INTRODUCTIONS

1

CODE OF CONDUCT

- **Always be respectful and kind.**
- **Value diversity**. The differences between people are an asset, bringing strength to a group through new ideas, innovation, and creativity. A variety of viewpoints and approaches are opportunities for discussion and learning. Discomfort is okay.
- **Share the stage**. Don't dominate the conversation, invite everyone's voice to be heard. Speak only to your own experience. Do not assume that you understand more or better than others.
- **Be present**. This experience will be what you make of it. Please leave non-urgent tasks, email, and texts for later.

2

NITARP: THE NASA/IPAC TEACHER ARCHIVE RESEARCH PROGRAM (OVERVIEW)

LUISA REBULL

8 JAN 2023

3

DATA IN THE CLASSROOM

- Four categories, with different audiences, challenges, goals:
  - Reproductions of simple or done projects, using real data (professional quality or really good amateur).
  - Essentially reproductions of done projects, using new data (or a combination of new+archival data).
  - Looking for new things in old data (e.g., citizen science).
  - Original research, professional quality new or archival data.
- Each is valid and worthy and important; each has a different footprint and reaches a different audience of educators and students and the public.
- …But the last bin is kind of…empty. Reaches fewest people, requires most of participants, and is the most intense for participants. NITARP IS HERE…

4

THINKING ABOUT THIS AS A FUNNEL

5

WHAT IS NITARP?

- NASA/IPAC Teacher Archive Research Project. (IPAC is where I work at Caltech; it has operations centers and archives for several missions/telescopes.)
- NITARP has been going since 2005.
  - 2005-08, called the Spitzer Research Program for Teachers and Students. Renamed in 2009.
- Goal is (and was) to ***give educators an authentic research experience*** using real astronomical data and tools.
- Educators then turn around and carry this experience into the classroom and beyond.

6

SCIENCE VS. ENGINEERING

7

BRIEF ASIDE: SCIENCE VS. ENGINEERING

- NITARP is going to be a science experience.
- (No reason it can't be expanded to engineering, but we haven't had the resources to do this.)
- So, what is the difference?
- Engineers build things, scientists learn about nature.
- Mars rovers – engineers got them to Mars; scientists' jobs really start once it's there.
- There is a continuum of individuals, but mostly two populations, two cultures, etc. NASA has a lot of both, but more engineers. And good missions/telescopes/facilities come out of the two groups working well together.

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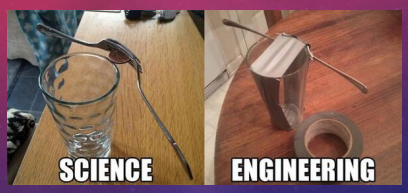

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REBUTTAL FROM VON KÁRMÁN (*)

- "Scientists discover the world that exists. Engineers create the world that never was."
- *(*) One of the founders of JPL*

10

Anyway, we're doing science….

Someone ask me a question before I move on…

11

WHAT IS REAL SCIENCE?

12

REAL SCIENCE VS. TEXTBOOK SCIENCE

- Science (history) as presented in textbooks may seem a never-ending series of right answers. Real science has a lot of dead ends and false starts as we struggle to find out what the 'right answer' is.
- Science problems in textbooks have well-defined problems, specific methods you're supposed to use to solve them, and right (exact) answers (1.2 can be wrong when 1.3 is right).
- Real science is not quite "made up as you go along," but different people approach the same problem in different ways, and many answers can be right (1.2 and 1.3 can both be right).

13

REAL SCIENCE VS. TEXTBOOK SCIENCE (2)

- ***The only way you know it's the right answer is if you believe that everything you did to get there is right.***
- This is NOT the same thing as "there is no right answer"! It is, however, "there is no answer in the back of the book"!
- **Wrong answers get published.** (Because they believed everything they did to get there was right.)

14

REAL SCIENCE VS. TEXTBOOK SCIENCE (3)

- Canned labs:
  - You (or someone) knows what the answer is going to be before you start.
  - You (or someone) knows exactly what to do to get that answer (and there is probably a cookbook provided with your lab).
  - Everyone in your class (and that of the prior year, etc.) is supposed to do exactly the same series of steps.
  - You probably went through the steps just once.
  - You may or may not have understood *why* you were doing each step.
  - You need to write up your report as: title, purpose, materials, procedure, conclusion.
- Or, the entirety of your research involves going to the library (or the web) and summarizing what humankind already knows about a topic as a term paper.

15

GUESS WHAT??

No real scientific research looks anything like that.

16

REAL RESEARCH

Real research is far more circular, redundant, non-linear, dynamic, creative, …

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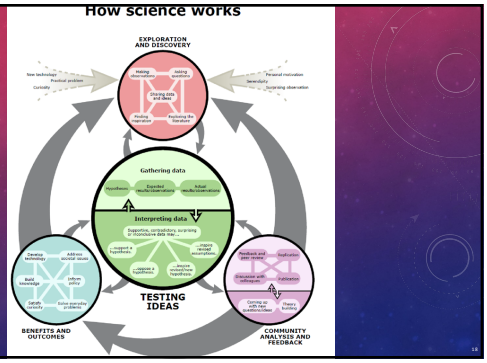

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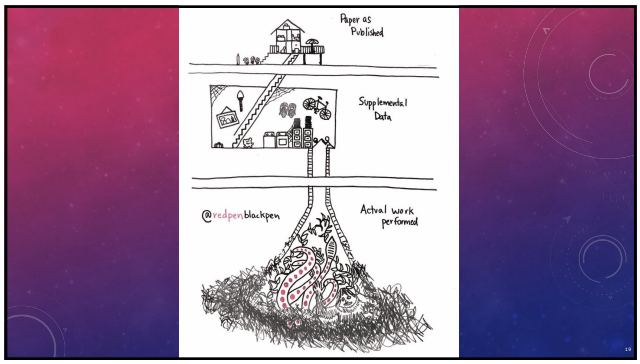

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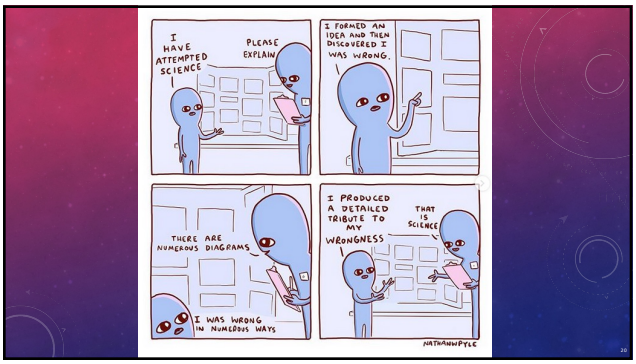

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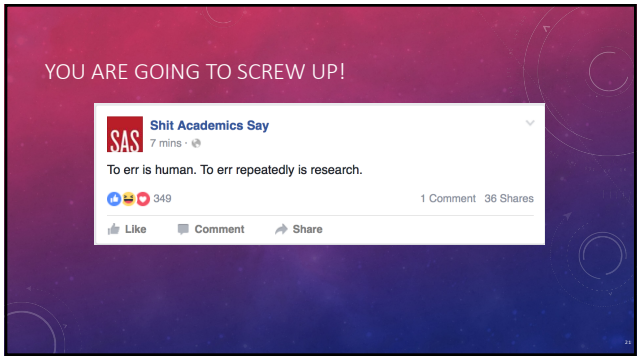

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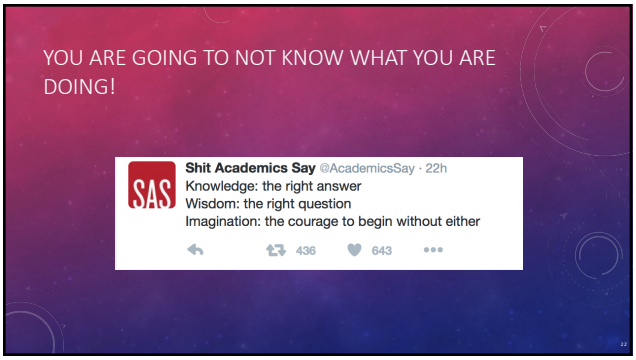

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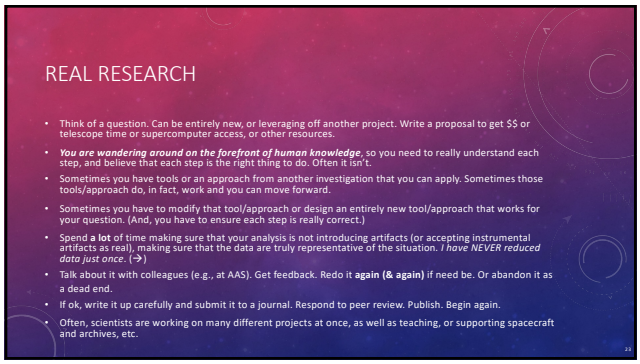

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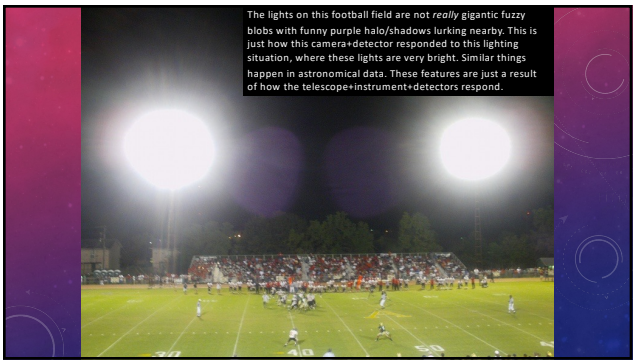

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Someone ask me a question before I move on…

Just because you don't understand what you're looking at doesn't mean it's aliens.

25

NITARP HISTORY/CONTEXT

26

BRIEF FUNDING HISTORY

- The original Spitzer program was funded out of the Spitzer EPO budget, which basically evaporated with Spitzer's cryogen.
- The NITARP program was rescued from the ashes in 2009 and was funded by discretionary money from the ADAP program (Doug Hudgins) combined with the archives at IPAC (Spitzer, NED, IRSA, etc.).
- Chaos in NASA EPO began in 2013. Somehow, Doug Hudgins still found us money (if you see Doug Hudgins, THANK HIM), but the rest of the money is now gone.
- Chaos in Federal Government means restrictions on NASA travel, so NITARP travel now through Caltech → much more expensive.
- The classes in 2014-date are half the size of the 2012,2013 classes. *But at least we are still here!*
- We are also formally now 100% a research program. (We are not an EPO program. AND, NASA is "not allowed" to do professional development of teachers. Really.)

27

FUNDING

- It's messy.
- No, really, it's messy.
- Lots of uncertainty.
- We generally aim for getting through one trip at a time. We got everyone here, and paid for the people we promised to pay for.
- We will start to deal with the Summer visits in the Spring, and by then we should have a better sense of the budgets. (Similarly, will deal with AAS travel in late summer.)
- *We won't let you book travel if we can't pay for it.*

28

EDUCATOR POOL

- We select our educators to be :
  - Very **savvy educators** (already capable of involving students in research or research-like experiences).
  - Reasonably savvy astronomers before we get to them, but **little/no experience in real (astronomy) research**.
  - Willing to commit to **fluctuating time commitment** over 13+ months, for **free**.
- National application process. (Due **September**!)
- Oversubscription ratio typically hovers around 4, can be >5!

29

ALUMNI POOL

- Historically, we have been aimed at high school classroom educators, and this is still our largest contingent (alumni and participants).
- First expansion was to 7-8th gr (in 2004-2008 era).
- Second expansion was to comm. coll. (2010, also 2019).
- Then amateurs (2011).
- Then museum educators (2012).
- Then 'lurkers' (2013) – other folks not in classrooms, not in museums, but in higher-level positions (we hoped both NITARP and their institutions can mutually benefit).
- Since 2014, mostly traditional educators (middle & high school).

30

PARTICIPANT REACTIONS

- "I just wanted to let you know that this 38 year veteran teacher believes [NITARP] is one of the **greatest types of professional development I have ever done**."
- [student:] "I cannot put into words how amazing and priceless the experience was."
- "You and this program (NITARP) have been truly remarkable and has already **changed my life forever**. I'm just waiting to see what happens next."

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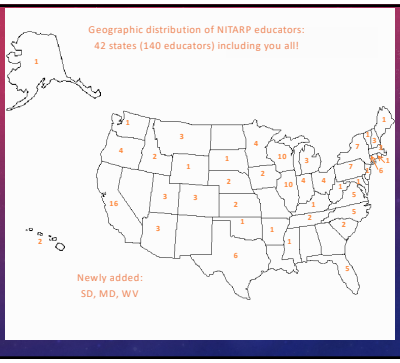

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Someone ask me a question before I move on…

SCIENTIST POOL

- We select our scientists to be :
  - Very **patient**. Educators are skilled but not undergrad students.
  - Able to help team come up with a project that MUST be done **within a year**, no deferrals.
  - Willing to **step in** and rescue team (quickly finish reducing data, code something up, etc.), if team becomes too frustrated.
  - Willing to commit to **fluctuating time commitment** over 13+ months, for **free.**
- Each team has a **mentor teacher** (who has been through program before) to act as deputy lead, translating for both camps, which helps everyone.
- All essentially local, experienced scientists (so far).
- Have let scientists work independently, manage their teams, with support if they want it.

33

NITARP PROGRAM COMPONENTS

34

MAIN PROGRAM COMPONENTS (1)

- ***Group of educators teamed with a scientist mentor; work to develop a science research program, do it, write it up.***
- Educators & scientist mentors attend a start-up workshop at a winter AAS (Jan 2022).
  - Workshop includes intro to program, etc.
  - Learn about how AAS meetings work.
  - Learn about science.
  - Start to define project, exchange contact information.
  - (We pay for teacher travel.)

You are here!

35

THIS IS THE INTRO WORKSHOP

36

MAIN PROGRAM COMPONENTS (2)

- Work long-distance with the team to write a proposal. (due 15 March 2023?!)
  - Must use data from IPAC: IRSA, NED, and/or NASA Exoplanet Archive.
  - Use telecons, internet-based resources such as our wiki, etc.
  - Proposal will be reviewed! (More on this later.)

37

MAIN PROGRAM COMPONENTS (3)

- Meet for 4 days at IPAC to work on the data and understand how science works (Summer 2023).
  - Each team decides on a mutually acceptable date – YOU SHOULD DO THIS TODAY!
  - Each **classroom** educator **should be able to** bring up to 2 students to this visit; students must be heavily involved in the project. [What if no students? What if young students? What if more students? Funding uncertainty.]
  - (We pay for educator/student travel.)
  - (Work remotely before and afterwards, using online resources.)
  - (Watch for: CA Bar exam.)

38

MAIN PROGRAM COMPONENTS (4)

- Present results of the project in AAS posters (Jan 2024).
  - At least 2 posters: Science and Education.
  - Again, each classroom educator should be able to bring up to 2 students; students must be heavily involved.
  - (We pay for educator/student travel.)
- "Culminating event" = "the NITARP restrospective night thing", and/or your poster day. ☺

39

MAIN PROGRAM COMPONENTS (5)

- Educators serve as NASA/NITARP ambassadors.
  - 12 hours' worth of professional development workshops, talks, etc. over 2 years.
- Educators report back to us all the cool stuff accomplished in connection with this. (Please do not forget!!)
- Some educators serve as mentor teachers to the rest of the NITARP community of educators and students.

40

MENTOR TEACHER CONCEPT

- Now have ~140 educators who have been through the program, and almost uniformly they want to do more; they don't want to stop after their intensive year!
- "First year" educators are the brand new ones (first AAS, first IPAC visit, learning the ropes).
- "Second year" educators start with their second AAS, (conduct workshops, work with students, etc.).
- "Second year" and later educators = alumni. Some join new teams as mentors. Some are involved in follow-up research of their original project using other telescopes. Some are involved in the proposal review.

41

Someone ask me a question before I move on…

ONE TEAM'S SUMMER VISIT

2011 - Bright Rimmed Clouds

42

STUDENTS!

43

WHAT IF NO STUDENTS?

- This program is for your enrichment first, because of your leveraging potential.
- Whether or not you are a classroom educator (or a HS educator):
  - You do not HAVE to bring students. If no one 'steps up', or you run into bureaucratic snags, or you would be more comfortable learning yourself first, or you feel your own learning would be enhanced if you were alone, THIS IS FINE.
  - We leave it to you to figure out (if) who to bring. Pick the leaders, or the ones who would benefit the most, or the smartest, or the ones who want it the most. You're their conduit; you gotta work with 'em!
  - If they crap out during the year, NO OBLIGATION to bring them back and/or keep working with them.
  - Resources donated from past participants for student selection are on the website.
  - Talk with your mentor teacher, your scientist, your team.
  - Talk to the 2022 participants & alumni while you're here!

44

WHAT IF NO STUDENTS?

- (Some people are offered a NITARP spot with the understanding you aren't bringing students **on our dime**.)
- If you are **not at all** a classroom educator:
  - Based on experience, it is **OK TO NOT** bring students.
  - Additional *adults* change the chemistry more substantially than additional students, so please don't raise money to bring more adults.
  - Be mindful that your teammates will be bringing underage students (who often do not look underage).

45

WHAT IF *YOUNGER* STUDENTS?

- We have had middle school educators since the beginning of the program.
- In the early years, far fewer teachers brought students at all.
- In the NITARP era, most educators have brought students, including MS educators.
- Students of all ages struggle. High school seniors: "expect to work harder than you ever have in your life"; "I thought that scientific research would be complex and complicated, but this exceeds that to a whole new level"; "This was an amazing experience, but is not for the faint of heart".
- From what we have seen, **the younger students struggle *far* more**. Some give up halfway through.
- Traveling with very young students also an issue.
- Please be aware of all of this, and don't just dismiss it.
- Some MS teachers have brought *former* students. Mixed thoughts afterwards.
- **TALK ABOUT IT WITH YOUR TEAM.**

46

WHAT IF *OLDER* STUDENTS?

- We have had community college educators before.
- Again, mixed luck here. Educators have brought some/none/one.
- Students of all ages struggle.
- The very nature of college is different – your students have lives, jobs, families. You don't see your students every day. This makes your experience fundamentally different than a "traditional" NITARP educator.
- You will be able to treat your students as more independent financially than the younger ones – let them pay for stuff and get reimbursed by us directly. (Will cover this more later.)
- **TALK ABOUT IT WITH YOUR TEAM.**

47

WHAT IF *MORE* STUDENTS?

- [If you were accepted with the offer of supporting students,] We are planning to pay for up to 2 students to come on the summer visit and next year's AAS.
- You can raise your own money to bring up to 2 more.
- We **strongly** recommend no more than 4 (empirical limit: you spend all your time shepherding rather than learning).
- The students you bring in the summer need not be the same ones you bring to the AAS – though they often are! Recommendation from alumni: should be the same.
- **TALK ABOUT IT WITH YOUR TEAM.** Talk to the 2022 participants (& alums) while you're here!

48

MORE PEOPLE AT HOME

- ***Of course, all of you can involve as many folks (of whatever age) as you want at home, to whatever degree makes sense to you, on whatever timescale.***
- Think about how you can best leverage your participation, given your resources.
- Talk with your mentor teacher, scientist, team.
- Talk to the 2022 participants (& alumni) while you're here!

49

All of a 2010 team

50

(Just part of) another 2010 team

51

WHAT WE EXPECT

52

WHAT WE EXPECT EDUCATORS TO KNOW

- How to work your computers. How to install software on your laptops.
- The basics of modern astronomy (what is a magnitude, what is a color-magnitude diagram, what is a FITS file).
- How to turn around and use research experiences in the classroom (or equiv).
- (If you feel you are weak on any of these, talk to your team for help -- someone on your team knows, or try other teams, or alumni!)

53

WHAT WE WILL HELP EDUCATORS LEARN

- Basics of infrared astronomy.
- Basics of your data (telescope, operations, data, processing) and the other archives (contents, usage) as needed.
- Basics of software usage (e.g., ds9, etc.).
- "How the sausage is made" -- what takes time, what goes fast. (And some surprisingly obvious things…)
  - "Astronomers are normal people."
  - "There is more programming involved than I realized."
  - "We spent SO MUCH TIME on …"

54

WHAT SOFTWARE WILL WE USE?

- It varies from team to team.
- Projects have ranged over 6 orders of magnitude in wavelength – UV to submm.
- Astronomers tend to use a wide variety of tools – they use whatever works fastest to accomplish the task at hand, and this will vary from person to person.
- Some of you may be doing photometry, maybe using APT and/or ds9 (NITARP tutorials on these if you want to get started). Some of you may be using Excel (many online tutorials, books, etc. on Excel!)…
- Some of you may need other tools.
- In any case, you'll learn as you go.

55

Someone ask me a question before I move on…

RESOURCES

- A LOT of material already developed (wiki, tutorials). You will probably want to develop more, but look at what exists before developing new from scratch.
- Material you need/develop for working remotely (Spring, Fall) will likely be different than what you develop for the Summer.
- We welcome any more material that you develop that you would like to share.

56

AAS MEETING (MORE LATER)

57

FIRST AAS MEETING

- (Day-long workshop to learn the basics, meet your team.) THIS IS IT.
- Learn about your science topic, start on your proposal.
- AAS meetings can be overwhelmingly busy!
- (We have something to guide this – more later).

You are here!

58

FIRST AAS MEETING – JUST ONE TEAM

2008 -- Luisa's team

59

AAS – JAN 2011 (SEATTLE, WA)

2010 class finishing up; 2011 class getting going!

60

AAS – JAN 2012 (AUSTIN, TX)

2011 class finishing up; 2012 class getting going!

61

AAS – JAN 2013 (LONG BEACH, CA)

2012 class finishing up; 2013 class getting going!
(Biggest. Delegation. Ever!)

62

AAS – JAN 2014 (WASHINGTON, DC)

2013 class (4 teams) finishing up; 2014 class (2 teams) getting going; AND alumni raised own $ to come!

63

AAS – JAN 2015 (SEATTLE, WA)

2014 class (2 teams) finishing up; 2015 class (2 teams) getting going;
AND alumni raised own $ to come!

64

AAS – JAN 2016 (ORLANDO, FL)

2015 class (2 teams) finishing up; 2016 class (2 teams) getting going;
AND alumni raised own $ to come!

65

AAS – JAN 2017 (DALLAS, TX)

2016 class (2 teams) finishing up; 2017 class (2 teams) getting going;
AND alumni raised own $ to come!

66

AAS – JAN 2018 (NATIONAL HARBOR,MD)

2017 class (2 teams) finishing up; 2018 class (2 teams) getting going;
AND alumni raised own $ to come!

67

67

AAS – JAN 2019 (SEATTLE, WA)

2018 class (2 teams) finishing up; 2019 class (2 teams) getting going;
AND alumni raised own $ to come!

68

68

AAS – JAN 2020 (HONOLULU, HI)

2019 class (2 teams) finishing up; 2020 class (2 teams) getting going; AND alumni raised own $ to come!

69

69

AAS-THAT-WASN'T JAN 2022

Many but not all of the 2021 class opted to attend the June 2022 AAS meeting in Pasadena and presented their results there.

70

70

AAS 2023

Someone ask me a question before I move on…

- 2023 class is similar to the size of the 2014-2022 classes.
- (A decent fraction of the people we send annually is the students presenting results.)
- ~30 people expected from 2022/2023 classes.
- A few alumni, seems no students from them.
- ~38 people(?) total.

71

71

WORKING REMOTELY AND IN PERSON (TRAVEL!)

72

72

WORKING REMOTELY

- Much of the time you spend on this project will be working remotely. First big task: Work remotely to write proposal. Proposals due March 15(?).
- (Have you worked across time zones before?)
- Historically, many long-distance collaboration tools blocked by schools, but this is no longer the case!! If you need it, we have a wiki on which people can share information, but I don't expect that this will be an issue.
- School email (used to?) breaks often – attachments vanish or entire mail vanishes. (Fall back to gmail [et al.] if any problems.)
- We strongly encourage regular telecons, via Skype or anything that works for you (Zoom; Google Hangouts). If you don't do this, team often dysfunctional. **SET UP A REGULAR TIME TODAY**. Really. We mean it.
- 2014 teams evaluation suggested 1 telecon per month be edu only, no sci – open questions, reflection, teaching each other. We have tried it, I'm not consistent; please push if you want this.

73

WORKING IN PERSON: VISITING IPAC

- 4-day IPAC visit (Pasadena, CA).
- Very very busy 4 days!
  - 0.5 day usually is a JPL tour.
  - If you want to do more (SOFIA? Mt. Wilson?), you have to do it, pay for it, beyond our 4 days.
- Historically 3 days; offered 4th in 2011 as "training wheels" – e.g., you guys work without scientist in the building but also not far away, modeling what you will do at home. This seemed to work really well.
- (Yes, we do take advice!)

74

Someone ask me a question before I move on…

TRAVEL ANXIETIES (PRE-COVID)

- Much of your most exciting participation in this is travel.
- I think this is cool!
- But this seems to cause the most angst, phone calls, stress, etc., even pre-pandemic!
- ***The faster you turn in receipts, the faster you get your money back*.**
- I consolidated EVERYTHING, all the most frequently asked questions, helpful advice, etc. into a multi-page travel advice document. (You got a version customized to you at the beginning of this process, and will get another one customized to each of your next trips.)
- **PLEASE PLEASE PLEASE read and follow those instructions!**

75

POSTERS, AND "FINISHING"

76

POSTER AUTHORSHIP

- You need to write up your results for the AAS, both science and education.
- For the science, an educator should be the lead author. We encourage teachers rather than students to lead this. Could be mentor teacher, need not be.
- For the education, an educator is expected to be the lead author, and may include the whole team as appropriate.
- If merited, your scientist will lead a paper for a refereed astronomy journal. Few posters turn into articles! (Not just NITARP, worldwide…)
- (NB: not science fair projects!)

77

POSTER CONTENT

- One of the big things you should do at this meeting is look at posters in preparation for your own.
- Science poster content is relatively well-defined, but bears little resemblance to a science *fair* poster.
- Science is what you're here for, and is (probably) where you should focus most of your effort.
- Education posters are *much less well-defined*. Does not have to be education research! (Probably should not be!)
- (Since 2005: "What are we supposed to put in the education poster?" *It is poorly defined.* **Anything works**.)

78

‘FINISHING’ UP THE PROJECT

- This is open-ended by design (it’s real science!), and ‘success’ is measured differently for each team.
- (Formal assessment was tried for the first time in 2013. Research done mostly in 2017.)
- Not every project will find what you thought going in. (Still successful.)
- Not every project will result in a journal article. (Still successful.)
- Some projects will open more questions than answers. (Still successful.)
  - Are there follow-up observations that would help?
- Can you do a similar analysis on your own of a different kind of object or region?

79

12 HOURS OF ‘SHARING’

- Generally we can’t stop you from sharing ☺, but **closing the loop** is hard.
- You know about our **12 hour PD obligation** going in, and had to write up tentative plans as part of your application.
- But, we know your **plans will change** in a year, and thus we are very flexible in what we ‘accept’ – basically, want you to share the experience:
  - Workshops/Lectures (school, local, regional, national)
  - Articles (you write, or are interviewed for)
  - Anything else …

80

Someone ask me a question before I move on…

YOU CAN’T ESCAPE…

- We are the “Hotel California.”
- (You can come in any time you like, but you can never leave.)
  - Lots of people take other jobs out of the classroom after NITARP (sometimes **during**!)
- As long as you WANT to stay involved, we are happy to have you, regardless of whether or not you are actively working with students.
- (Remember, NITARP is for YOU because of YOUR leveraging potential. If you’re not teaching students, you’re still reaching someone, likely someone*s*, we would never reach.)

81

OTHER IMPORTANT THINGS

82

HOW *NOT* TO DO SCIENCE

- Several people in the past have suggested one of these:
  - Why not assign one task per school team? Then the intensive work for that team would be <<year.
  - Why not just let each person do just what their strength is?
- Cold War encryption worked this way. Each team had no idea what the other teams had done to the numbers.
- We will NOT be doing that. My goal is to make sure that you UNDERSTAND each step, and can reproduce at LEAST some of it on your own afterwards. Toolkit building!

83

YOU CAN NEVER BE ‘PREPARED’ FOR THIS

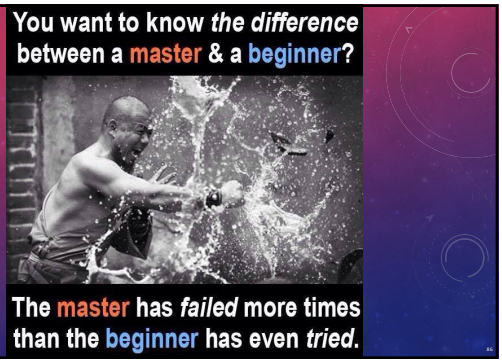
- The original incarnation of the program had the AAS, proposal in Feb, then NOTHING until Summer visit, then VERY LITTLE until AAS.
- Teachers: Please, can we do more work in the Fall, before the AAS? So, more work in Fall.
- Teachers: Please, can we do more work before the visit? So, more work before the visit.
- Teachers: Please, can we do more work in the Spring? So, more work in Spring.
- Teachers: Please, can we do more work in the previous Fall, before teams start? <luisa and varoujan crushed under anvils>
- Teachers: give us video training! So, Tutorials.
- 2013 Evaluation : we don’t feel prepared! Give us more prep work!
- Yes. I know. You can’t do the program before you do the program. You WILL FEEL unprepared. It will not be ‘comfortable.’

84

FEELING OVERWHELMED?

- At some point in this process, you will probably feel overwhelmed. Maybe you already feel like you're in the deep end of the pool.
- This will ebb and flow over the course of the meeting and the year. *I guarantee it.*
- Talk to your mentor teacher. Talk to your scientist. *Talk to your teammates.*
- Everyone brings different strengths and weaknesses to your team. You're all in this together!
- I have a "major milestones" document for you with a summary of, well, milestones through the next 12 months.
- If it doesn't feel like you or your team is "on track" *talk about it*! Talk to your mentor teacher, me, or Varoujan. Maybe you need a nudge back on track. Maybe your team really actually does need to do something different than the 'standard path.'

85



86

IT'S OK TO FEEL DUMB (1)

- *Advice from 2013 teacher*:

  "Teachers need to maybe be reminded that **it is OK if they don't have any idea what they are doing at times** – and that they are not expected to be experts in the field. They **do need to be able to admit when they are confused**, be open to feed back from other team members, and have time to commit to the study."

87

IT'S OK TO FEEL DUMB (2)

- Scientists spend their careers feeling dumb. We are trying to figure out how things work, and fail often. Feeling dumb is part of our job description.
- Moreover, your mentor scientists work at Caltech.
- We are NOT the big fish in a small pond, and we are used to this. (I mean, we're holding our own, but …)
- You may very well be a big fish in your pond. You are most likely not a big fish in this pond. This may take some adjustment.

88

IT'S OK TO FEEL DUMB (3)

- *Feeling dumb is part of our job description.*
- No, really.
- This is a *state of being* for scientists.
- "I was born not knowing and have had only a little time to change that here and there." – Richard Feynman

89

Essay 1771

The importance of stupidity in scientific research

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I recently saw an old friend for the first time in many years. We had been Ph.D. students at the same time, both studying science, although in different areas. She later dropped out of graduate school, went to Harvard Law School and is now a senior lawyer for a major environmental organization. At some point, the conversation turned to why she had left graduate school. To my utter astonishment, she said it was because it made her feel stupid. After a couple of years of feeling stupid every day, she was ready to do something else.

I had thought of her as one of the brightest people I knew and her subsequent career supports that view. What she said bothered me. I kept thinking about it; sometime the next day, it hit me. Science makes me feel stupid too. It's just that I've gotten used to it. So used to it, in fact, that I actively seek out new opportunities to feel stupid. I wouldn't know what to do without that feeling. I even think it's supposed to be this way. Let me explain.

90

SUBTLETY ABOUT FEELING DUMB

https://bit.ly/learningabyss

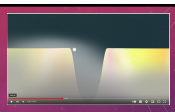
- I don't mean the stupidity that comes with the process of learning something new – that's there, of course; I mean something different than that.
- This video: https://www.youtube.com/watch?v=zKDe094o-Q8 captures one man's mission to image a galaxy with his own telescope and camera, and he describes the process of learning in general as crawling through an abyss…

91

92

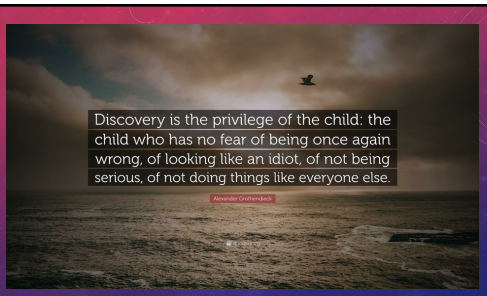
SUBTLETY ABOUT FEELING DUMB

https://bit.ly/learningabyss



- In the video – which is long but surprisingly engaging – he goes through all of his efforts, including at one point describing how he thought he was on the bottom of the crevasse and clawing his way out, only to discover that oh, no, he hadn't even really started to descend yet. But, he does it! He gets out of the fog and succeeds.
- When you are learning, often you don't know how much you need to learn and you really do feel like you are lumbering around in the dark. And, yes, you will be learning a LOT with us this year.
- BUT…
- In most cases, when you are learning, you know there is solid ground on the other side. He knew that it was theoretically possible for someone to image a galaxy with a small home-based telescope and camera. He knew that *someone* could; he didn't know if *he* could.
- In science, **we don't always know if there is solid ground on the other side**. Varoujan and I do everything we can to make sure that your NITARP projects do have solid ground on the other side, even if it might be a little mushy in spots. But in general, we don't know that. THAT is what I mean by "feeling stupid is part of being a scientist."

93



94

Also kind of a "crevasse" process…

The Creative Process:

1. This is awesome!
2. This is tricky.
3. This is crap!
4. *I* am crap!
5. This might be ok.
6. This is *awesome*!

95

IT'S OK TO FEEL DUMB (4)

We are ALL here to help each other understand. Make all of us slow down until you get it. We need to promise each other that we will reach across the gulf to you. **But you need to reach back.**

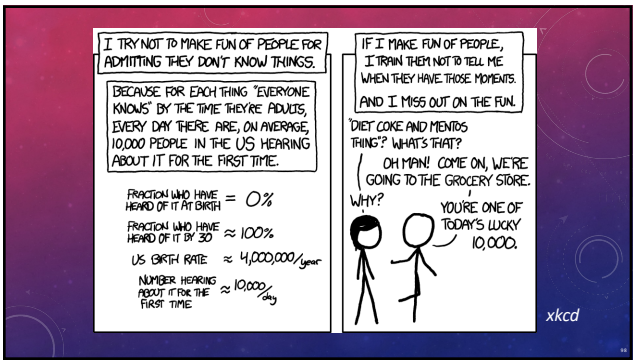
96

ASK QUESTIONS

Someone ask me a question before I move on…

- Ask questions, ask questions, ask questions.
- This is the number one thing that people tell us they wish they knew going in, & advice they would give to the new people.
- Ask questions, ask questions, ask questions.
- Ask questions, ask questions, ask questions.
- Ask questions, ask questions, ask questions.
- *There are no dumb questions*. I may look at you incredulously for an instant, you may catch me quietly putting my head in my hands, but, honestly, I would MUCH rather you ask now than be still confused in 6 months.

97



98

WEBSITES

- http://nitarp.ipac.caltech.edu/
- This is our "public face" and will have a profile for each of you soon (tonight).
- http://coolwiki.ipac.caltech.edu/
- This was a working area – you can have accounts if you want.
- In both cases, I need team names to finish this process.
- We will post talks from today when we get a chance (also "soon").
- There is a 'resources for participants' area on the NITARP site that includes all sorts of good stuff. (policies, procedures)

99

FINALLY, TODAY …

100

RETURNING TO THE PRESENT (1)

- The rest of today has big blocks of time to work with your team.
- TAKE ADVANTAGE OF THEM.
- Rearrange things if you have to, e.g., don't pick up registration materials until after 5 if you need to.
- START THE HEAVY USE OF EMAIL NOW. Get the communication channels lubricated. After today, you should be able to 'hear' each other's voice in your head as you read emails. Make sure you are not in anyone's spam filter. Go get a gmail account if you need to.

101

RETURNING TO THE PRESENT (2)

- Plan to meet later in the meeting.
- Plan to attend oral sessions relevant to your science.
- Plan to look for NITARP posters and talk to the 2022 folks.
- Plan to look for posters relevant to your science.
- Plan to look for what makes a good poster (& presentation) and what doesn't, because you have to do this in 12 months!

102

RETURNING TO THE PRESENT (3)

- We found, from past years, that the one thing that educators wanted us to do was help them get good press (literal and virtual) at home.
- Towards that end, we collected media and administrative contacts from you.
- We will put out a press release Tuesday with a few words advertising this class and the prior class's results.
- If you gave us no contacts, it's up to you to relay the release.

103

103

NASA News
JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY

MEDIA RELATIONS OFFICE
JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY
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Whitney Clavin 818-354-4673
Jet Propulsion Laboratory
whitney.clavin@jpl.nasa.gov

EMBARGOED UNTIL Jan. 11, 2012 9:20am CT

TEACHER PROGRAM BRINGS NASA RESEARCH TO HIGH SCHOOLS, MIDDLE SCHOOLS, MUSEUMS

Imagine you are a high school student walking into your science class in September and you learn that your teacher is doing research with NASA and you can actually participate.

This experience is occurring in schools around the US as more and more teachers become part of the NASA/IPAC Teacher Archive Research Program. 2012 marks the program's 8th year.

This program partners professional scientists with (primarily) high school teachers to carry out an original research project and present the results at the semi-annual meeting of the American Astronomical Society, the professional organization for astronomers in the US.

104

104

SOCIAL MEDIA

- Tweet away!
- Follow Wil Wheaton's law (see here if you need to look it up: http://en.wikipedia.org/wiki/Wil_Wheaton)
- NITARP hashtag is #nitarp
- AAS hashtag is #aas241
- (AAS and AAS media office have useful feeds to follow. Some presentations may ask: no tweets; people are actively looking for something other than Twitter, so watch for it.)
- There is a Facebook NITARP group – let me know if you want to join, and/or add your students if you want.

105

105

LIST OF SPECIFIC TASKS FOR TODAY

- (Interspersed with listening to the rest of the talks here.)
- Mark 15 March 23(?) on your calendar as the NITARP proposal deadline.
- Get started learning about your science.
- Pick a summer visit date (or window for dates) so people don't double-book.
- Pick a time/day/frequency for a regular telecon.
- Pick a team name (so I can get you on the website).
- Plan a time tomorrow and/or later this week to meet again to keep working.
- Get a group picture! ☺ How about now?

106

106