to show his power to his community."

This curious chimp has been given the name Tsutomu, and

he lives with his female companion Maruko and their baby Mamoru. Hoshino explains further, "Although we have a breeding style here that results in nuclear-style families, in the wild chimpanzees display a variety of behaviors. They tend to form bigger communities and communicate with various voice and gesture patterns. You can tell their mood just by looking at them. If they're happy they smile, but if they're angry you'll know it by their bristling hair. The display we just saw was to confirm his place in the group, but I think Tsutomu was also broadcasting his appeal to all of his human guests."

Hoshino throws some tree branches into Tsutomu's area. Tsutomu picks one up and uses it to drive holes in an arti-

cial anthill that contains honey. Hoshino explains, "He's using the branch to fish out the honey from inside. He purposely picks the best-positioned hole in the anthill and then selects a branch that is a good length. Then he chomps down on the end of the branch to make a brush to soak up the honey. He has made his own tool."

Studies have shown that in the wild, chimpanzees in different areas develop their own tool "cultures." Communities in some regions use tree branches to dig out ants from anthills, while communities in other regions place hard nuts on a flat stone and break them open by striking them with another stone. "Young chimpanzees learn by watching their parents and other adults. Mamoru will probably learn how to get honey by watching his father Tsutomu."

Hoshino visited Tanzania two years ago on research and was thrilled to see for himself a group of wild chimpanzees swinging through the jungle. His dream, he explains, is to enable visitors to witness the extraordinary primal nature of chimpanzees, even if that happens at a zoo in central Japan. **SW**

Discover the Milky Way

The Milky Way holds a special significance in Japanese culture due to its role in the Tanabata festival. According to the Tanabata legend, the deities Orihime (a princess) and Hikoboshi (a cowherd) are quite literally star-crossed lovers who can only meet once per year on July 7. They are represented by the stars Vega and Altair which are separated by the Milky Way. To discover more about the Milky Way, we asked Dr. Ryoya Saji of Tamagawa University.

Why does the Milky Way look the way it does?

Saji: Put simply, it is because countless stars appear to form a shining path across the sky. In Japanese, we call it the “River of Heaven.” Put scientifically, what you are seeing is just a portion of stars from the center and arms of our Milky Way Galaxy.

Is our galaxy the same as the Universe?

Saji: The Milky Way is just one of the hundreds of billions of galaxies in the Universe, each containing billions or trillions of stars. Earth is located within the Solar System in the Milky Way, with the Andromeda Galaxy just next door.

What is the shape of the Milky Way Galaxy?

Saji: The center forms a flat disc and arms spiral around it. Our Solar System is located approximately 30,000 light years from the center. Think of it as somewhat close to the outer side. Most of the stars that we can see in the night sky are relatively nearby, but the Milky Way (as observed from Earth) comprises the light of stars which are extremely far away compared with those.

Does the Milky Way we see correspond to the center of the Milky Way Galaxy?

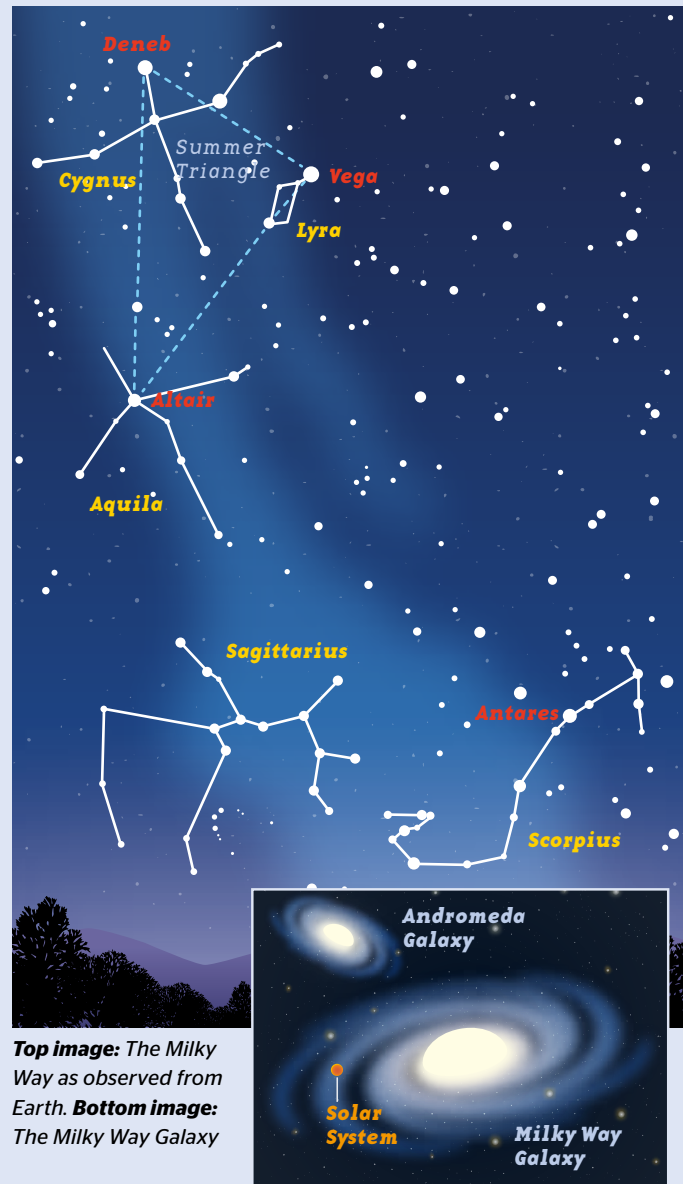
Saji: No, the center of the Milky Way Galaxy is observed in the direction of Sagittarius. Nearly all the stars we see in the night sky, whether near or far, are stars of our galaxy.

How can you find the Milky Way in the sky?

Saji: From the northern hemisphere you should look south and use Scorpius as a landmark. In the heart of Scorpius is Antares, which shines red. The area around the tail, which extends like an S from Antares, glows white like a river.

Is it possible to see the Milky Way in cities?

Saji: It is difficult in cities because of light pollution (an excess of artificial light).



Top image: The Milky Way as observed from Earth. **Bottom image:** The Milky Way Galaxy

What are your tips for seeing the Milky Way clearly?

Saji: You need a clear sky and a very dark location. You can use the opportunities of holidays or school trips to try to go stargazing.

How does the Milky Way give you a sense of the great expanse of space?

Saji: Space has depth, although that can be hard to grasp by just looking at the sky. If you try to picture the relationship between the stars that shine from the very-distant central part of the galaxy and the stars that shine near to the Solar System, you should be able to sense its depth. [sw](#)

DR. RYOYA SAJI

With a doctorate in engineering and specializing in research on the brains of babies, he is an Associate Professor at Tamagawa University Brain Science Institute. He also leads teacher training at Tamagawa University Research Institute Astronomical Observatory.



Eco-Friendly Aquaculture

Japan can only domestically supply 10% of the shrimp necessary to feed its high demand. However, the establishment of a new shrimp aquaculture system is garnering attention for its stable production capacity and low environmental impact.

Native to Central and South America, whiteleg shrimp are farmed worldwide due to their rapid maturation, disease resistance, and great flavor.



Global demand for shrimp is on the rise. The saltwater shrimp farming industry is huge, with a market size of over 20 billion USD and annual production of over four million tons.

Saltwater whiteleg shrimp comprise approximately 80% of shrimp farming production. Along with the Japanese tiger prawn, it is the shrimp for which there is most research progress. The young shrimp used in aquaculture originate in countries such as the US and Thailand, where facilities isolate pathogen-free shrimp to be supplied worldwide.

The farming of shrimp suffers a number of problems, including the influence of weather, natural disasters, and incidence of disease. For this reason, it is best if shrimp can be farmed within a closed facility on land. However, this presents difficulties in terms of technology and cost, among other challenges.

According to Dr. Marcy N. Wilder, Senior Research Scientist at the Japan International Research Center for Agricultural Sciences, “Our research consortium composed of four organizations, has developed a production system that clears many challenges, enabling cost-efficient, eco-friendly aquaculture.”

The system is characterized by cultivating whiteleg shrimp native to Central and South America in water with a high degree of hardness under conditions that are close to fresh water. Since Wilder is an expert in culturing and molting mechanisms, she took charge of the physiological aspects of researching the optimal growing environment.

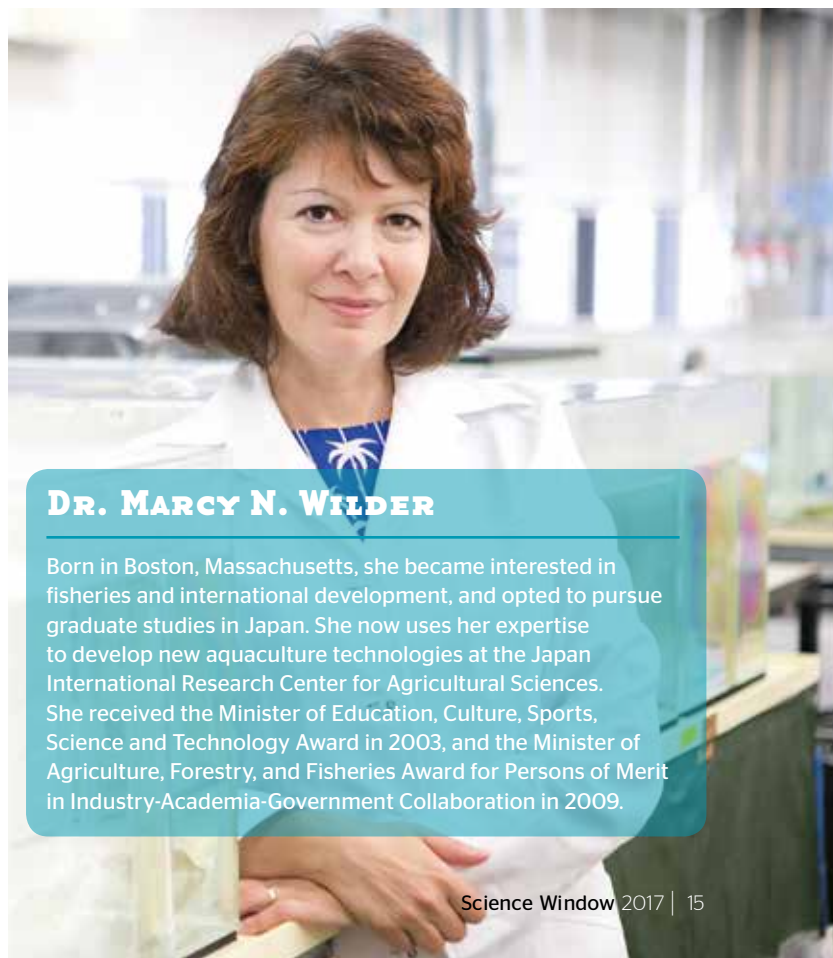
Whiteleg shrimp are saltwater shrimp, but Wilder’s research revealed the mechanism whereby they become accustomed to changes in water salinity. She found that even in low-salinity water, young shrimp are able to develop if a period of at least one day is allocated for them to adapt. However, when the salt concentration reaches close to that of fresh water, minerals and calcium become much diluted. Without enough minerals, the shrimp cannot develop a robust shell. Meanwhile, a lack of calcium injures the shrimp bodies, which appears as black flecks. Wilder notes that water with low salinity and a high degree of hardness is required for the developed aquaculture.

At the culture plant, the optimal water temperature, oxygen consumption, water flow speed, quality, and other factors were researched for each stage of the development of the shrimp. A commercial plant has been in operation since 2007 in Myoko,

Niigata Prefecture. The whiteleg shrimp molt as they increase in size within a tank, reaching around 18 grams at 18 weeks.

With this method it is possible to farm saltwater shrimp on land as well, which is hoped will bring an increase to the shrimp self-sufficiency rate of Japan. The first overseas shrimp plant using this method was established in Mongolia, and inquiries have been arriving from other overseas locations.

Wilder states, “Aquaculture contributes to food availability. However, we should not assume that this benefit justifies adverse impacts on the environment.” She stresses that it is vital to pursue farming methods optimized for each region. [sw](#)



DR. MARCY N. WILDER

Born in Boston, Massachusetts, she became interested in fisheries and international development, and opted to pursue graduate studies in Japan. She now uses her expertise to develop new aquaculture technologies at the Japan International Research Center for Agricultural Sciences. She received the Minister of Education, Culture, Sports, Science and Technology Award in 2003, and the Minister of Agriculture, Forestry, and Fisheries Award for Persons of Merit in Industry-Academia-Government Collaboration in 2009.

■ FAMILY PORTRAIT



Oshima Cherry (*Oshima Zakura*)
Found around the Izu area of Japan, it is characterized by its large, fragrant blossoms. It is the father of the Tokyo cherry.



Spring Cherry (*Edo Higan*)
Found throughout most of Japan, its petals range from white to pink. Its leaves do not grow while the flowers are in bloom. It is the mother of the Tokyo cherry.



Tokyo Cherry (*Somei Yoshino*)
The star of Japan's cherry blossoms, it can be found throughout the country as well as around the world. For example, thousands of trees, originally a gift from Tokyo City in 1912, bloom every spring in Washington D.C.



The ABCs of Nature Observation



Cherry Blossom Viewing

Every spring, the cherry blossom front advances north across Japan, bathing the country in an exquisite yet ephemeral beauty. Japanese people eagerly await the blossoms, consulting “cherry blossom forecasts” that take into account numerous factors to predict when these fickle flowers will bloom. *Sakura* (cherry blossoms) are celebrated with gatherings called *hanami* (flower viewing parties).

The most prominent cultivar of sakura is the Tokyo cherry, but a myriad of varieties also exist. But what are the secrets of sakura? For observation methods, we went to Dr. Toshio Katsuki of Tama Forest Science Garden, Forestry and Forest Products Research Institute.

According to Katsuki, while a total of ten wild sakura species exist in Japan, Japanese sakura lovers have propagated over 100 cultivars that bring out their favorite characteristics. One method of producing cultivars involves creating clones through grafting, preserving desired characteristics. Some varieties are the result of mutations, such as the weeping cherry (*Shidare Zakura*). Although sakura naturally tend to have five petals per blossom, the double flowered cherry (*Yae Zakura*) has more.

As for the popular Tokyo cherry? It is a hybrid with the Oshima cherry as its father and the Spring cherry for its mother. From these origins, it inherited the attractive characteristics of large blossoms that bloom before leaves appear that might dilute their splendor. **SW**

Photos: Toshio Katsuki

■ WILD SAKURA



Korean Mountain Cherry (*Kasumi Zakura*)
Widespread in Japan, Korea, and China. Its blossoms range from white to light pink. It blooms late and is thus not the subject of *hanami*.



Sargent's Cherry (*Oyama Zakura*)
Found throughout most of Japan, it has pink petals.



Japanese Mountain Cherry (*Yama Zakura*)
Found in relatively southern parts of Japan, it is known for its white flowers and red young leaves. Japanese Mountain Cherry trees have been traditional subjects of *hanami* for over 1,000 years.



Bell-flowered Cherry (*Kanhi Zakura*)
The focal point of many *hanami* in warm regions such as Okinawa, its Japanese name refers to the fact that it blooms in winter due to the warm climate. This sakura features hot pink petals in bell-shaped blossoms.