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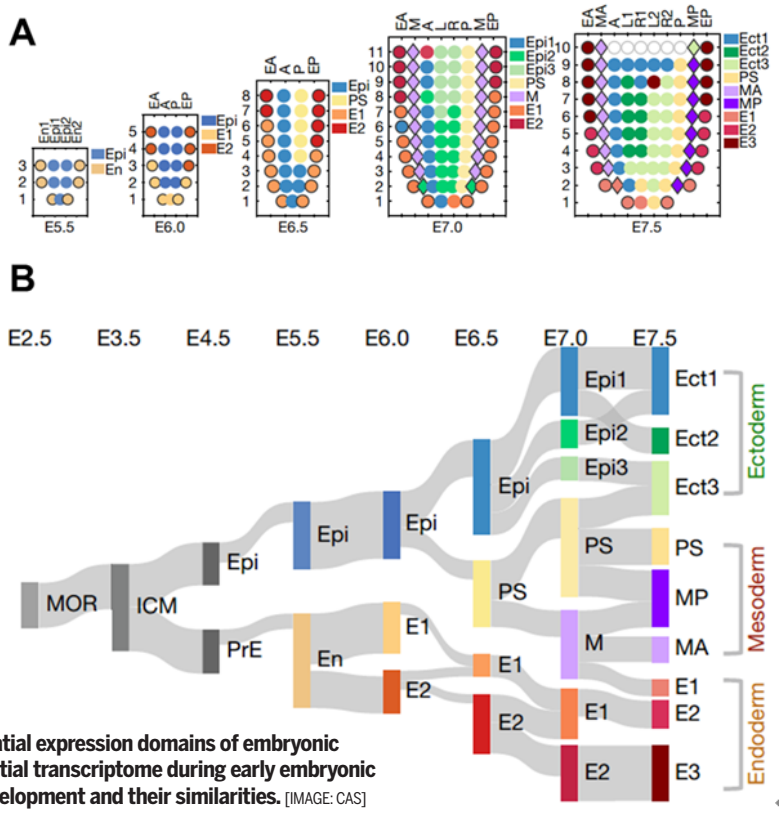
LEAD ARTICLE



Spatial expression domains of embryonic spatial transcriptome during early embryonic development and their similarities. [IMAGE: CAS]

Chinese scientists trace development of cells in early embryos

A research team led by Jing Naihe, a researcher with the Shanghai Institute of Biochemistry and Cell Biology, Chinese Academy of Sciences (CAS), has established a molecular map for genes in mouse embryos with several scientists.

Their discoveries, which were published on the website of the UK-based journal *Nature* on Aug 8, enabled the tracking of cell "ancestors" in different locations and paved the way for more efficient methods of obtaining stem cells for certain human organs.

This may in turn promote the development of stem cell-related regenerative medicine.

A living individual develops from the embryo emerging from a fertilized egg. The cells in the embryo multiply from generation to generation, and ultimately produce a complete individual.

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HOT ISSUE

CAS joins China's high-speed data processing network construction

ICT under CAS announced on Aug 1 that high-throughput computing data centers will be built in more than 10 cities and form a high-speed network to improve the country's data processing ability. >> PAGE 2

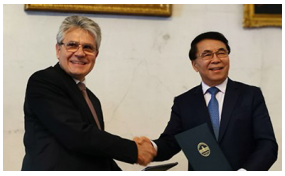
RESEARCH PROGRESS

A new generation of lithium metal battery anodes

A research group led by Prof. Li Chilin from Shanghai Institute of Ceramics of CAS proposes a new strategy of in-situ catalytic grafting at interface. >> PAGE 3

INTERNATIONAL COOPERATION

CAS promotes cooperation with Spain, the UK and Russia



Bai Chunli, president of CAS, was invited to visit Spain, the United Kingdom and Russia from July 11 to 20. >> PAGE 6

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Some thoughts on academicians' lectures

In the past three days, I have experienced the richness and wonder of the animal world, the cutting-edge technology of our country and the brilliance of the academicians of CAS. >> PAGE 7

NEWS IN BRIEF

China issues plan to improve math research

A plan aiming at strengthening the country's math research was recently released. >> PAGE 7

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Sun Ninghui (L), director of the ICT under CAS and Cao Lubao, mayor of Yancheng, unveil the country's first high-throughput computing data center in the city in East China's Jiangsu province. [IMAGE: ECONOMIC DAILY]

CAS joins China's high-speed data processing network construction

The Institute of Computing Technology (ICT) under the Chinese Academy of Sciences (CAS) announced on Aug 1 that high-throughput computing data centers will be built in more than 10 cities and form a high-speed network to improve the country's data processing ability.

The first data center has been completed and put into use in Yancheng, East China's Jiangsu province.

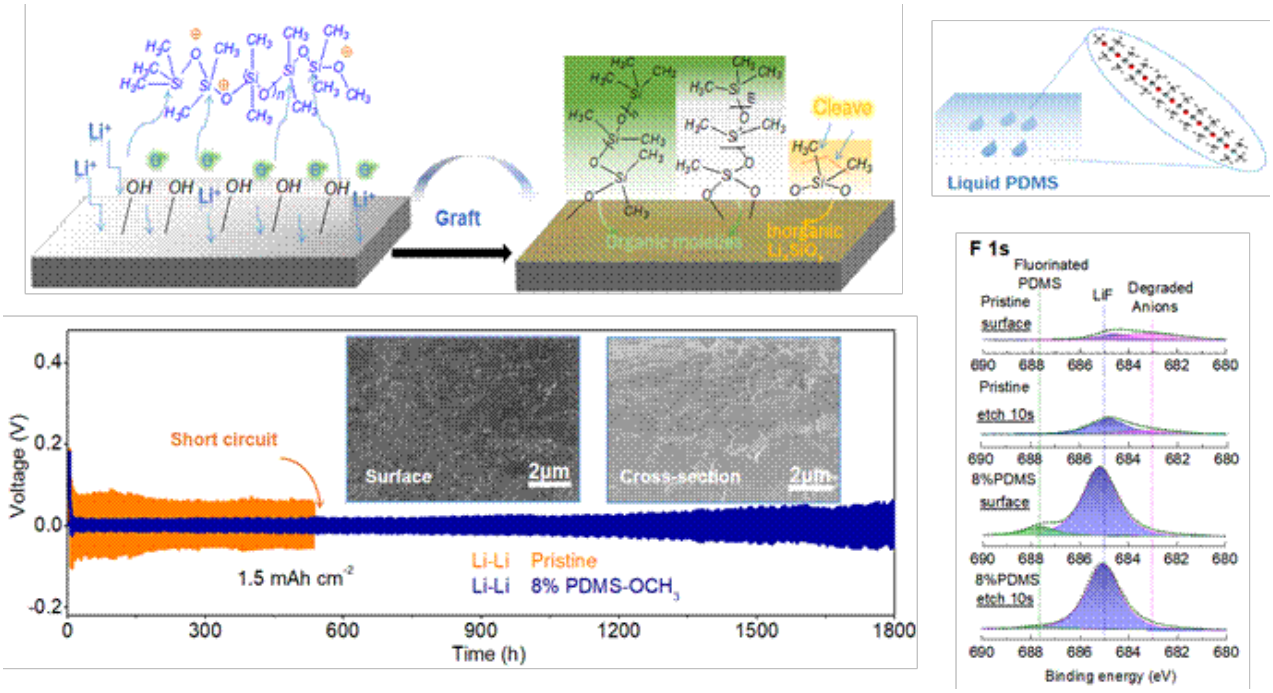
The center has 1,000 compute and storage nodes and 30,000 processor cores. It can efficiently process 10 million video streams per second but consume only 750 kilowatts of power, according to Fan Dongrui, director of the ICT's High-throughput Center and the president of SmartCo, a leader in high-throughput computing in China.

The data generated by people around the world is increasing at an alarming rate. A report predicted a tenfold increase in global data volumes from 2016 to 2025.

High-throughput computing, with strong data processing ability, can support hundreds of billions of new terminals and massive information processing, said Sun Ninghui, director of the institute.

The high-speed "information railway" composed of high-throughput data centers and high-speed dedicated line networks will provide abundant AI models as well as knowledge graph and application services to promote the landing of the digital economy in the future.

Source: Xinhua



In-situ catalytic grafting of liquid polydimethylsiloxane to achieve dendrite-free lithium plating and highly reversible lithium metal batteries.
[IMAGE: PROF. LI CHILIN'S GROUP]

A new generation of lithium metal battery anodes

Facing the challenges of the poor flexibility of solid electrolyte interface (SEI) layers composed of a sole inorganic component as well as the complicated procedure to construct an organic-inorganic hybrid SEI, a research group led by Prof. Li Chilin from Shanghai Institute of Ceramics, Chinese Academy of Sciences proposes a new strategy of in-situ catalytic grafting at interface. By using liquid polydimethylsiloxane terminated by -OCH_3 group (PDMS-OCH_3) as a graftable additive, the "grafting" and "fragments" reactions on lithium metal surfaces occur under the impact of electrochemical potential and an electric field. It enables high-efficiency plating stability and dendrite inhibition of lithium metal battery anode. The result was published in *Advanced Functional Materials* (2019, 1902220, DOI:10.1002/adfm.201902220).

Lithium metal has the potential to become the next-generation anode material due to its high theoretical specific capacity (3860 mAh g^{-1}) and low redox electrochemical potential (-3.04 V vs. standard hydrogen electrode). When coupled with conversion-type S, sulfides and fluorides, much higher energy densities (500 ~ 900 Wh kg^{-1}) can be obtained for the corresponding Li metal batteries (LMBs).

However, the growth and spread of lithium dendrites on the anode side tends to cause poor cycling stability of LMBs, and increase their risks of short circuits, a safety issue. The extruded lithium dendrites may also destroy the SEI layer or cause the formation of "dead lithium". With the increase of specific surface area and porosity of lithium metal anodes, the electrolyte consumption would be correspondingly increased. Moreover, the SEI accumulates and becomes thicker, which results in electrode passivation. These unfavorable factors lead to the increase of cell impedance and voltage polarization, as well as the degradation and fluctuation of Coulombic efficiency (CE), which severely frustrates the development of LMBs.

Therefore, adjusting the SEI component by adding a low content electrolyte additive is a most common way to reinforce the SEI film and improve the anode interface for the suppression of lithium dendrite growth. However, the reinforcement effect of SEI depends on the degradation reaction of additive with the reductive Li surface.

Prof. Li's group proposes a facile and effective strategy of in-situ catalytic grafting at interface. The thin "skin" layer of Li_2O and LiOH naturally existing on the surface of lithium metal can catalyze and activate the dissociation reaction of PDMS-OCH_3 under charge transfer. The broken macromolecules can be grafted onto the surface

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of lithium metal, while the smaller molecules can be condensed into inorganic Li_xSiO_y moieties with fast ion conductivity. Such an organic-inorganic hybrid interfacial phase (i.e. grafted SEI) is further reinforced by the injection of high concentration of LiF during the electrochemical process. The combination of hard inorganic components of LiF and LixSiOy provides fast-ion channels and interfaces for homogenization of Li-ion flowing and Li-mass deposition, while the soft PDMS branches can enhance the flexibility and buffer effect of the entire SEI. By adding liquid PDMS-OCH_3 to the carbonate system, the protected Li anode with grafted surface can be endowed with a stable cycling of Li|Li symmetrical cells for 1800 h and a low potential polarization of ~25 mV. The Li|Cu asymmetric cells enable a high CE value up to 97% even under high current density and high areal capacity. Thus, compared with other solid silicone additives with poor grafting capability, the liquid PDMS additive shows significant advantages in realizing lithium metal compaction and SEI stabilization.

In addition, the research group made progress in recent research on the anode interface modification of lithium metal batteries, especially in adopting functional additive/filler and conformal coating methods to design stable artificial SEI layers. For example, they firstly proposed a two-dimensional carbon-nitrogen polymer (C_3N_4) reinforced electrolyte to achieve the effective inhibition of lithium dendrite growth (*ACS Appl. Mater. Interfaces* 2017, 9, 11615). They proposed in-situ construction of porous magnesium metal networks to stabilize the reversible plating of lithium metal anode (*ACS Appl. Mater. Interfaces* 2018, 10, 12678). They firstly proposed a solution to a category of lithium-rich open framework solid electrolytes of fluorides with high-ionic conductivity and their homogenization effect on Li-ion flowing (*Energy Storage Mater.* 2018,14,100; *ACS Appl. Mater Interfaces* 2018, 10, 34322). They proposed a series of metal-organic frameworks (MOFs) as solid additives to trigger the in-situ injection of high-concentration LiF into robust Zr-O-C-based SEI for dual reinforcement (*ACS Appl. Mater. Interfaces* 2019, 11, 3869). They proposed a conformal coating of sericin protein to enable air-stable lithium metal anode and high-rate Li-S batteries (*J. Power Sources* 2019, 419, 72). They proposed the construction of an alloyable three-dimensional skeleton to guide unusual conformal and coaxial lithium deposition (*ACS Appl. Energy Mater.* 2019, DOI:10.1021 / acsaem.9b00573).

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Source: Shanghai Institute of Ceramics, Chinese Academy of Sciences

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>> PAGE 1

It is essential to understand the origin of life and trace the causes of diseases by exploring the "genealogy" of cell families, tracing their "ancestors" at an early stage of embryonic development and analyzing their "lineages".

In the early stage of embryonic development, the fertilized eggs first develop into blastocysts, and then form three embryonic layers: outer, middle and inner.

The ectoderm eventually develops into nerve, skin and other tissues, the mesoderm develops into heart, blood, muscle and bone, and the endoderm develops into lung, liver, pancreas and intestines.

The formation of the three embryonic layers directly affects whether the fetus can be born smoothly from the mother. However, it is not clear how cells multiply, differentiate, and determine their destiny. The development of each cell from the embryonic stage remains to be revealed.

Jing's team developed a new technique to analyze the transcription histology of cells in different spatial locations and developmental times of early mouse embryos, and successfully mapped a three-dimensional stereogram of cell growth trajectory with both temporal and spatial information.

"Scientists can trace the ancestors of different embryonic cells through this encyclopedic growth trajectory," Jing said, adding that after tracing the origin, the team found that some of the endodermal cells originally thought to have developed entirely from the epiderm were likely to have "crossed" the epiderm directly from the primitive endoderm, while some specific cells were thought to have followed other differentiated paths.

Mesoembryonic and ectodermal cells may have common "precursor" cells, he said, adding that these discoveries have overturned people's understanding of traditional cell genealogy.

In recent years scientists have mostly followed the "growth" path of cells, and differentiated the "precursor" cells from pluripotent stem cells for regenerative medicine and disease-related research into stem cells.

The findings will help to improve the differentiation system of cells in liver, pancreas, spinal cord and other organs, and provide a new possible way to obtain the stem cells of organs through differentiation, which may be more efficient and faster than the path based on "traditional cell genealogy", said Peng Guangdun, co-author of the paper and a researcher with the CAS Guangzhou Institute of Biomedicine and Health.

Jing said that the findings are a major revision and supplement to the classical hierarchical pedigree theory of developmental biology, and will greatly promote the development of early embryonic development and stem cell regeneration medicine.

Source: China Science Daily

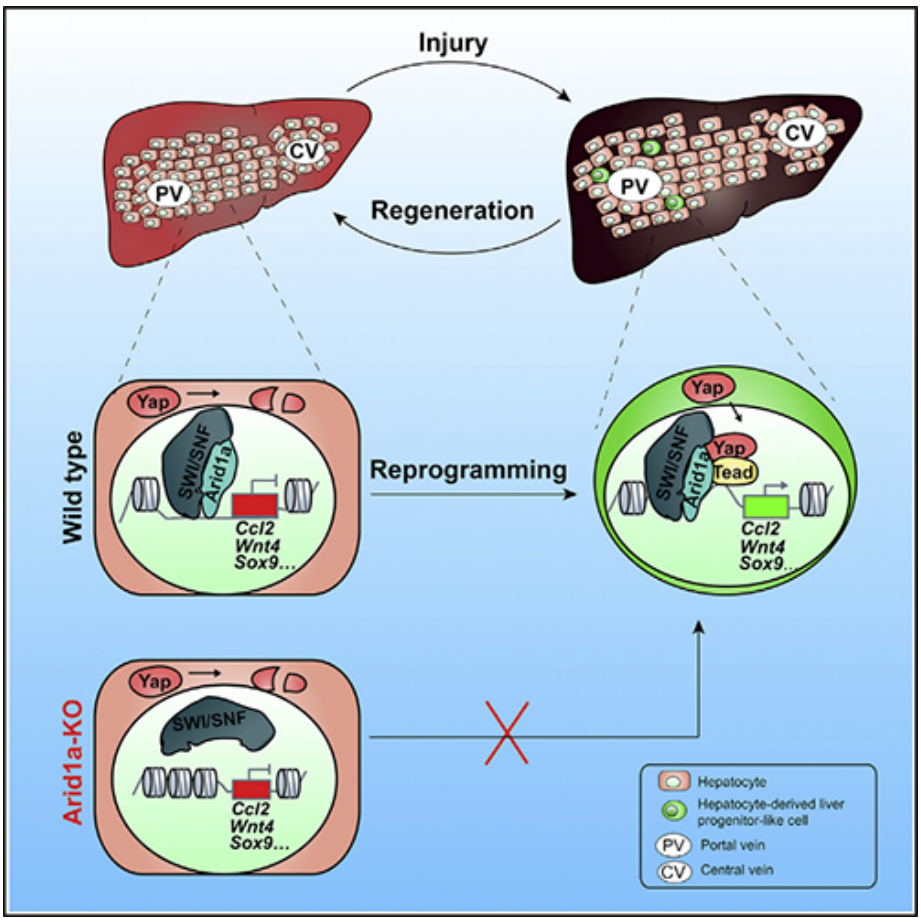
Roles of Arid1a in injury-induced liver reprogramming revealed

Mammalian organs comprise an extraordinary diversity of cell and tissue types. Following injury, differentiated epithelial cells can serve as a stem cell-independent source for tissue regeneration by undergoing reprogramming into other cell types. However, the intrinsic molecular basis underlying plasticity of differentiated cells remains largely unaddressed.

On July 3, 2019, a research paper named "A Homeostatic Arid1a-Dependent Permissive Chromatin State Licenses Hepatocyte Responsiveness to Liver-Injury-Associated YAP Signaling" was published in *Cell Stem Cell*. This work indicates an intrinsic epigenetic basis underlying hepatocyte competence in responding to regenerative signals in injury, which may help us to understand cell plasticity in other epithelial tissues.

This research was jointly accomplished by Prof. Hui Lijian's group at the Shanghai Institute of Biochemistry and Cell Biology of the Chinese Academy of Sciences (CAS) and Prof. Li Yixue's group at the CAS-MPG Partner Institute for Computational Biology of the Shanghai Institute of Nutrition and Health of CAS. Prof. Hui Lijian's group has been engaged in the research of liver pathology and hepatocyte reprogramming for a long time and Prof. Li Yixue's group has been engaged in algorithm development and big data mining of complex diseases such as tumors.

In the latest research, they found that Arid1a deletion inhibits damage repair of the liver by constructing Arid1a knockout-out mice of hepatocytes. As Arid1a is a key component of the SWI/SNF chromatin remodeling complex, the researchers studied the chromatin open area of the liver by ATAC-seq. They found that Arid1a helps liver cells to respond quickly to injury-induced signals by endowing a permissive chromatin state of hepatocyte reprogramming genes in their normal condition. Then the researchers identified the transcription factor Yap in response to Arid1a-mediated hepatocyte reprogramming by combining ChIP-seq and RNA-seq. Arid1a facilitates binding of YAP to hepatocyte reprogramming genes, endowing hepatocytes with critical competence in responding to the Hippo/Yap signaling pathway in vivo. These findings provide a framework for studying the contributions of injury-induced LPLCs to periportal liver regeneration.



Roles of Arid1a in injury-induced liver reprogramming revealed [IMAGE: PROF. LI YIXUE'S GROUP]

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Source: Shanghai Institute of Nutrition and Health, Chinese Academy of Sciences

CAS promotes cooperation with Spain, the UK and Russia

Bai Chunli, president of the Chinese Academy of Sciences (CAS) was invited to visit Spain, the United Kingdom and Russia from July 11 to 20.

In Spain, Bai visited the Polytechnic University of Catalonia, the Institute of Marine Sciences under the Spanish National Research Council and the Barcelona Supercomputing Center, and met with the heads of the three institutions.

He also witnessed the signing ceremony of an inter-school cooperation agreement between the University of CAS and the Polytechnic University of Catalonia and a memorandum of understanding between the National Space Science Center of CAS and the Spanish National Research Council, hoping to promote cooperation with Spain in space science, satellite marine remote sensing, high performance computing and joint training of postgraduates.

In the UK, Bai met with the presidents of the University of Exeter, the University of Bristol and the University of Warwick to promote joint training and cooperation in research of mutual interests.

Bai received honorary doctorates from the University of Exeter and the University of Warwick.

He signed a cooperation agreement between the Institute of Engineering Thermophysics of CAS and the Warwick Manufacturing Group of the University of Warwick and in a speech at a graduation ceremony at Warwick he hoped the students will devote themselves to scientific research and invited them to continue their studies at CAS.

In Russia, Tatyana Golikova, deputy prime minister of Russia, met with Bai and congratulated him on the 70th anniversary of the founding of CAS on behalf of Russia. She pointed out that strengthening science and technology innovation was an important part of the China-Russia comprehensive strategic partnership of coordination for a new era and also a strategic choice in the long run.

CAS President Bai Chunli (R) and Alexander Sergeev, president of the Russian Academy of Sciences, at the signing ceremony of a document on science and scientific research cooperation between the two academies [IMAGE: CAS]

She said Russia would actively implement the consensus reached by the two countries, launch the China-Russia Science and Technology Innovation Year successfully, promote cooperation between large-scale facilities, and encourage exchange of science and technology talents between the two countries.

She added that Russia attaches great importance to the proposal put forward by CAS on strengthening bilateral scientific and technological cooperation, which the government will support.

Bai Chunli suggested promoting cooperation between CAS and the Russian Academy of Sciences to a new level, namely a China-Russia comprehensive strategic partnership of coordination for a new era, and under that framework to institutionalize bilateral seminars between the two academies and establish long-term cooperation mechanisms for joint funding of projects. The Russian deputy prime minister responded positively to Bai's suggestions.

During Bai's visit to Russia, he and Alexander Sergeev, president of the Russian Academy of Sciences, signed a route map of science and scientific research innovation cooperation between the two academies, clarifying the core directions for cooperation in the next five years.

Source: Chinese Academy of Sciences (CAS)

The group photo of the 2019 summer camp of middle school students at the UCAS in Beijing, from July 15 to 20 [IMAGE: UCAS]

Some thoughts on academicians' lectures

By Fu Chenlin
(a summer camper from Hubei)
Date: July 19

Today is the fourth day on the campus of the University of the Chinese Academy of Sciences (UCAS). In the past three days, I have experienced the beauty of nearby Yanqi Lake, the richness and wonder of the animal world, the cutting-edge technology of our country and the brilliance of the academicians of the Chinese Academy of Sciences.

This morning I listened to two lectures given by two academicians. One was delivered by Ouyang Zhongcan. It made me recognize the convenience that technology brings to life. Technology is making a fundamental change to our lives, from the first-generation cellular phone that weighed 750g to modern smart phones that weigh less than 200g and have only a few milliwatts of power.

The other lecture, given by Wang Jingxiu, was about "solar activity and its impact on humanity's living environment". His lecture gave me a better understanding of the sun and its impact on the earth. The earliest record about sunspots is in *Huai-nan Tzu,* a Chinese philosophical masterpiece from around 140 BC in the early Han Dynasty (202 BC-220).

Human's observation of the sun has never stopped since ancient times, and we are moving toward a more precise understanding of it. It is both far away from us, and close to us. Only by predicting its movements accurately can we minimize the threat it poses to us and maximize the benefits it brings to us.

The academicians I listened to informed me in detail of many matters beyond my imagination. For example, I had never thought that progress in smart phone development could be a highlight of engineering or that the sun poses a threat to life on Earth.

They are our predecessors, and passing on knowledge to us is their mission. We are the new generation of youth in the 21st century and taking up the country's scientific and technological progress is our mission. At the University of the Chinese Academy of Sciences, I found science and a better self!

Source: University of the Chinese Academy of Sciences (UCAS)

China issues plan to improve math research

A plan aiming at strengthening the country's math research was recently released by the Ministry of Science and Technology, the Ministry of Education, the Chinese Academy of Sciences and the National Natural Science Foundation of China.

According to the document, efforts will be made to support basic mathematics science, strengthen research on applied mathematics and applications of math, and promote and deepen high-level domestic and international exchange and cooperation.

At present, many teenagers and their parents in China do not clearly understand math. Most students learn it to get good grades and be enrolled by better schools. Many teachers do not pay attention to training students' mathematical thinking ability.

Mathematicians' thinking is always very active in their young adulthood and youth should be the key for developing mathematics in a country, according to Tian Ye, a young mathematician at the Chinese Academy of Sciences.

China is expecting more teenagers

to improve their knowledge and love of math and devote themselves to reaching new heights in math research.

Source: People's Daily