

## Zwicky Transient Facility Nabs Supernovae, Stars, and More

WHITNEY CLAVIN  
Office of Strategic  
Communications

The results are rolling in from Caltech's newest state-of-the-art sky-surveying camera, which began operations at the Palomar Observatory in March 2018. Called the Zwicky Transient Facility, or ZTF, the new instrument has so far discovered 50 small near-Earth asteroids and more than 1,100 supernovae, and it has observed more than 1 billion stars in the Milky Way galaxy. One of the near-Earth asteroids discovered by ZTF, called 2019 AQ3, has an orbital period of just 165 days, the shortest known "year" for any asteroid.

"It's a cornucopia of results," says Shri Kulkarni, the principal investigator of ZTF and the George Ellery Hale Professor of Astronomy and Planetary Science at Caltech. Recently, several new papers about early results and technical specifications for ZTF were accepted for publication in the journal *Publications of the Astronomical Society of the Pacific*. "We are up and running and delivering data to the astronomical community. Astronomers are energized."

ZTF uses the 48-inch Samuel Oschin Telescope at Palomar to survey the northern skies for anything that explodes, moves, or changes in brightness. Because the ZTF camera covers 240 times the size of the full moon in a single night-sky image, it is discovering the most fleeting, or short-lived, of cosmic events, which were impossible to catch before now.

"ZTF is surveying the whole northern sky every three nights," says Kulkarni. "It's already discovering a few supernovae a night, and we expect that rate to go up."

The cost to develop and run ZTF is about \$24 million, with about \$11 million of

the funding coming from the U.S. government via the National Science Foundation (NSF) and the rest coming from an international collaboration of partners. Additional support comes from the Heising-Simons Foundation, along with Caltech itself.

on notable objects of interest using other telescopes, including the 60-inch and 200-inch Hale telescopes at Palomar. An NSF-funded program called GROWTH, with 18 international observatories in the Northern Hemisphere, also follows up on the ZTF alerts.

specializes in "big data," and specifically how to handle and process large streams of astronomical data. "It's like running a major newsroom. We've never operated at this scale before, and handling all the data is quite a feat," he says.

Discoveries from ZTF so far include not only new supernovae, binary stars, and asteroids but two black holes caught shredding stars. As stars wander too close to black holes, they can be "tidally disrupted" by the gravity of the black hole and stretched into oblivion. Graham says that he and the team working on the tidal disruption data, led by Suvi Gezari of the University of Maryland, got fed up with referring to the technical names for the objects, consisting of long strings of numbers. "We decided to nickname them Ned Stark and Jon Snow, after Game of Thrones characters," he says.

ZTF also caught two near-Earth asteroids, 2018 NX and 2018 NW, that zipped by Earth at distances of only 72,000 miles and 76,000 miles away, respectively, or approximately a third of the distance between Earth and the moon. These discoveries were enabled by the NSF-funded GROWTH program.

On January 4, 2019, ZTF caught the near-Earth asteroid 2019 AQ3. "This is one of the largest asteroids with an orbit entirely within the orbit of Earth—a very rare species," says Quanzhi Ye, a postdoctoral scholar at IPAC who first spotted the asteroid in the ZTF data.

Tom Prince, one of the co-investigators of ZTF and the Ira S. Bowen Professor of Physics at Caltech, says that the instrument is particularly adept at identifying new gravitational-wave sources—in particular, pairs of compact stars like white dwarfs—that will be observed with future space-based gravitational-wave detectors.

"Because we cover so much sky so often, we can find these rare exotic binary systems that contain two white dwarf stars, each about the size of Earth but about half the mass of our sun. Their orbits are predicted to become smaller and smaller because of the loss of energy due to gravitational waves."

ZTF is also laying the groundwork for the future NSF-funded Large Synoptic Survey Telescope (LSST), which will, in every exposure, scan a volume of sky 13 times larger than that scanned by ZTF. LSST is scheduled to begin operations in 2022.

"The same alert techniques that ZTF is developing for international networks of observatories to follow up on its findings will be applied to LSST when it joins the search," says Kinney.

The newest ZTF papers are: "The Zwicky Transient Facility: System Overview, Performance, and First Results," led by Eric Bellm of the University of Washington; "The Zwicky Transient Facility: Science Objectives," led by Graham; "The Zwicky Transient Facility: Data Processing, Products, and Archive," led by Frank Masci of IPAC; "Machine Learning for the ZTF," led by Ashish Mahabal of Caltech; "The Zwicky Transient Facility Alert Distribution System," led by Maria Patterson of the University of Washington; "The GROWTH Marshal: A Dynamic Science Portal for Time-domain Astronomy," led by Mansi Kasliwal of Caltech; and "A Morphological Classification Model to Identify Unresolved PanSTARRS Sources: Application in the ZTF Real-Time Pipeline," led by Yutaro Tachibana of Tokyo Institute of Technology and Caltech and Adam Miller of Northwestern University and the Adler Planetarium.



A new, composite image of the Andromeda galaxy made by combining three bands of visible light captured by ZTF. The image covers 2.9 square degrees of sky, which is one-sixteenth of ZTF's full field of view. Andromeda, also known as Messier 31, is the nearest major galaxy to our Milky Way galaxy, lying 2.5 million light-years away.

CREDIT: ZTF/D. GOLDSTEIN AND R. HURT (CALTECH)

"The start of routine operations of ZTF marks a new era in our ability to capture the nightly and hourly changes transpiring in the universe," says Anne Kinney, NSF assistant director for mathematical and physical sciences. "They are now recording real-time events from distant supernovae to nearby asteroids and are poised to discover the violent mergers and explosions generating gravitational-wave events."

Because nearly half of ZTF is paid for by the U.S. government, nearly half of its observations are shared publicly in near-real-time with the astronomy community. When varying, or transient, objects are detected, an automated alert system is activated, sending notices out to astronomers, who then quickly follow up

All data from the ZTF camera are sent via a microwave network managed by UC San Diego to IPAC, an astronomy center at Caltech that processes and archives up to 4 terabytes of data each night. "This is the first time IPAC has generated real-time alerts from a survey and the first time a survey has made public up to hundreds of thousands of alerts per night," says George Helou, ZTF co-investigator and executive director of IPAC. Ultimately, the detailed data are also made available to astronomers around the world through IPAC.

"It takes only 10 to 20 minutes from the time a transient observation is made to the time the alert goes out," says Matthew Graham, the ZTF project scientist at Caltech. Graham

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# ARC Minutes

Meetings are every week in SAC 13

## ARC Meeting Minutes

No ARC meeting this week due to midterms.

**The ARC website at [arc.caltech.edu](http://arc.caltech.edu) has more information about what the ARC does if you are interested. We meet every Sunday at 2pm in SAC13 and our meetings are open to everyone! If you have any questions, please feel free to email [esalzman@caltech.edu](mailto:esalzman@caltech.edu).**

# ASCIT Minutes

Meetings are every week in SAC 13

## ASCIT Board of Directors Meeting

Minutes for 10 February 2018. Taken by Rachel Sun.

**Officers Present:** Sakthi Vetrivel, Erika Salzman, Sarah Crucilla, Varun Shanker, Irene Chang, David Berger Maneiro, Rachel Sun

**Guests:** Alejandro Lopez

**Call to Order:** 8:02 PM

### President's Report (Sakthi):

- Met with Felicia on Friday and talked about:
  - Bechtel representatives on various campus committees (BoC, ARC, CrC, IHC, etc.). These people are useful to have as resources in Bechtel, so will talk with these committees about getting Bechtel representatives.
  - Better marking the doors of PAs and other resources in Bechtel.
  - Bechtel social events.
- Midnight Donuts is happening on the Friday-Saturday interface (3/1-3/2).

### Officer's Reports:

#### V.P. of Academic Affairs (Erika):

- ARC has new representatives.
- Dean's meeting 2/21.
- Student Faculty Lunches 2/28. Location and professors attending are TBA.
- A Cue meeting is happening soon and the ARC will present their new TQFR changes.
- Please fill out SFC option surveys. These surveys are all compiled on the ARC website.

#### V.P. of Non-Academic Affairs (Sarah):

- Continuing transitioning the new members of the IHC.
- Going over Rotation and houses should have Rotation reflection meetings soon. This is to give IHC more information to improve the qualitative aspects of Rotation. Will also ask freshmen about Rotation and how it works. Want to make sure transparency is continued.
- IHC has a VPSA meeting on Tuesday; will go over Orange Watch.
- Meeting with Felicia and Chief Clay a week from Tuesday; will go over Orange Watch and general party safety. Aiming to set up future meetings with Caltech Security to form a better relationship with them.

#### Director of Operations (Varun):

- Sakthi and Varun talked with a potential candidate for a new Tech advisor.
- Will send out an email regarding the amendment for a new Tech editor succession process.

#### Treasurer (Irene):

- Discussing funding for alternate events at Interhouses.

#### Social Director (David):

- Nothing to report.

#### Secretary (Rachel):

- Nothing to report.

If anyone has any questions or concerns about a section of the minutes please email the appropriate officer. We are happy to answer any questions.

**Meeting Adjourned:** 8:54 PM

Please see the Training Calendar for monthly training dates. You may also contact the Training Coordinator or call 626-395-6727 for assistance.

Contact Safety Office [safety.training@caltech.edu](mailto:safety.training@caltech.edu) at 626-395-6727

For more information see EH&S Safety Training.

### Emotional Well-Being Workshop Series - Emotion Regulation, Eating, and Food

Wednesday, February 13 | 12 PM | Avery Library – Avery House

Each year, Counseling Services presents the Emotional Well-Being Workshop Series to bring in mental health professionals from both on- and off-campus to discuss a wide variety of topics related to having a healthy emotional life. Each workshop will be on a Wednesday from 12:00 - 12:55 in Avery Library, and free lunch will be provided on a first-come basis.

On February 13th, Heather Russo, LMFT, CEDS and Amaia Perts, MS from The Renfrew Center for Eating Disorders will talk about the interrelationships among emotional regulation, eating, and food. Come join us!

For more information see <http://wellness.caltech.edu/resources/workshops-and-groups>

### Caltech Library Workshop: You and Your Thesis

Wednesday, February 13 | 2 PM | Sherman Fairchild Library 328 (Multimedia Conference Room)

This class will give a brief overview of techniques useful in the production and publication of Caltech electronic theses, including tips on formatting and submitting. It will also touch on intellectual property considerations and access, as well as thesis dissemination policies. Additional topics may include author identification (ORCID) and preservation of thesis-related research data.

### Elliot Meyerowitz - Plant Growth: How Stem Cells Make Stems

Wednesday, February 13 | 8 PM | Beckman Auditorium

Plants are the dominant source of our food, clothing, shelter, and many pharmaceutical drugs, yet we know very little about how they live and grow. In this talk, Caltech plant biologist Elliot Meyerowitz will describe how plant stem cells create patterns of leaves and flowers, answering questions that long have intrigued mathematically inclined biologists.

This event is free; no tickets or reservations are required. A minimum of 700 seats will be available on a first-come, first-served basis, beginning at 7:30 p.m. Reserved section tickets are available to members of The Friends of Beckman Auditorium and the Caltech Associates, and to Caltech alumni.

### SURF Proposal Follow Up Session A

Friday, February 15 | 12 PM | Center for Student Services 360 (Workshop Space) – Center for Student Services

Location: Hixon Writing Center Keep in mind you can also sign up to talk one-to-one with a writing specialist during our regular tutoring hours to discuss a SURF

proposal at other times. While the large group meeting held on February 4th at noon will explain the basics of the SURF proposal and give you an opportunity to ask questions about it, it will not be a venue for reviewing your draft. Sharing your draft with others, including your mentor and co-mentor, is crucial to writing an excellent proposal. To help you out with getting feedback on your draft, the HWC will host two proposal workshops. These workshops will be led by a STEM Writing Specialist and will involve getting guided feedback from peers on the strengths and limits of your proposal. You must sign up to attend a workshop. Please consult these detailed instructions about how to make your reservation. There is a cap of 20 participants per workshop.

Contact Student Faculty Program Office [sfp@caltech.edu](mailto:sfp@caltech.edu) at 6263952885

### Let's Talk

Friday, February 15 | 3 PM | Jorgensen 126 – Earle M. Jorgensen Laboratory

Let's Talk is a chance for students to have brief, informal, and confidential chats with Counseling Services staff. You can ask questions, troubleshoot concerns, find advocacy opportunities, and learn about campus resources. It's not a substitute for formal counseling and is not considered mental health treatment. Let's Talk staff can listen to your specific concerns, help you problem-solve, and connect to resources both on- and off-campus that could be helpful to you.

Fridays 3:00 PM - 4:30 PM from January 11th - March 15th, 126 Jorgensen.

### Coping with Procrastination and Work Avoidance

Friday, February 15 | 4 PM | Avery Library – Avery House

Counseling Services is pleased to offer a workshop on coping with procrastination and work avoidance. It's open to all graduate and undergraduate students - come join us! No signup is necessary - just show up. We'll meet in Avery Library from 4:00 - 5:00.

\* Learn tools for coping with procrastination and work avoidance;

\* Learn practical, behavioral strategies for responding differently to old habits;

\* Respond differently to unhelpful thoughts like, "I can just get up early and do this tomorrow."; and

\* Sign up for an optional text-based reminder system to keep the lessons from the workshop fresh.

For more information see <http://counseling.caltech.edu>

### Caltech Art Gallery and Art of Science Opening Gala

Friday, February 15 | 7 PM | Chandler Cafe

Thanks to the many submissions from the Caltech+JPL community, we have over 100 pieces to display in the upcoming Caltech Art Gallery! To celebrate its opening, we are holding a Gallery Opening Gala on February 15th from 7-9pm in Chandler Cafe and on the Chandler Patio.

All are welcome to take part in the art appreciation, converse with the artists, listen to Caltech music groups, and enjoy some light refreshment. We hope to see you there!

# Upcoming Events

EDITORS-IN-CHIEF

The Upcoming Events column serves to inform students of upcoming events. The list is compiled by the Editors-in-Chief from information available around campus.

## Shop Safety Training

Wednesday, February 13 | 10 AM | Central Engineering Services, Student Shop – Central Engineering Services

This is a mandatory class for persons using the Caltech Student Shop. Instruction covers hazards in the shop, personal protective equipment, and safe machine operation. Persons attending the class must wear shop appropriate clothing,

including closed toed shoes and long pants. For more information about the Student Shop please go to: <http://www.its.caltech.edu/~studshop/>.

Location: Caltech Student Shop is located in Central Engineering Services (CES Bldg. 85)

This course is typically held on the second Wednesday of each month and is also available as a group-specific course that can be scheduled on demand.

Pre-registration required. Please use the following link to register for upcoming classes: Access/OLM. Under Training opportunities, select your desired course and use the drop-down menu for date desired.



## Seeking Successor for (Generation 2) Housetalia Comic

As most of you may know, four years ago, I started the Housetalia comic on social media/the internet. It starred eight walking Rotation violations and was primarily a funny House-based humor comic. It proved to be fairly popular over its run. Now that I have graduated, I can't continue; but the Houses belong at Caltech. *They don't belong with me.*

So... I'm considering passing on the Housetalia comic to an underclassman. I'd like someone who:

- Has at least one year left at Caltech
- Can draw competently
- Keep a consistent weekly update schedule during the school year
- Write all Houses/Residences fairly, and stay funny

If you are or know someone who is interested, contact me and I'll let them "apply". It'll probably consist of making a sample comic, and a short conversation learning about the series being inherited.

Contact Amulya Mohan at [amohan@alumni.caltech.edu](mailto:amohan@alumni.caltech.edu)

Housetalia comic archive at:  
<https://www.facebook.com/groups/housetalia/>  
<https://web.archive.org/web/20180901232026/http://housetalia.caltech.edu/comics/79.html> (Website recovered from Internet archive, about 1 term outdated)



## Emotional Well-being Series

2019

FEBRUARY 6  
GET MOVING WITH BEHAVIORAL ACTIVATION

FEBRUARY 13  
EMOTION REGULATION STRATEGIES

FEBRUARY 20  
GETTING UNSTUCK FROM EMOTIONAL RUTS

FEBRUARY 27  
HEALTHY SEXUAL RELATIONSHIPS

MARCH 6  
MINDFULNESS AND EMDR FOR SELF-CARE

MARCH 13TH  
MANAGING YOUR FAMILY'S EXPECTATIONS

LUNCH PROVIDED  
AVERY LIBRARY @12PM  
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MARCH 20  
WELCOMING THE DIFFERENT PARTS OF YOUR PERSONALITY

[wellness.caltech.edu](http://wellness.caltech.edu)

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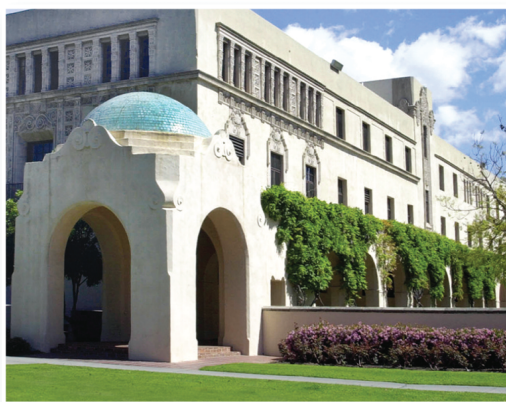
[WELLNESS.CALTECH.EDU](http://WELLNESS.CALTECH.EDU)



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## Seeking Ushers for CaltechLive!

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Seeking energetic, articulate people to provide excellent customer service for Caltech Public Events. Serve as a goodwill ambassador; ensuring audiences have a safe and enjoyable experience while attending performances and programs in Beckman and Ramo auditorium. Ushers must be able to stand on their feet for long periods of time, assist patrons to their seats, read and comprehend printed tickets and communicate respectfully and clearly. Assist with concession or souvenir sales as needed. Must be able to lift up to 25lbs. Ushers are scheduled on an event basis, typical shifts include nights and weekends. Prior theater experience is a plus.

To apply contact: Ed Brown at [edbrown@caltech.edu](mailto:edbrown@caltech.edu)

## LET'S TALK

Brief, confidential,  
supportive conversations

NO APPOINTMENT NEEDED  
NO PAPERWORK

Fridays 3 - 4:30pm  
Jan 11 - Mar 15  
126 Jorgensen

meet counseling services staff  
problem-solve & ask questions

[wellness.caltech.edu](mailto:wellness.caltech.edu) | 626-395-8331

*Let's Talk is not a substitute for formal counseling  
and is not considered mental health treatment.*

## AMAZON SKYMALL



### Goldfish Water Bag Shape Dangle Hook Earrings

**\$2.95** ★★★★★

It doesn't violate Housing's pet policy... probably.  
<https://amzn.to/2GxQGjO>



### Bloody Halloween Handprint Footprint Window Floor Clings

**\$6.99**

Casual lounge decor.  
<https://amzn.to/2GBNljW>



### Wide Spinner Ring Band Creative Dice Pattern Design

**\$13.89** ★★★★★

See XKCD 221.  
<https://amzn.to/2N1eOwh>

Enter this week's raffle for your favorite Amazon SkyMall item here:  
<https://goo.gl/forms/sNoTUHmoESiAW9Y33>



# Fresh Perspective Leads No. 32 Men's Tennis Into 2019

## GOCALTECH.COM

Actual Sports Content Editor

PASADENA (Feb. 7, 2019) – The 32nd-ranked Caltech men's tennis team will have a chance to build on a historically good 2018 and Fall ITA Regionals, returning last year's entire SCIAC Postseason Tournament team.

The Beavers will also take the court for the first time under new Head Coach Jason Cohen. Cohen joins the Beavers off a stint as the men's and women's coach at Colby College, one of Caltech's 19 opponents this year, and one of nine nationally ranked teams the Beavers will play outside of the SCIAC.

Cohen believes his squad can take a step forward into the next tier of teams by making the necessary mental improvements, some of which they have already shown in addition to controlling the factors immediately in front of them, both on and off the court.

"Some of the things we've been working on this year have specifically related to our mentality in matches and practice," Cohen said. "We're looking to better manage the things we can control, such as competing and having mental and physical toughness in matches in addition to how we can develop that within our team. Obviously you want to win and that's what I'm hoping for us to do this spring, but there are many things that will contribute to whether or not we are a winning team."

Caltech is returning the nation's fourth-ranked doubles team in Varun Shanker (Midland, Mich. / Midland Dow) and James Wei (Chappaqua, N.Y. / Horace Greeley). The sophomores will be fixtures atop the Beavers' singles and doubles lineup as the reigning champions at the ITA West Regionals in 2018. Shanker and Wei then got a taste of playing some of the nation's top teams at the ITA Cup in Rome, Ga., none of which they had played against previously. Breaking into the nation's top-four teams as sophomores, however, may give the talented team the confidence necessary to improve on last year's 12-win season, a single-season program record for a doubles pairing.

The sophomores have shown themselves to be just as potent singles players. Wei set the single-season wins record last year with 15, 11 of which came

from the second singles spot, while Shanker, aided by strength-of-schedule playing out of the top spot, comes into the season as the west region's 19th-ranked singles player.

"It was helpful to see James and Varun playing against some high-level teams while getting to work on some new strategies and formations in doubles," Cohen said. "That's one of those things that we as a whole need to work on but especially with James not being 100-percent, it really opened up opportunities to mixing it up because we had to. They've learned that doing the same thing over-and-over again isn't quite good enough. I think it allowed them to see that they need to be more flexible mentally in matches."

Shanker, along with seniors Derik Nguyen (Anaheim, Calif. / Canyon) and Zixiao Li (Coppell, Texas / Coppell), will captain this year's 11-man squad. Nguyen has consistently played among the top-four singles spots and could see similar usage this year. He has also typically played doubles alongside classmate Zixiao Li, though Cohen is open to mixing things up if it's going to produce results. Li is an accomplished bottom-three singles player and previously set the single-season wins record as a freshman with 14 before Wei broke it in his debut season last year. Nguyen and Li combined for double-digit wins last season and will be looking to go out on a high-note in their final season of collegiate tennis where they will have the opportunity to lead a team with the potential to compete with the SCIAC – and nation's very best teams.

"Derik and Zixiao have been one of the major driving forces behind Caltech becoming a good tennis team," Cohen said. "That senior class really helped turn the team around and those guys have really been at the forefront of the program's turnaround. Varun is one of the hardest workers we have and is a leader by example. It was easy for me to make him a captain because he works super hard and it's made life pretty easy for everyone."

Caltech will also be returning junior Miha Valencic (Colleyville, Texas / Grapevine), who has seen success primarily as a singles player. Valencic tied for the team lead with nine wins as a freshman before breaking out even further in his sophomore season with



Started from the bottom, now we're here.

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13 wins between three different positions, second to only Wei and his record season. The junior will certainly be in the conversation to occupy a mid-tier singles spot once again as the team's winningest player over the past two seasons. Sophomore Kevin Yu (Mason, Ohio / Cincinnati Country Day) had a similarly dominant year going 8-0 between fourth and fifth singles in 2018. He too could factor into more singles wins in 2019, as could former SCIAC Athlete of the Week junior Connor Soohoo and senior Andre Liu (Novi, Mich. / Novi), who picked up 11 wins his sophomore season.

The Beavers are also adding three freshmen in Matthew Gonzalgo (Plantation, Fla. / St. Thomas Aquinas), Patryk Kozlowski (Irvine, Calif. / University High) and Jake Will (Honolulu, Hawaii / Punahou School). Gonzalgo, a three-star recruit, is a proven winner against players of similar skill-level and could immediately factor into the Beavers' bottom-three. Kozlowski comes to Caltech similarly heralded but brings with him some key doubles credentials

as well that could make him another instant contributor. Will originally stepped foot on campus as a two-star recruit but has already shown tremendous improvement since then and could continue to do so playing alongside a tremendous crop of Caltech tennis players in 2019.

"We have a fairly balanced team in terms of class breakdown," Cohen said. "I think the underclassmen have particularly bought into some of the things I've been teaching them, which bodes well for the future of our program. Soon, incoming freshmen will just follow along with what the upperclassmen are doing and that will lock in the culture of our program. That said, the upperclassmen have done a great job as well, but it's especially encouraging from the underclassmen. Everything is going pretty well."

Cohen and the Beavers will begin their season on the road this Sunday, Feb. 10 when they travel to the University of California, Santa Cruz for a 9 a.m. match.

## SCORES

**Feb 9, 2018**

*Women's Basketball*

**L 47-62**

*Men's Basketball*

**W 69-85**



## Caltechlive!

### THE EARNEST C. WATSON LECTURE SERIES

## PLANT GROWTH: HOW STEM CELLS MAKE STEMS

Elliot M. Meyerowitz, George W. Beadle Professor of Biology; Investigator, Howard Hughes Medical Institute, Caltech Division of Biology & Biological Engineering



Plants are the dominant source of our food, clothing, shelter, and many pharmaceutical drugs, yet we know very little about how they live and grow. In this talk, Caltech plant biologist **Elliot Meyerowitz** will describe how plant stem cells create patterns of leaves and flowers, answering questions that long have intrigued mathematically inclined biologists.

WED., FEB. 13, 2019 • 8 PM

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4PM - 5PM AVERY LIBRARY

FRIDAY, FEBRUARY 15TH,  
4PM - 5PM AVERY LIBRARY

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Wednesday, February 6  
12pm @ Avery Library  
Lunch is provided!

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[wellness.caltech.edu](http://wellness.caltech.edu)

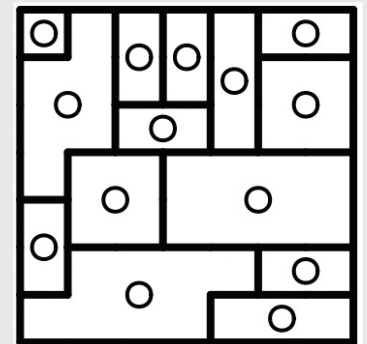
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## Galaxy

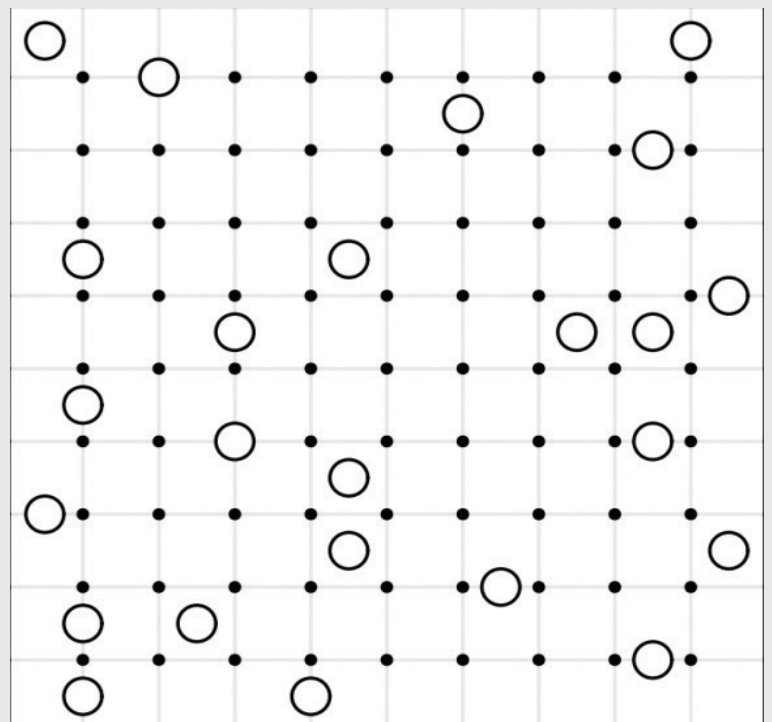
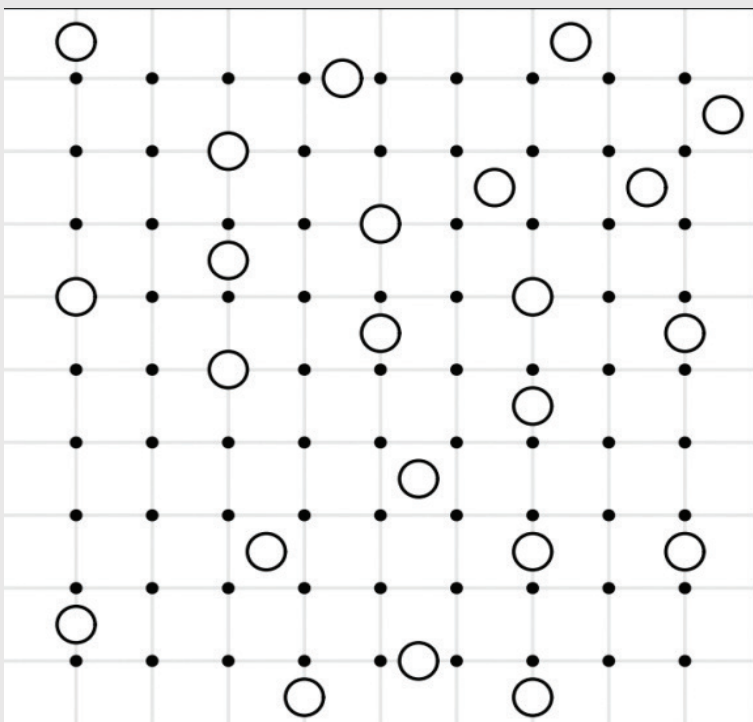
Back to Galaxy Puzzles!

### Directions

Connect the dots to make edges so that each circle is surrounded by a symmetrical galaxy shape, and the puzzle is completely filled with galaxies. The galaxy shapes must be rotationally (or 180°) symmetric, like the shapes shown here:



I'm hungry... =(









**SI Units**

N.O. Standards

Some time ago, a friend told me that instead of the customary or metric system, everything should be in the FFF system (furlong-firkin-fortnight). I thought he was crazy, but then I realized how cool such a system sounded. You could tell people you were going half a furlong per fortnight and everyone would know what you meant.

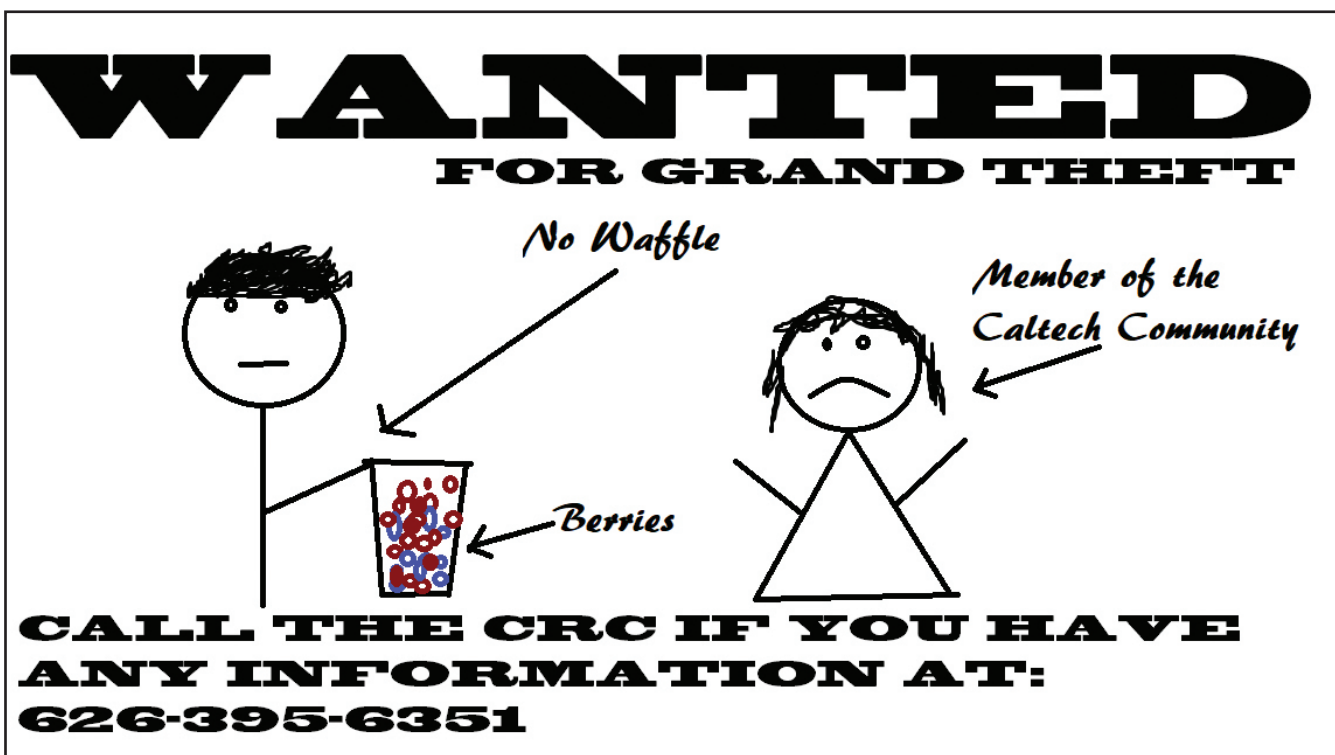
Yesterday, I started thinking about how I really like the shortened forms of many metric units. For example, I think that micron sounds so much cooler than just micrometer and that just saying kilo is better than kilogram. How-

ever, when I tried to do this with other measurements, people stared at me like I grew another head. I said centons to someone yesterday and the guy just looked at me straight in the eye and said "huh?". I explained to him my rationale behind this word and he just thought it was dumb. I think he's dumb for not seeing the promise of a better tomorrow. The world isn't ready for this new revolution in measurement.

Fun fact, the plural of micron is micron or micra.

**Answers to Puzzles and Crossword:**

<http://bit.ly/2tjJXlz>



Daniel Xu  
CRC's Most Wanted 2019  
Made with Paint

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We are always accepting submissions for comics, and will pay you.

**Letters from the Editors-in-Chief**

Amrita Rhoads: someone make me take my midterm. please.

Milan Roberson: my head hurt. HYDRATE OR DIE-DRATE

Sophie Piao: im not sure im actually an editor anymore but it's nice to have this platform? maybe? if you're reading this please know that i love my cats.

Dan Xu: I am a jelly donut.

This week's recommended The California Tech usage after reading is: makeshift wetsuit in this time of flooding

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