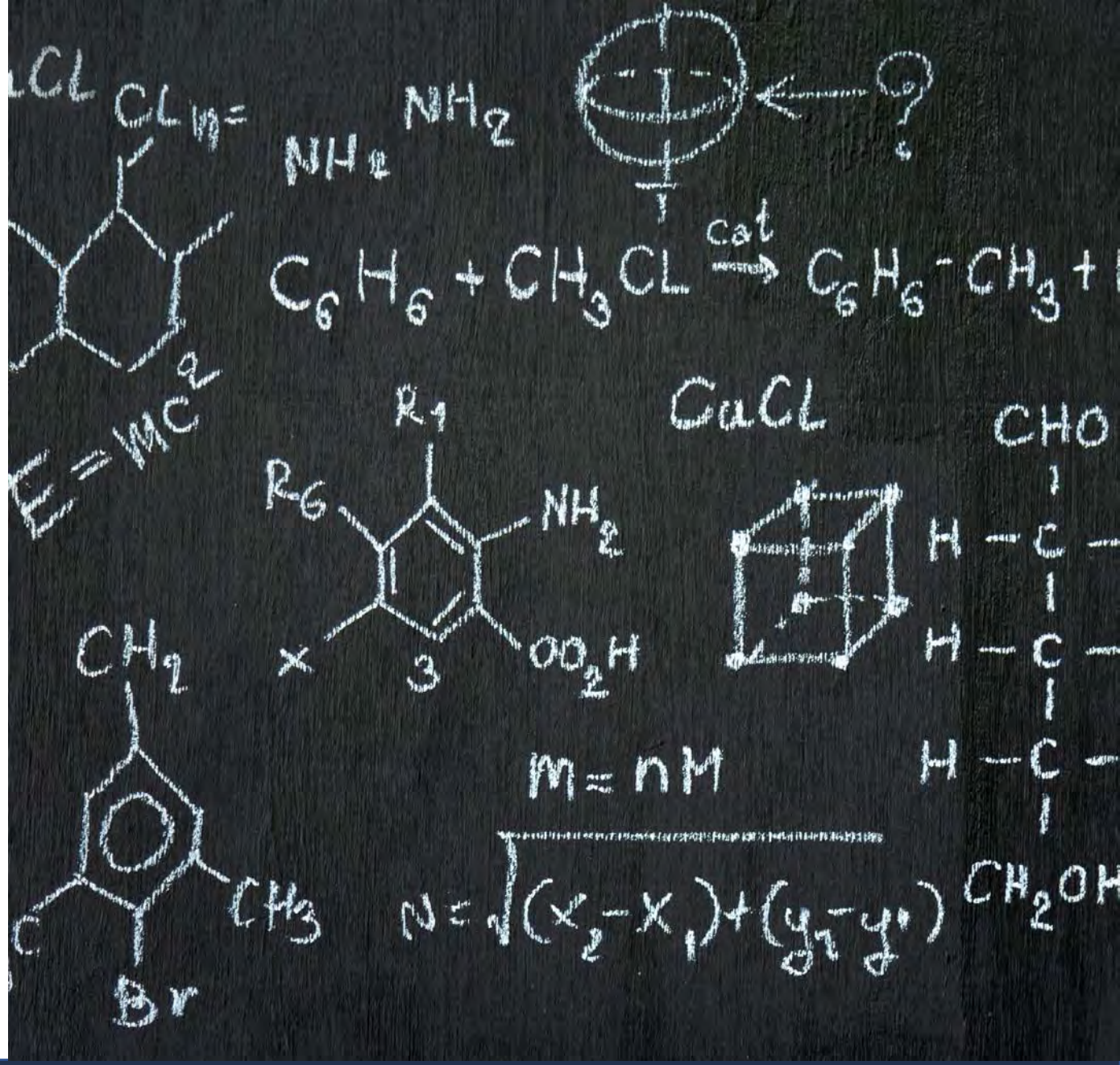
Proposal Development

A Presentation for ACerS Colorado Section

Amy Brice, Proposal Coordinator
Mechanical Engineering, Colorado School of Mines
April 28, 2021

The bad news first

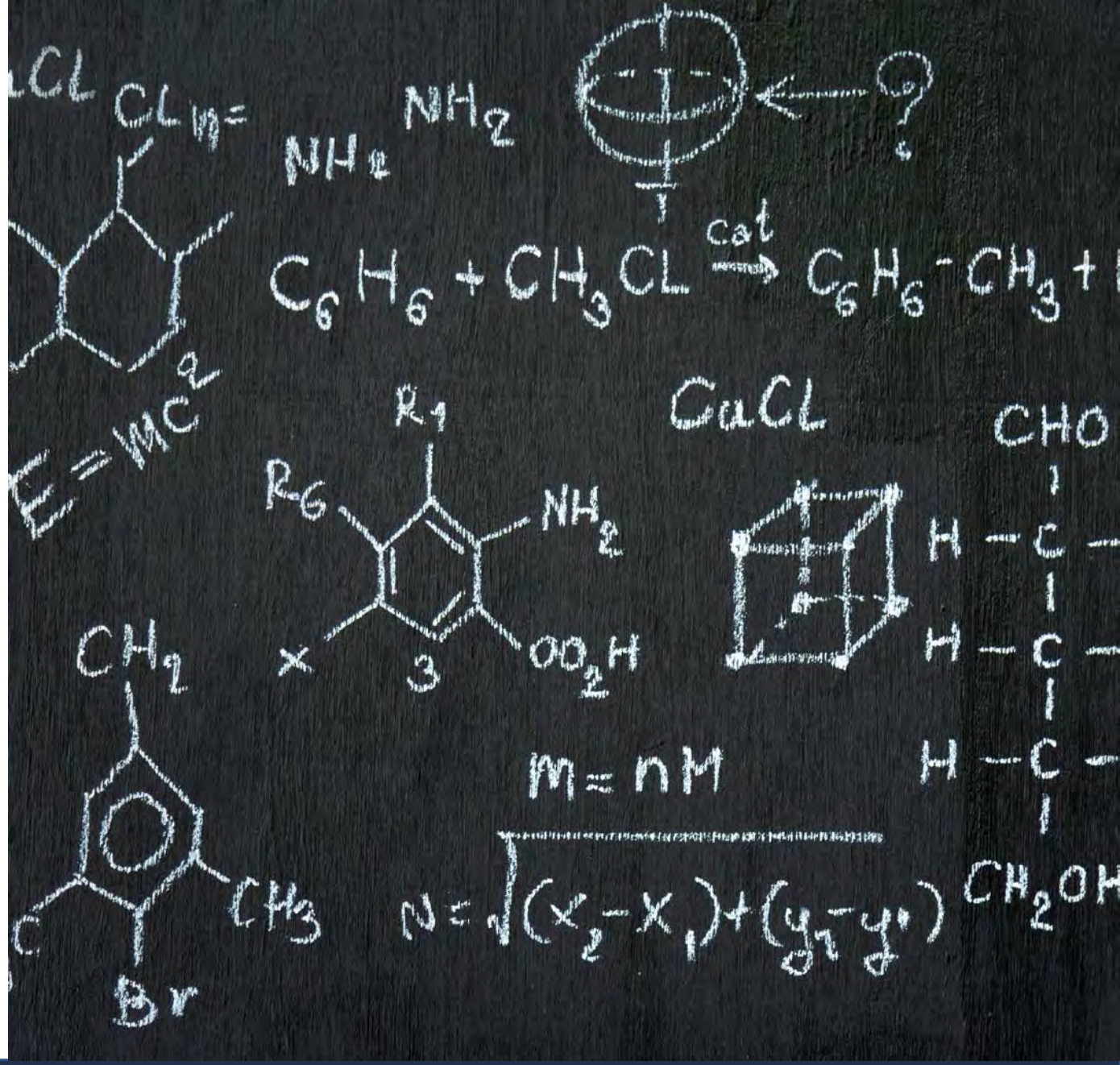
There is no magic formula for writing a winning proposal!



The bad news first

There is no magic formula for writing a winning proposal!

However, with a disciplined, methodical approach, you can make the process easier.



Between Submissions

Between proposal efforts

- The work you do *between* funding opportunities will increase your odds of getting funded

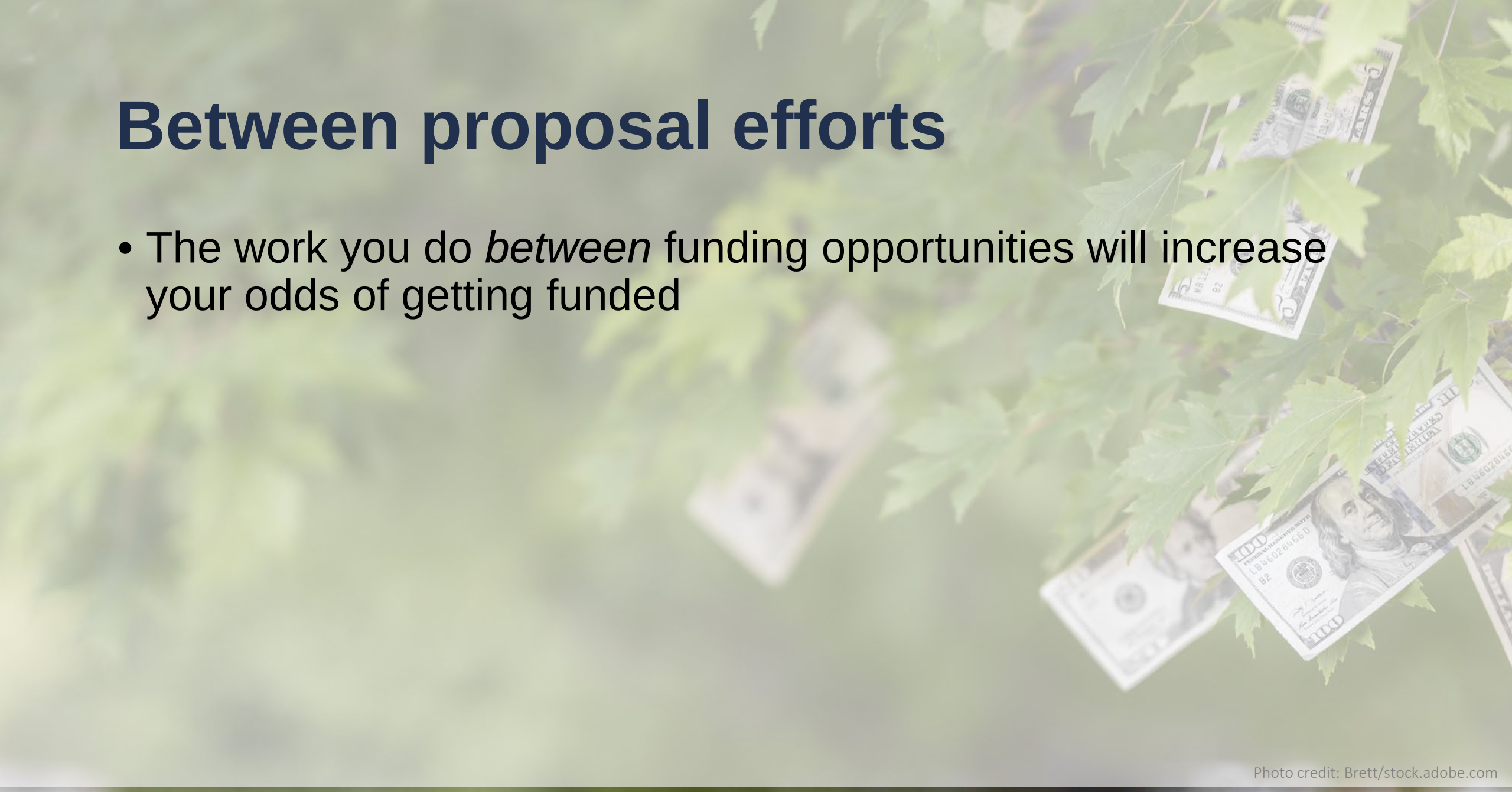
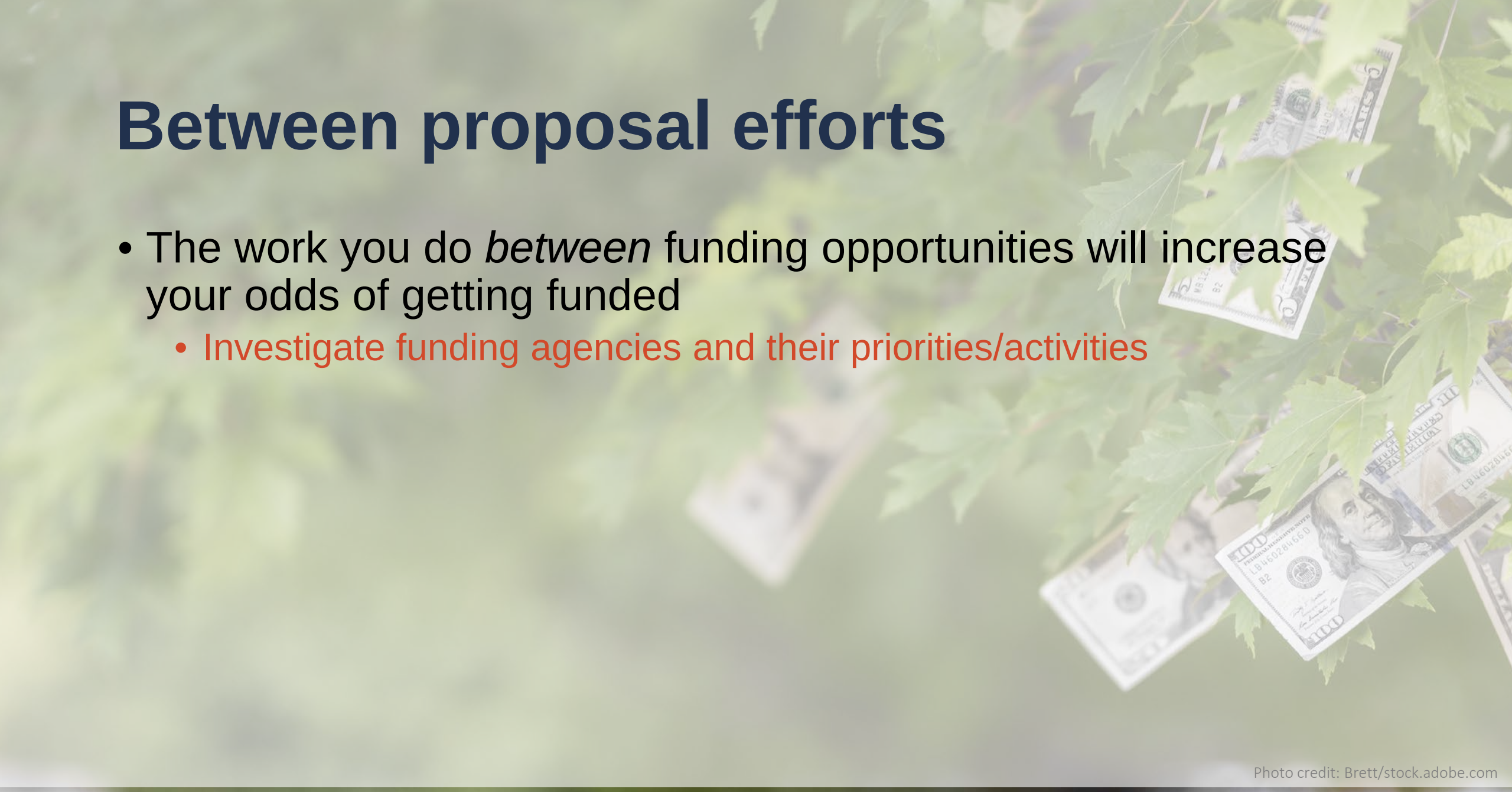


Photo credit: Brett/stock.adobe.com

Between proposal efforts

- The work you do *between* funding opportunities will increase your odds of getting funded
  - Investigate funding agencies and their priorities/activities



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Between proposal efforts

- The work you do *between* funding opportunities will increase your odds of getting funded
  - Investigate funding agencies and their priorities/activities
  - Iterate on your research ideas – create white papers, quad charts

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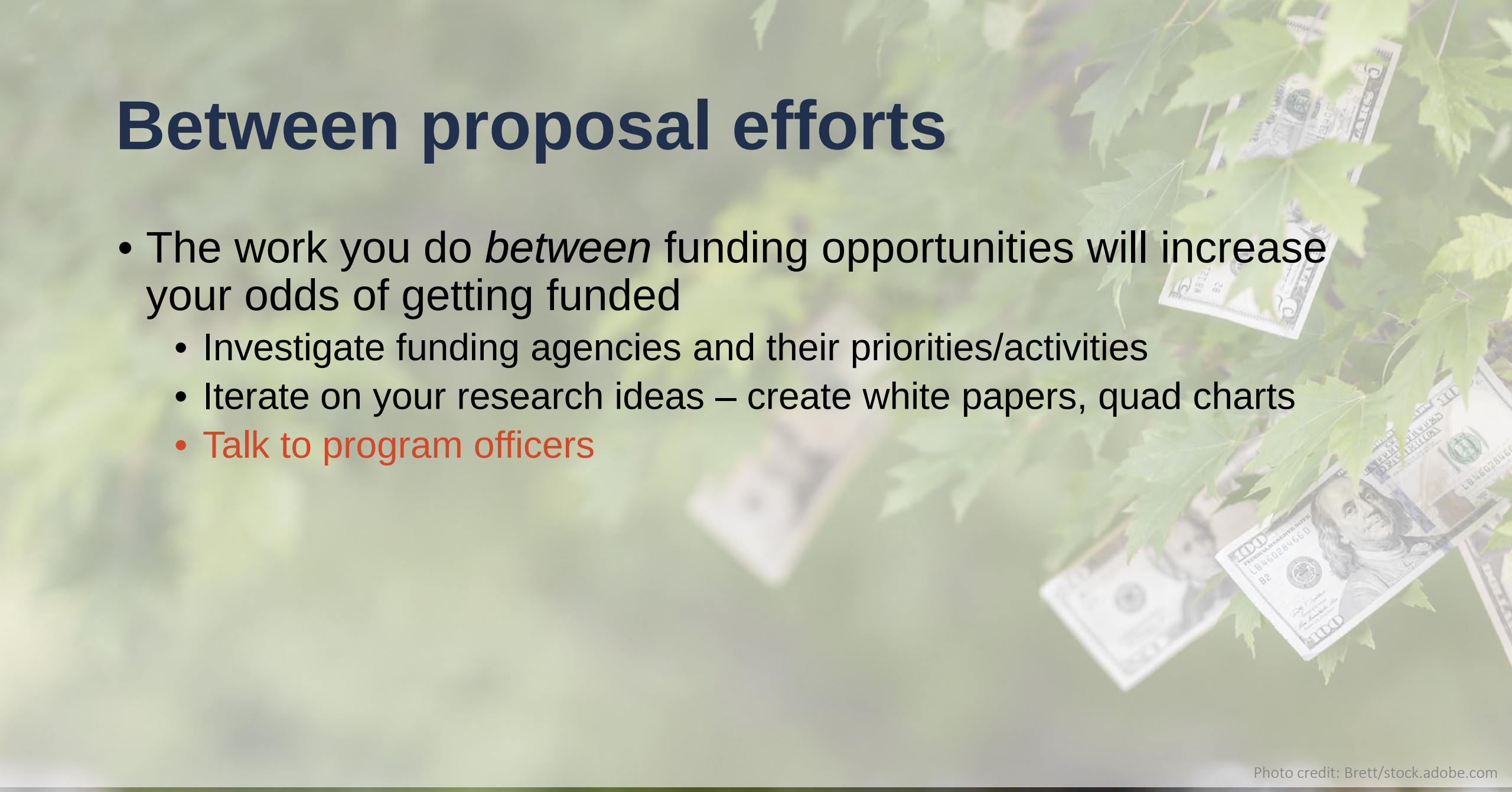
Between proposal efforts

- The work you do *between* funding opportunities will increase your odds of getting funded
  - Investigate funding agencies and their priorities/activities
  - Iterate on your research ideas – create white papers, quad charts
  - Talk to program officers



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  - Know your field – what are others doing, what are the precedents, obstacles, and gaps in knowledge

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  - Find collaborators that complement your expertise

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  - Know your field – what are others doing, what are the precedents, obstacles, and gaps in knowledge
  - Find collaborators that complement your expertise
  - If you are early career, know which agencies offer opportunities specifically for you (e.g., DoD Young Investigator Program, NSF CAREER, DOE Office of Science Early Career Research Program, DARPA Young Faculty Award)

Photo credit: Brett/stock.adobe.com

Find Funding

Find funding

- Grants.gov (federal)
- Beta.SAM.gov (federal, also includes contracts)
- GrantForward.com (more than just federal) – requires subscription
  - Similar aggregators include SPIN (https://spin.infoedglobal.com) and Pivot (https://pivot.proquest.com)

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- Colorado Office of Economic Development and International Trade (OEDIT): https://oedit.colorado.gov/programs-and-funding

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- SBIR.gov
- Colorado Office of Economic Development and International Trade (OEDIT): https://oedit.colorado.gov/programs-and-funding
- Zintellect.com (internships, experiential learning opportunities, academic fellowships and scholarships funded by government and private sector organizations; administered by Oak Ridge Affiliated Universities (ORAU) and the Oak Ridge Institute for Science and Education (ORISE)

Photo credit: Brett/stock.adobe.com

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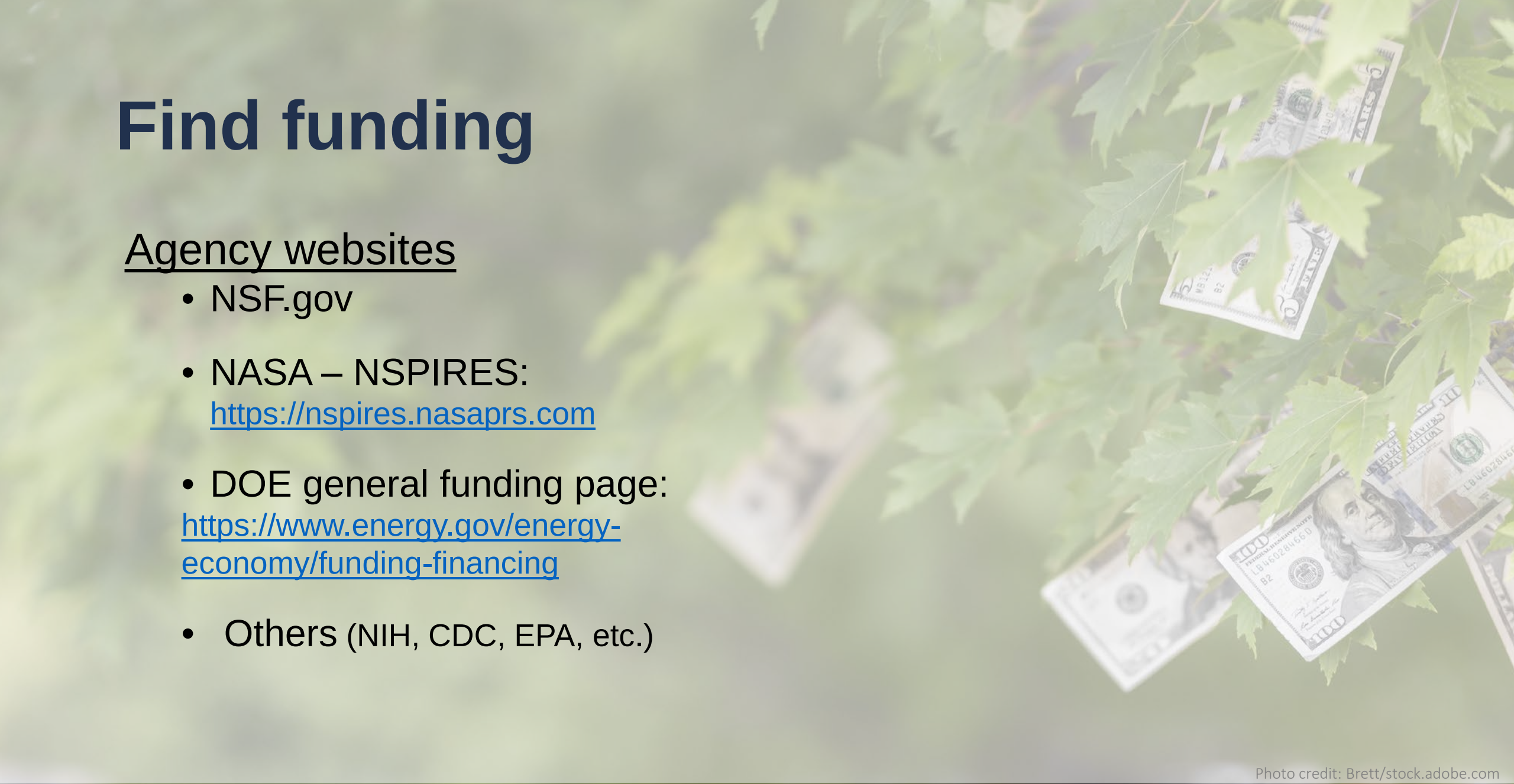

Agency websites

- NSF.gov
- NASA – NSPIRES: https://nspires.nasaprs.com
- DOE general funding page: https://www.energy.gov/energy-economy/funding-financing
- Others (NIH, CDC, EPA, etc.)

Photo credit: Brett/stock.adobe.com

Find funding

DOD broad agency announcements (BAAs)

- Army Research Office (ARO): https://www.arl.army.mil/business/broad-agency-announcements/
- Office of Naval Research (ONR): https://www.onr.navy.mil/en/work-with-us/funding-opportunities/announcements
- Air Force Office of Scientific Research (AFOSR): https://afrl.dodlive.mil/funding/
- Defense Advanced Research Projects Agency (DARPA): https://www.darpa.mil/work-with-us/office-wide-broad-agency-announcements
- Defense Logistics Agency (DLA): https://www.dla.mil/HQ/Acquisition/StrategicMaterials/BAA/

Other DoD funding

- National Security Agency (NSA)
- US Army Medical Research and Materiel Command, which oversees the Congressionally Directed Medical Research Programs (CDMRP)
- Defense Threat Reduction Agency (DTRA)

Photo credit: Brett/stock.adobe.com

Find funding

- The case for unsolicited opportunities
  - Pursue your own agenda (aligned with broad program goals)
  - Build relationship with program officers for subsequent funding

Chart source: NSF FY 2020 Performance and Financial Highlights (nsf21003)
https://www.nsf.gov/pubs/2021/nsf21003/nsf21003.pdf

In the NSF Fall 2020 Virtual Grants Conference, "Introduction & Overview" presentation, this data was presented through FY19. The speaker attributed lower proposal volume to the removal of deadlines in many programs.

Notes:
- FY19 funding: $8,075 million
- FY20 funding: $8,354 million (3% increase)
- COVID impact on FY20 increase in submissions/awards? *Not known from this report*

Photo credit: Brett/stock.adobe.com

Choose what to pursue

The “throw spaghetti at the wall” approach

Proposal efforts are time-consuming!

What are your odds?

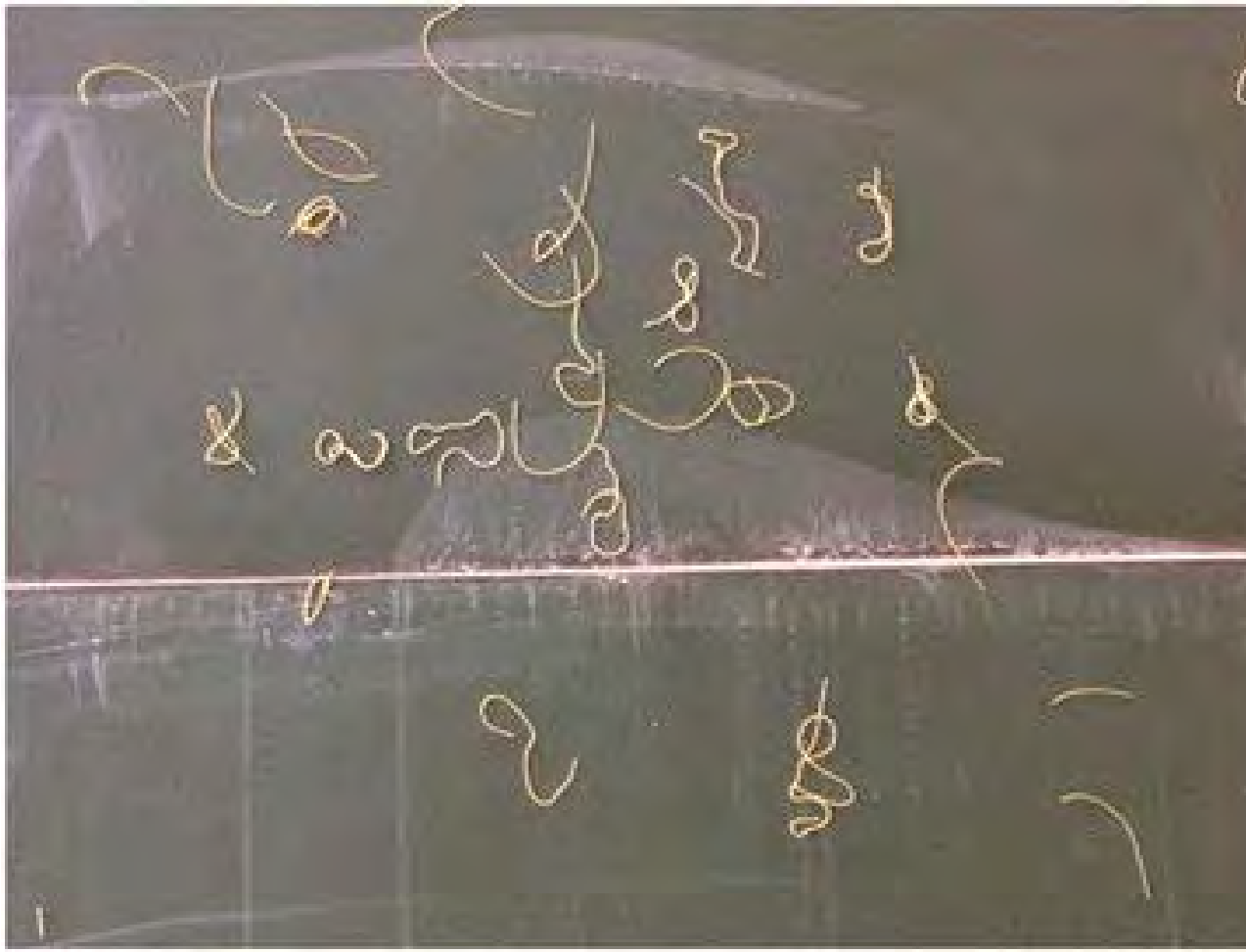

Photo credit: Montangero, S., Vittone, F., Olderbak, S., Wilhelm, O. (2018) “Exploration of experimental design and statistical methods using the stick-on-the-wall spaghetti rule,” *Teaching Statistics* 40(2):40–45, 10.1111/test.12149

Step 1: READ the solicitation

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Note all the key details in a checklist

- Eligibility restrictions / limited submission
- Required letter of intent, concept paper or preliminary proposal
- Due dates
- Period of performance and budget
- Required cost share
- Required team composition
- Etc.

NSF PROPOSAL CHECKLIST	Mines PI: Daisy Duck Internal Team: Co-PI: Bugs Bunny, Mickey Mouse; Senior Personnel: Charlie Brown External Collab: Co-PI from ACME LLC: Wile E. Coyote	
General Information		
Sponsor	NSF	
Opportunity	21-559: National Robotics Initiative (NRI) 3.0	
Link to program page	https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503641	
Link to solicitation	https://www.nsf.gov/pubs/2021/nsf21559/nsf21559.htm	
Link to Sponsor Requirements (PAPPG 20-1)	https://www.nsf.gov/pubs/policydocs/pappg20_1/index.jsp	
Due to Sponsor	Rolling: April 19, 2021 - May 3, 2021	
Submission method	FastLane/Research.gov or Grants.gov	
Font requirements	≥11-pt TNR (see PAPPG for other options); 10-pt allowed for formulas, equations, figures, tables, capt	
Format/spacing requirements	1-inch margins	
Solicitation-Specific Information		
Eligibility	- Investigator may participate as PI, Co-PI, or Senior Personnel in no more than 2 proposals - Proposals may not duplicate or be substantially similar to other proposals under consideration by pa	
PoP and Budget	NIH target: 1-3 years; $100k-$250k per year in direct costs	
Related preliminary proposal # (if applicable)	n/a	
Title prefixes/requirements	NRI: [title]	
Collaboration	"Collaboration between academic, industry, non-profit, and other organizations is encouraged to esta fundamental science and engineering and technology development, deployment, and use."	
Other notes	Participating agencies: NSF, USDA, NASA, DOT, NIH, NIOSH: proposals targeting specific agency sponsc PO and receive permission	
Documents (green=solicitation-specific)	**Page Limit**	**Templates**
Project Summary	1	
Project Description	15	
References Cited		
Biographical Sketches	2 each	https://www.nsf.gov/bfa/dias/policy/biosketch.jsp
Budget and Justification		
Facilities, Equipment and Other Resources		https://ora.mines.edu/all-mines-facilties/
Data Management Plan	2	Resources: http://libguides.mines.edu/RDM. Contact Emily Bongiovanni 1 month bef
Postdoc Researcher Mentoring Plan (if	2	https://ora.mines.edu/nsf-postdoc-mentoring-plan-template/
Letters of Intent/Collaborations	1	
Current and Pending Support		https://www.nsf.gov/bfa/dias/policy/cps.jsp
Collaborators & Other Affiliations		https://www.nsf.gov/bfa/dias/policy/coa.jsp
Collaboration Plan	2	
Human Subjects Protection (if applicable)	2	If submitting to NIH, the Human Subjects Protection document must include a Planne count toward the 2-pg limit
Vertebrate Animals (if applicable)	2	
List of Project Personnel and Partner Institutions		

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- Your goals vs. the funding agency's goals

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- Highlight all the "must" and "should" statements

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- Read the merit review criteria

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- Highlight all the "must" and "should" statements
- Read the merit review criteria
- Does the solicitation recommend talking to a Program Officer (PO) before submitting?

Step 2: Gather competitive intelligence

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If possible, review what the program has funded in the past

Know your competition in your research space

Identify your competitive edge and key differentiators

Participate in webinars and Q&A sessions for the program

Talk to colleagues who have submitted to the program or to other programs within the agency

Step 3: Build your team and high-level plan

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- Who do you need on your team to be successful? (expertise, facilities/equipment…)
  - Line up external team members early and determine funding arrangement (e.g., subawards)

Photo credit: EtiAmmos/stock.adobe.com

Step 3: Build your team and high-level plan

- Who do you need on your team to be successful? (expertise, facilities/equipment…)
  - Line up external team members early and determine funding arrangement (e.g., subawards)
- What tangential stakeholders do you need to engage
  - Research/contracts office; proposal support
  - Broader impacts development; diversity, equity and inclusion plans
  - Export control; intellectual property (IP); facilities office

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  - Export control; intellectual property (IP); facilities office
- For large, interdisciplinary teams, consider budgeting team science training and/or facilitation for your kickoff meeting

Photo credit: EtiAmmos/stock.adobe.com

Step 3: Build your team and high-level plan

- Outline your high-level thoughts and ideas – use the Heilmeier catechism as a guide *(https://www.darpa.mil/work-with-us/heilmeier-catechism)*
  - What are you trying to do? Articulate your objectives using absolutely no jargon.
  - How is it done today, and what are the limits of current practice?
  - What is new in your approach and why do you think it will be successful?
  - Who cares? If you are successful, what difference will it make?
  - What are the risks?
  - How much will it cost?
  - How long will it take?
  - What are the mid-term and final “exams” to check for success?

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  - How long will it take?
  - What are the mid-term and final “exams” to check for success?
- Gather literature support for state of the art / research problem

Photo credit: EtiAmmos/stock.adobe.com

Step 4: Create a timeline, and stick to it

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Begin with the end in mind

- Know what your internal deadlines are (research/contracts office, mandatory reviews)

Calvin and Hobbes by Bill Watterson

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- Meet regularly with your team: assign writing tasks, set interim deadlines

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- Block time on your calendar to write

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Step 5: Pre-writing: Outline and iterate

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- READ the solicitation – again

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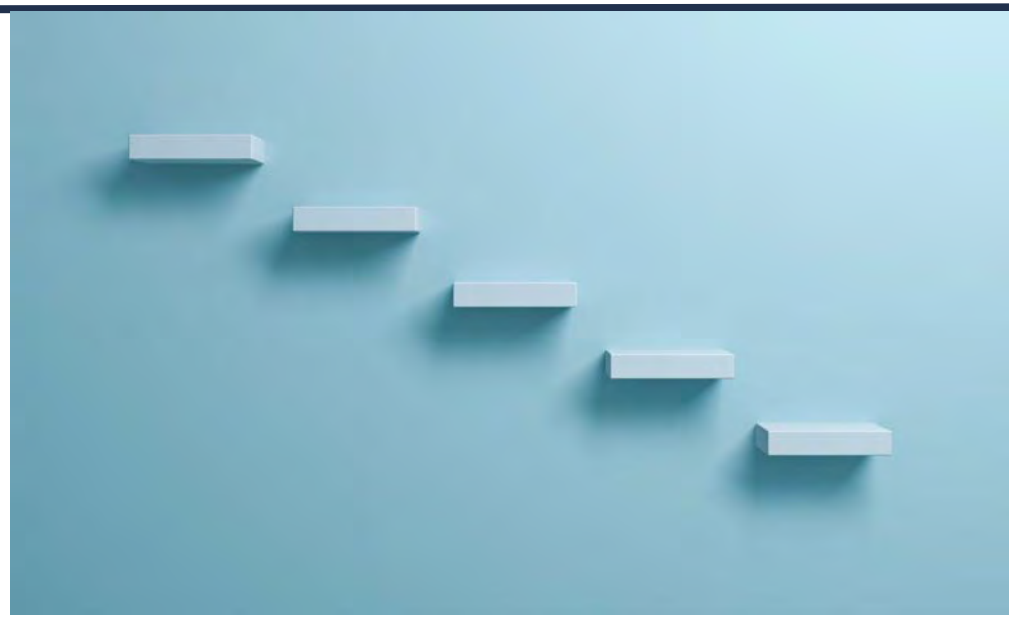
- READ the solicitation – again
- Create an outline
  - Solicitation requirements and generic guidelines (e.g., NSF PAPPG)
  - Required templates (don't change them)
  - Page limitations
  - Include directions and merit review criteria in your outline to keep them front of mind
  - Include requirements in the form of questions in appropriate sections of your outline (those "must" and "should" statements from the solicitation that you highlighted in Step 1)



Step 5: Pre-writing: Outline and iterate

- READ the solicitation – again
- Create an outline
- Iterate on your objectives – are they specific, measurable, attainable, relevant, time-bound (SMART)?
  - Know the difference between goals and objectives:

Goals	Objectives
Goals are Broad	Objectives are narrow
Goals are General Intentions	Objectives are Precise
Goals are Intangible	Objectives are Tangible
Goals are Abstract	Objectives are Concrete
Goals are generally difficult to measure	Objectives are measurable

Step 5: Pre-writing: Outline and iterate

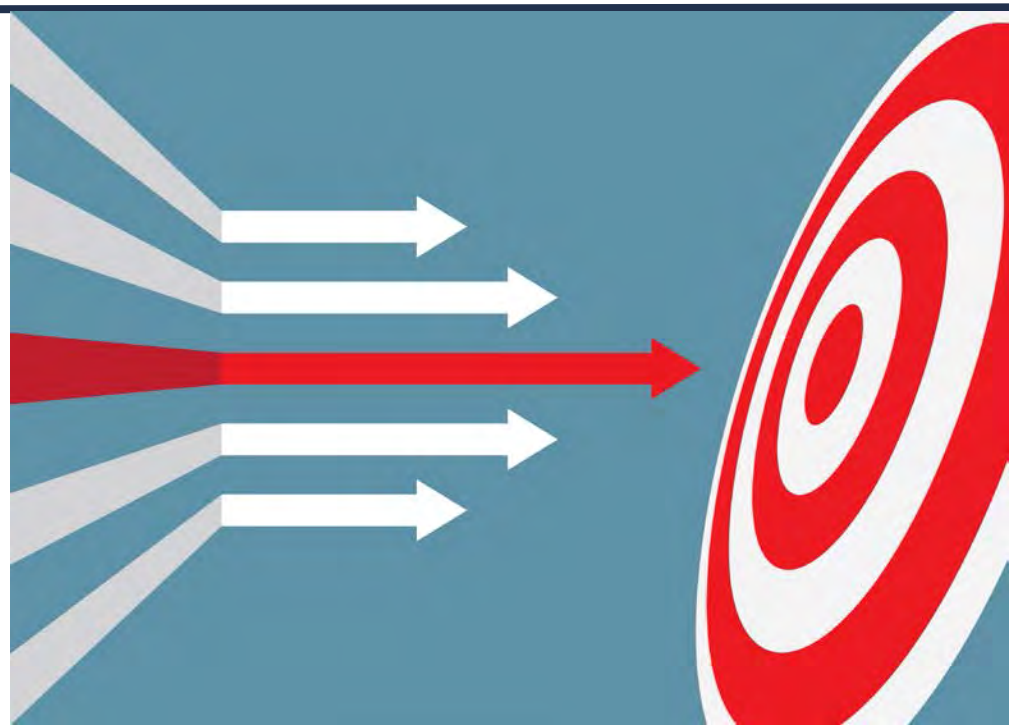
- Document the high-level and detailed tasks needed to achieve your objectives
  - DOE: Narrative is built around detailed statement of project objectives (SOPO), so solidify task outline first

Step 5: Pre-writing: Outline and iterate

- Document the high-level and detailed tasks needed to achieve your objectives
- Think like the reviewer: do your objectives and expected outcomes align with agency goals?

Step 5: Pre-writing: Outline and iterate

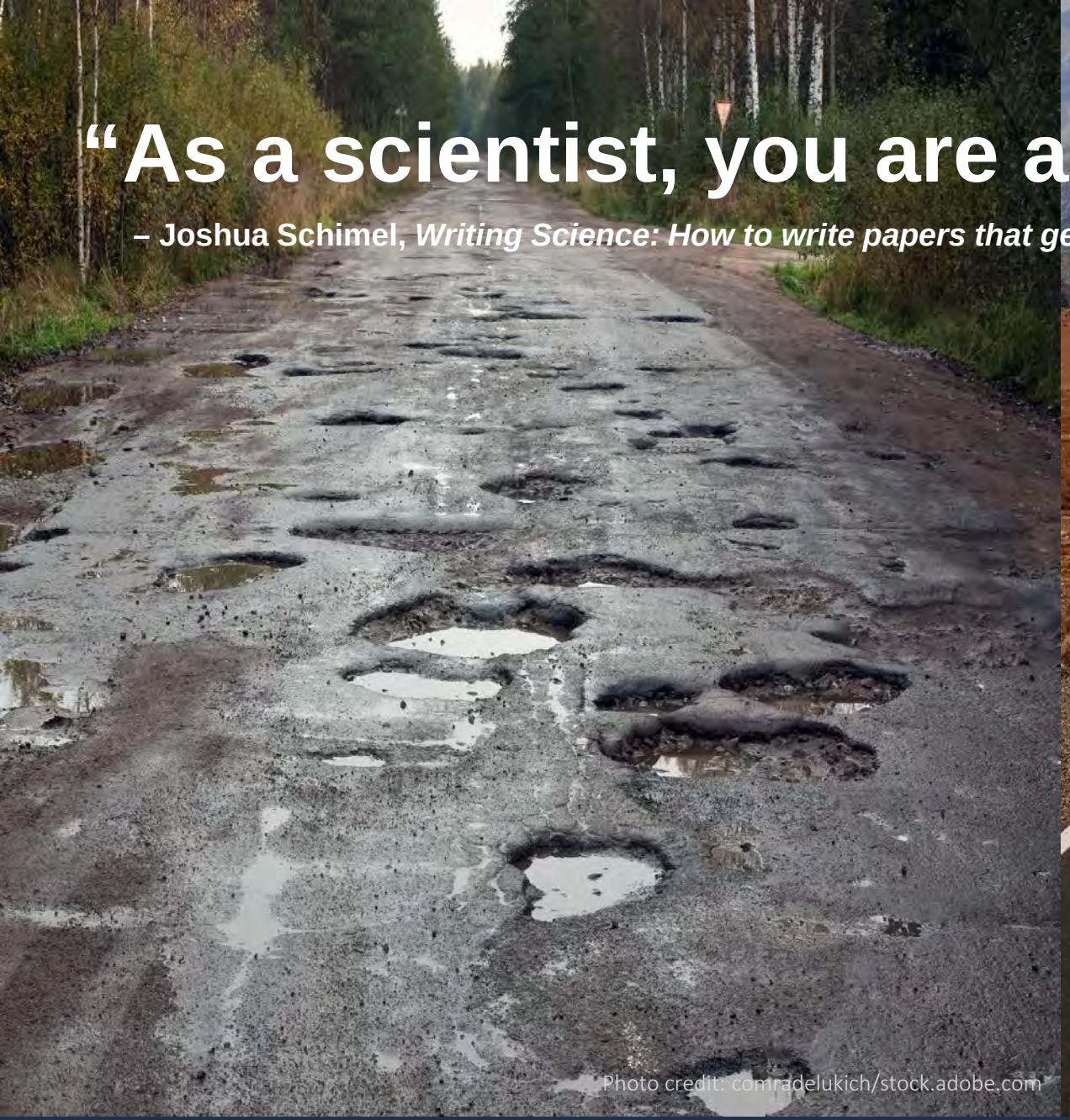
- Document the high-level and detailed tasks needed to achieve your objectives
- Think like the reviewer: do your objectives and expected outcomes align with agency goals?
- Work in parallel on all required documents
  - Budget, diversity plan, broader impacts, data management plan, project management plan, etc.



Step 6: Write

“As a scientist, you are a professional writer.”

– Joshua Schimel, ***Writing Science: How to write papers that get cited and proposals that get funded***



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Step 6: Write

- READ the solicitation – again

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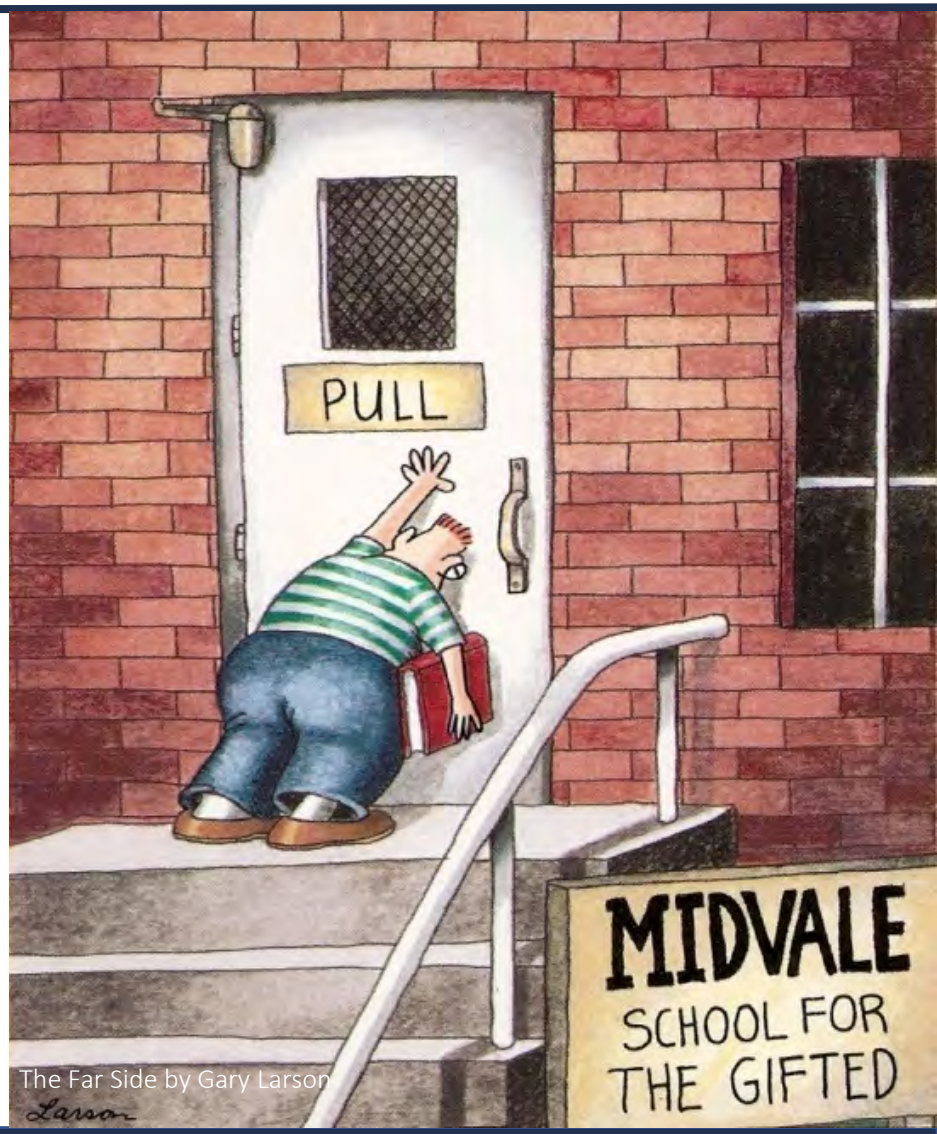
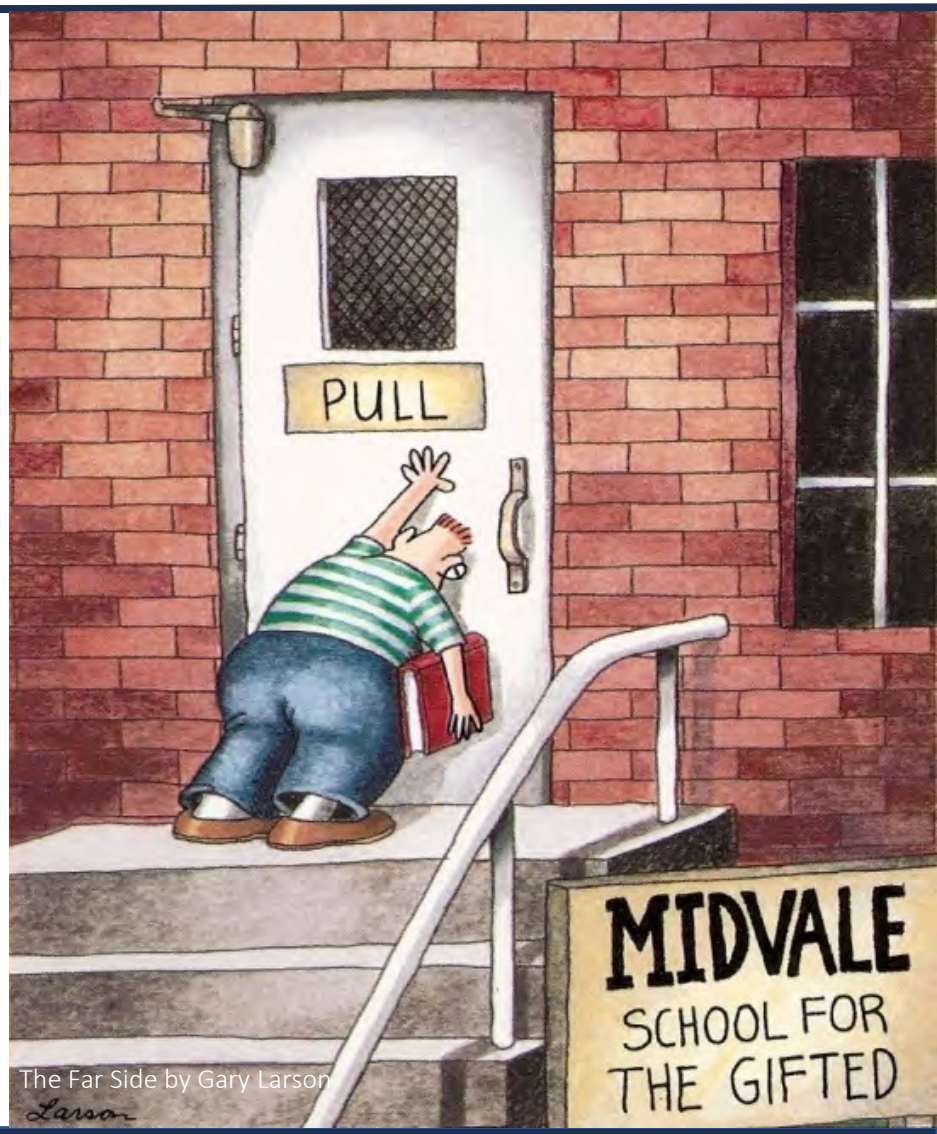
- Follow directions



Step 6: Write

- READ the solicitation – again
- Follow directions
- Know your audience
  - Who are the reviewers for the program or funding opportunity?
  - Recognize that reviewers are often serving voluntarily



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- READ the solicitation – again
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- Know your audience
- It's not a mystery novel – open your narrative with a spoiler that clearly states what you intend to do
  - Give the reviewer the lens through which you want them to read the rest of your proposal

Step 6: Write

- READ the solicitation – again
- Follow directions
- Know your audience
- It's not a mystery novel – open your narrative with a spoiler that clearly states what you intend to do
  - Give the reviewer the lens through which you want them to read the rest of your proposal
  - Get them interested right away – first page:
    1. Set the stage – lay out the problem (answer the question "who cares?")
    2. State the theme – your solution
    3. Create a vision (answer the question "so what?")

    See Resources slide – link to Bob Porter's grant writing articles

Step 6: Write

- Use simple, clear writing that leads your reviewer through a well-organized argument
  - Tell them what you're going to tell them
  - Tell it to them
  - Tell them what you just told them
  - Make it easy to read and easy to remember – avoid jargon and over-complicated language
  - Avoid losing your reader in a literature review

  - Writing guides (see Resources slide):
    - *The Grant Application Writer's Workbook* (NSF version)
    - *Writing Science: How to write papers that get cited and proposals that get funded* by Joshua Schimel

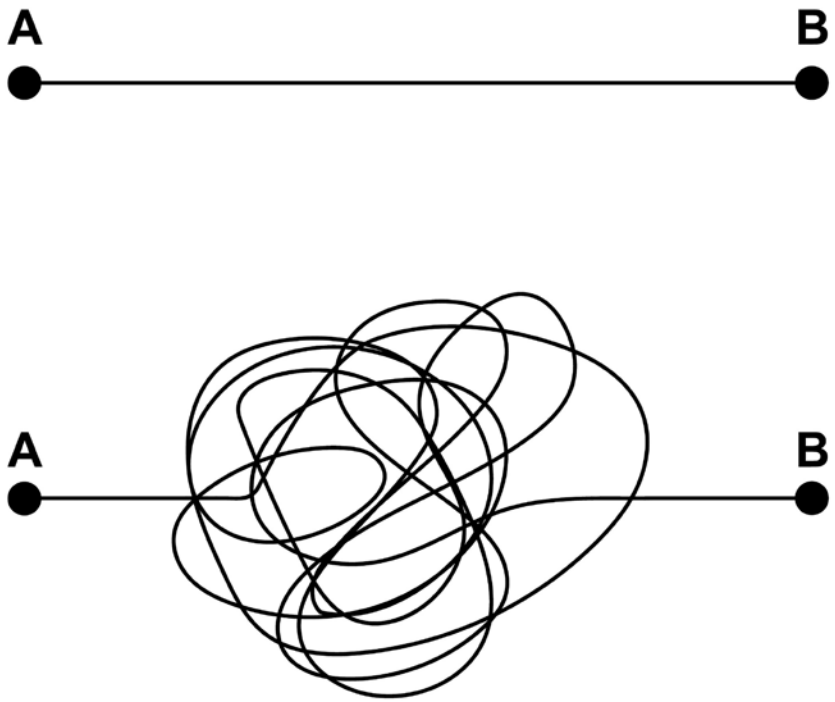
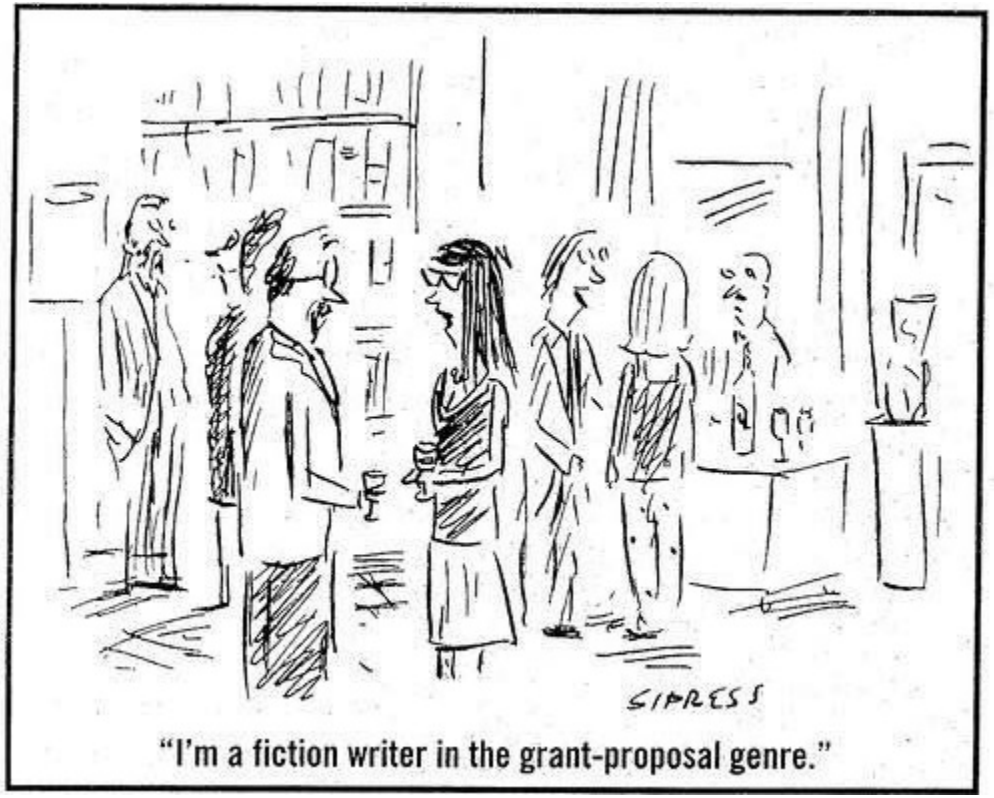


Photo credit: sumkinn/stock.adobe.com

Step 6: Write

- Be thorough and concrete
  - Objectives/aims > tasks > metrics > outcomes
  - Broader Impacts: activities should be reflected in timeline and budget and should be related to work



David Sipress, *The New Yorker*

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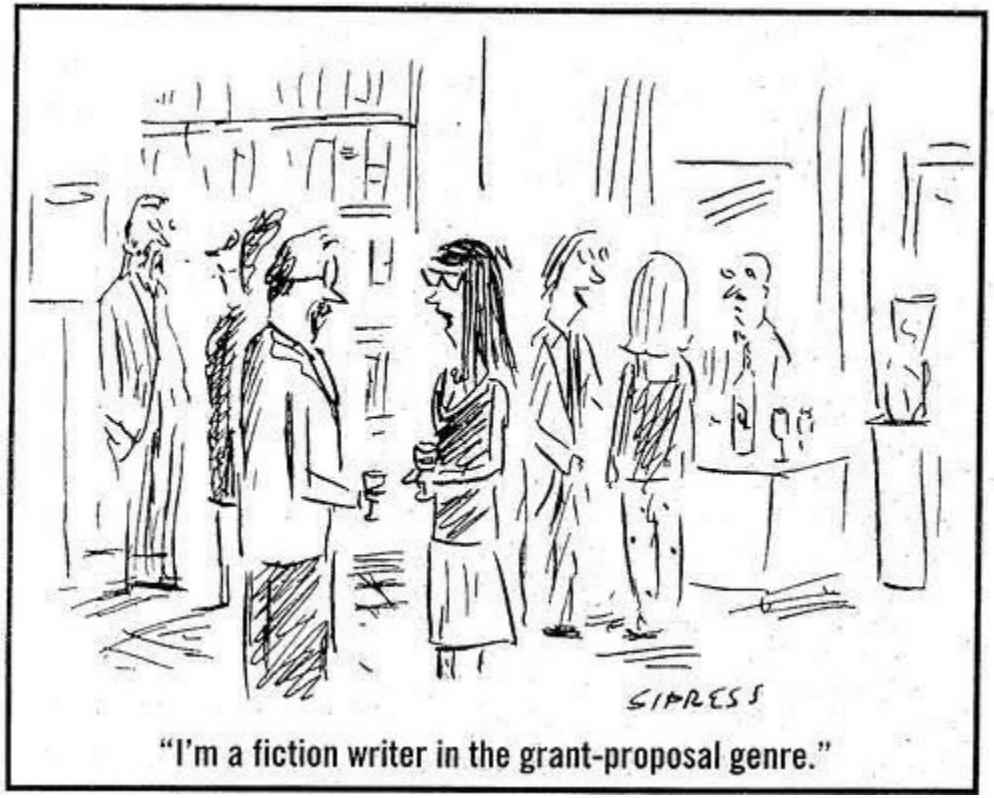
- Use visuals



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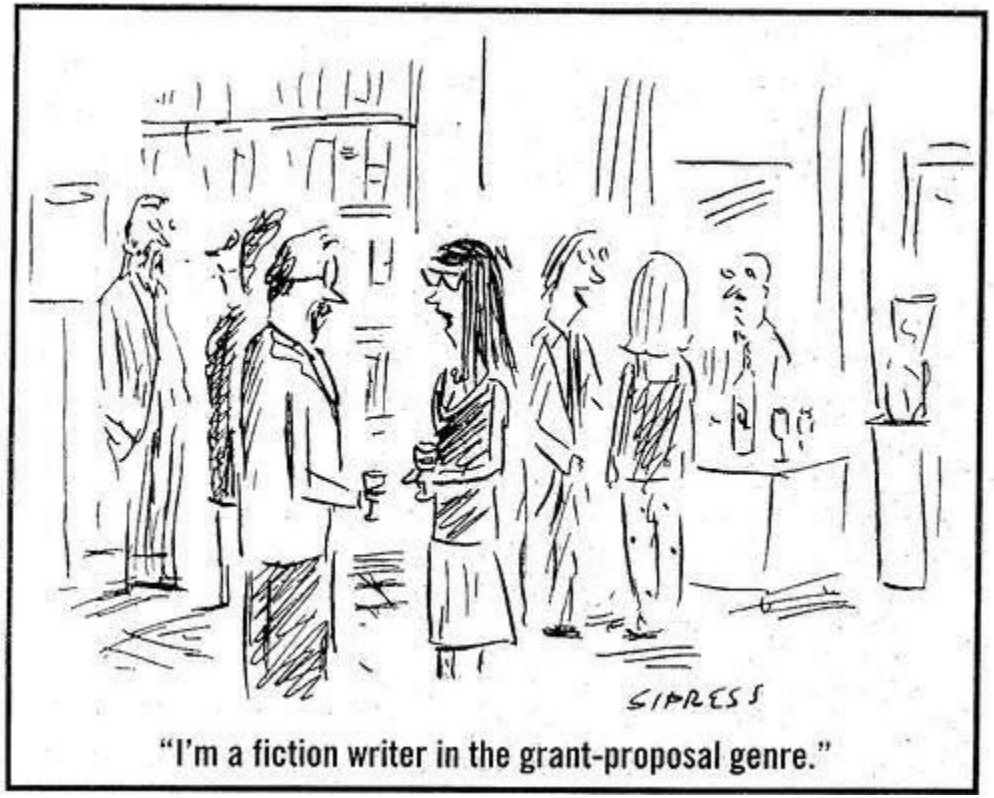
Step 6: Write

- Be thorough and concrete
  - Objectives/aims > tasks > metrics > outcomes
  - Broader Impacts: activities should be reflected in timeline and budget and should be related to work
- Use visuals
- Enlist an editor and peer reviewers



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Common Pitfalls

- Waiting too long to state objectives
- Unfocused objectives/aims
- Need for funding is not made explicit; missing data
- Vague research plan
- Lack of innovation
- Meandering literature discussions
- Disconnect between program needs and proposed research
- Proposer does not understand the state of the art
- Unrealistic timeline and/or budget for proposed activity
- Unclear analytical techniques and/or unclear plan for evaluation
- Formatting issues (not adhering to formatting guidelines)
- Confusing or hard-to-read narrative
- Dense, academic prose (like a journal article)
- Unnecessary verbosity
- Didn't proofread: spelling and grammar errors; inconsistent formatting and writing style
- Too much text without section headers and/or visuals

First impressions are critical:
"If I don't get interested by the first page, the proposal is lost."

Reviewer quote in Porter, R. "What Do Grant Reviewers Really Want, Anyway?" *The Journal of Research Administration* 36 (2005): 47.

- Not investing in building a relationship with the program officer
- Saving everything other than the project narrative for the last few days
- Not identifying team early enough (especially if involving industry team members)

In the end…

Even the best-written proposals don’t always hit the funder’s target, but you’ve gone through a worthwhile and valuable effort that you can build on for future opportunities.

Resources

- Grants.gov Grants Learning Center https://www.grants.gov/web/grants/learn-grants.html
- Grant development consulting (also team science / interdisciplinary collaboration)
  - Grant Training Center: https://granttrainingcenter.com/
  - Known Innovation: https://knowinnovation.com/
  - Divergent Science: https://teamdivergentscience.com/
  - AtKisson Training Group: https://www.atkissontraininggroup.com/
- Writing guidance
  - *The Grant Application Writer's Handbook* (NSF version) http://www.grantcentral.com/workbooks/national-science-foundation/
  - *Writing Science: How to write papers that get cited and proposals that get funded* by Joshua Schimel (on Amazon)
  - Bob Porter's articles posted at https://www.nordp.com/resources

Resources

- Graphics
  - Mike Parkinson's Billion Dollar Graphics: https://www.billiondollargraphics.com/
- Data management plans
  - DMPTool: https://dmptool.org/
  - NSF DMP guidance by directorate: https://www.nsf.gov/bfa/dias/policy/dmp.jsp
- Broader impacts
  - Advancing Research Impact in Society (ARIS): https://www.researchinsociety.org/
- Gantt charts: https://www.gantt.com/

- Other books
  - *Marketing for Scientists: How to Shine in Tough Times* by Marc Kuchner
  - *Handbook for Planning and Writing Successful Grant Proposals* by M.S. AtKisson (link)
  - *Grantsmanship Second Edition: Program Planning and Proposal Writing* by Norton Kiritz & Barbara Floersch

Thank you!