

COMMUNITIES OF PRACTICE

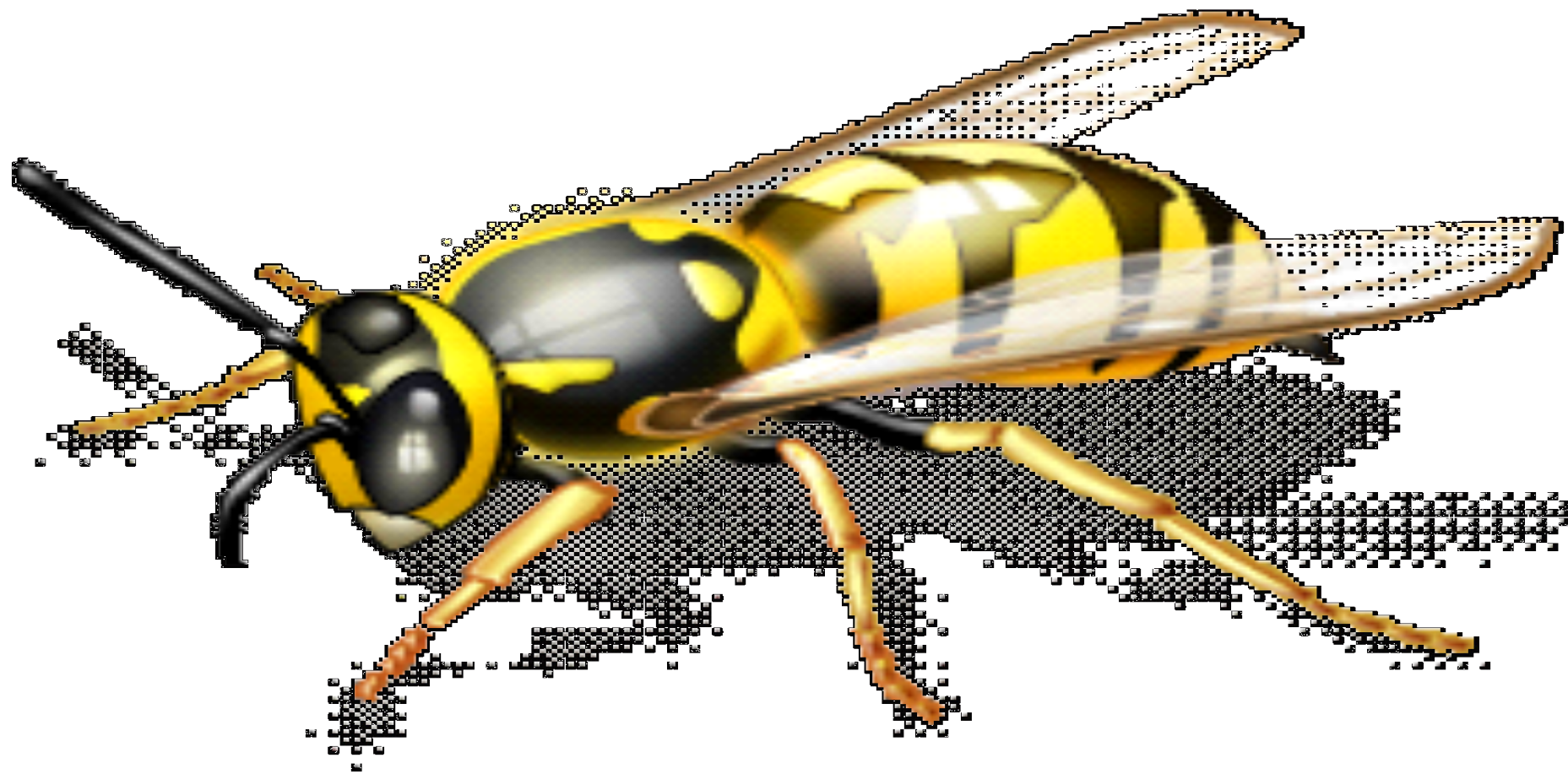
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KICKOFF FEB 16



Metacognition and How to Improve Student Learning







**What are our students likely to face
as they climb the academic ladder
or enter the job market?**



**Folks whose *miscalculations*
tell *them* that *they* should
not be able to fly!**

Expect Obstacles

Remember that stumbling blocks and steppingstones may look identical; WE determine which role they will play!



Turning Stumbling Blocks Into Stepping Stones



STUMBLING
BLOCK



Metacognition Is The Key!

Metacognition

The ability to:

- think about your own thinking
- be consciously aware of yourself as a problem solver
- plan, monitor, evaluate, and control your mental processing (e.g. “Am I *understanding* this material, or just *memorizing* it?”)
- accurately judge your level of learning
- know what you know and what you don’t know

Flavell, J. H. (1976). Metacognitive aspects of problem solving. In L. B. Resnick (Ed.), *The nature of intelligence* (pp.231-236). Hillsdale, NJ: Erlbaum

What is “Metacognitive Equity”?

- **Equity***

reducing the discrepancy in educational outcomes between low-income versus high-income students and minority versus majority students (closing the gap)

- ***Metacognitive Equity*****

reducing the discrepancy in metacognition (*thinking strategies*) between low-income versus high-income, minority versus majority, and well prepared versus underprepared students

*<https://www.kaganonline.com/grants/Excellence&Equity.pdf>

**McGuire, S. (2021). *Academic Support Programs Are the Key to Helping Institutions Achieve Metacognitive Equity*. [Manuscript submitted for publication]. Center for Academic Success, Louisiana State University

Why is there a metacognitive equity gap?

- Children from low-income families enter high school with average literacy skills five years behind those of high-income students (Reardon et al., 2012)
- Economically disadvantaged students have less access to mentors who will model metacognitive thinking skills (Gordon, 2016)
- Students from under resourced schools more likely to be less academically challenged (Theokas & Saaris, 2013)
- Minoritized and low-income students more likely to have a fixed mindset about intelligence (Flannery, 2016)

Impact of Privilege on Metacognitive Development*

- “Through privilege that included knowledgeable support in homes and schools, **some entering freshmen have rich prior experiences and well-developed metacognitive capacities that many more students do not have.**”
- Institutions may be able to **remedy** some of the **disadvantage *during college*** by focusing on developing metacognitive skills
- To overcome some disadvantages due to differential privilege institutions might consider **reducing content coverage in introductory courses and introducing instruction in metacognitive skills and awareness.**

*Nuhfer, E. (2019). Understanding the impacts of privilege on metacognitive development – part 1. The National Teaching and Learning Forum, 28(4), 8-11. <https://doi.org/10.1002/ntlf.30204>

Why haven't most students already developed metacognitive skills?



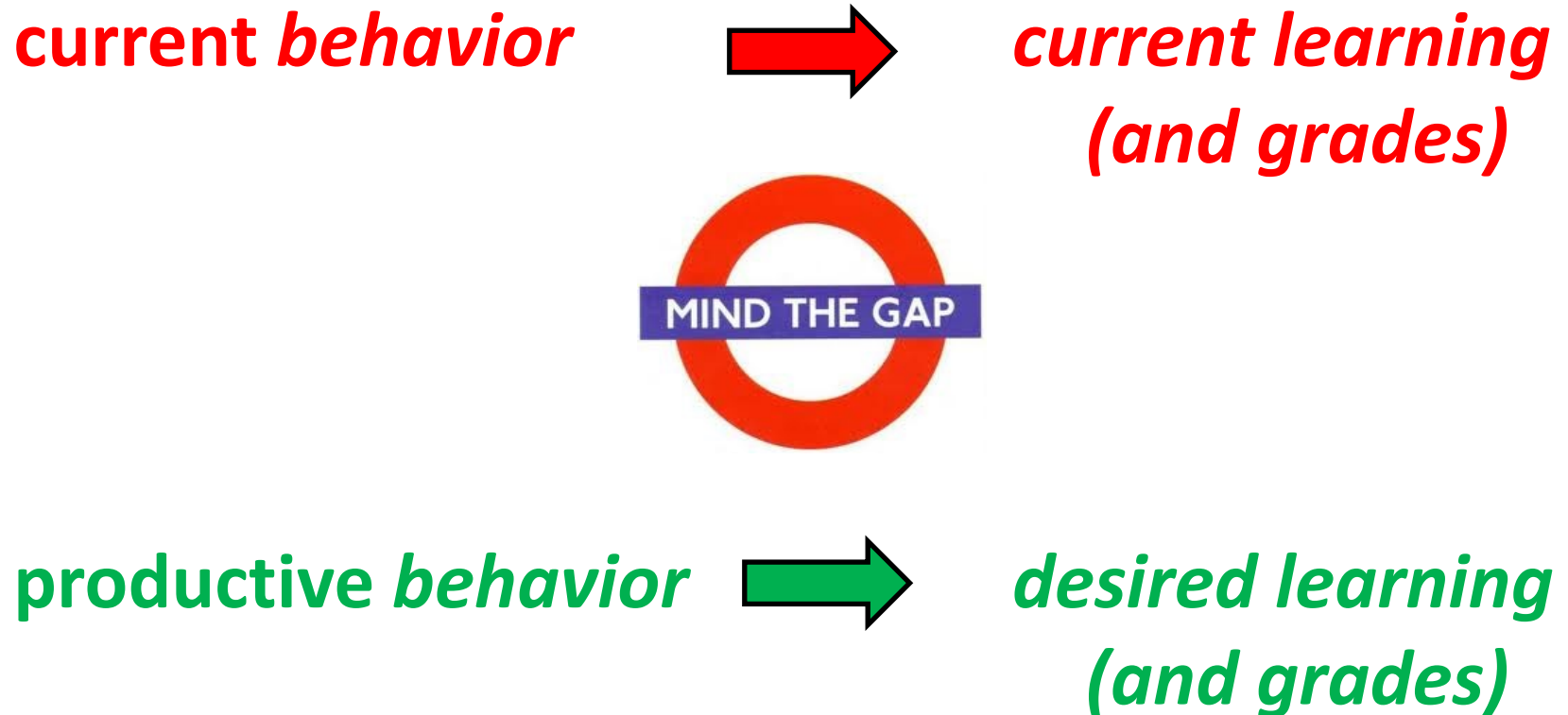
It wasn't necessary in high school

How do you think most students would answer the following?

- What did most of your teachers in high school do the *day before the test*?
 - What did they *do* during this activity?
 - What grade would you have made on the test if you had gone to class *only* on the day before the test?
-

Faculty Must *Help Students Actively Engage in Learning*

Help students identify and close “the gap”



Invaluable Faculty Partner



BE THE DIFFERENCE.

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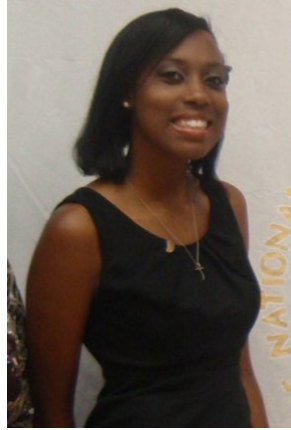
Welcome to the Office of Student Educational Services

[CLICK HERE](#)  for information on the Fall 2022 Academic Censure Process

The Office of Student Educational Services (OSES) is a resource for students who want to reach their full academic potential. OSES offers free tutoring, academic coaching and peer mentoring. The OSES staff takes a holistic approach to learning and specializes in helping students with study skills, time management, motivation and resilience. Our goal is to help students take control of their academics



Metacognition Helped Dana Engage With Physics



Dana, *first year physics student*
80, 54, 91, 97, 90 (final)

Before Metacognition: Memorizing formulas and using online homework programs

After Metacognition: Solving problems with no external aids and testing mastery of concepts

Dana Lewis, MS in Medical Physics, 2015

Univ of Texas Graduate School

of Biomedical Sciences at Houston

Thesis research at UT MD Anderson Cancer Center



Practicing Medical Physicist as of 8/28/2016
when she completed her residency!

Effective Homework Strategy

- **Study material first**, before looking at the problems/questions
- **Work example problems** (without looking at the solutions) until you get to the answer
- **Check** to see if **answer** is correct
- If answer is not correct, **figure out where mistake was made**, without consulting solution
- **Work homework** problems/answer questions as if taking a test

Metacognitive Reading Increased Engagement for Travis



Travis, *junior psychology student*
47, 52, 82, 86

Problem: Reading Comprehension

Solution: Preview text before reading*

Develop questions*

Read one paragraph at a time
and paraphrase information

* Developing an anticipatory set

A Reading Strategy that Works: SQ5R

- **Survey** (look at intro, summary, bold print, italicized words, etc.)
- **Question** (devise questions that you think the reading will answer)
- **Read** (one paragraph at a time)
- **Recite** (summarize in your own words)
- **Record or wRite** (annotate in margins)
- **Review** (summarize the information in your words)
- **Reflect** (other views, remaining questions)

Flying a Kite

A newspaper is better than a magazine/ A seashore is a better place than the street/ At first it is better to run than walk/ You may have to try several times/ It takes some skill, but it is easy to learn/ Even young children can enjoy it/ Once successful, complications are minimal/ Birds seldom get too close/ Rain, however, soaks in very fast/ Too many people doing the same thing can also cause problems/ One needs lots of room/ If there are no complications, it can be very peaceful/ A rock will serve as an anchor/ If things break loose from it, however, you will not get a second chance/

Bransford, J.D. and Johnson, M. K. Contextual Prerequisites for Understanding: Some Investigations of Comprehension and Recall, *Journal of Verbal Behavior*, (1971), 11, 717-726, 1972.

<http://www.cogsci.umn.edu/docs/pdfs/Bransford1972-JVLVB.pdf>

Impact of Reading Strategy

Text Forwarded from College Admissions Reviewer on 2/22/2021

...When I first started teaching Jamiyah **she was not passing my exams**...She wanted to drop to a lower-level Physics course. I asked her how she studies. Jamiyah told me **she reads the textbook**. I then asked her how she took notes. It turns out that she did not! She was **reading it like a novel**. After having read *Teach Students How to Learn* I decided to put one of those strategies into practice. I asked Jamiyah **not to give up yet, but to make one little change**. I asked her to **read a paragraph, close the book and then summarize it herself. Re-open the book and continue... this way not only would she have to take notes, but she would have to think about it and summarize it in her own words**. This worked. Not only did that turn her around in my class, but she **applied the same technique in all her other classes and saw her grades go up**... Now she has **found confidence** and knows what to do. Jamiyah will do nothing but exceptional work in college.

Impact of a Metacognitive Reading Strategy On High School Biology Student

*Excerpt of email received on Monday, April 19, 2021, 4:34 PM
from Univ of the District of Columbia CC workshop
participant about reading strategies discussed on 4/17/2021*

*...During your presentation, I disconnected my headsets in order for my son to hear your suggestions on effective reading strategies. My son, Darien, currently attends Dematha HS with a GPA of 4.2. **Three weeks ago, my son received a 72 on his test for Honors Biology.** Yesterday, I told him to follow your strategy on his next test which is scheduled for today. **Darien received an 86 on his test today!!!** He was so relieved and grateful for the advice...Thank you so much!!*

Reflection Questions Are Key to Engaging Students in Metacognitive Behaviors

- What's the difference, if any, between *studying* and *learning*?
- For which task would you work harder?
 - A. Make an A on the test
 - B. Teach the material to the class

The Power of Teaching to Learn: What Happened When Ty Taught His Betta Fish



- First encounter on September 17, 2018
- Email on October 25, 2018

Bio Exam Grades: 66, 98, 90; Final Grade B

Chem Exam Grades: 62, 83; Final Grade B

Impact of Teaching as a Learning Strategy

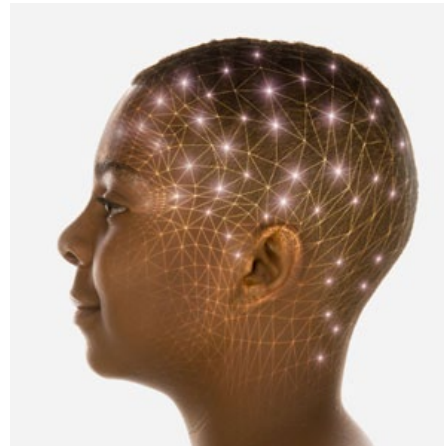
Ty, LSU First Year Student

Email Received on October 26, 2018

I attended more of the Supplemental Instruction (SI) sessions and the exam reviews. Before the exam reviews and SI Sessions I would try to answer as many of the questions as possible to see about where I was in terms of grasping the information, then at the exam reviews/SI sessions I would know what I needed to understand. Next after the reviews/SI sessions **I would go to my room and “teach” the materials to my betta fish. The material I couldn’t explain, I would study more. I would continue that cycle until I could explain everything in my notes....**

Why Is Fast and Dramatic Improvement Possible?

It's all about the *strategies*, and getting *them* to *engage their brains!*



Finding Numbers in Sequential Order



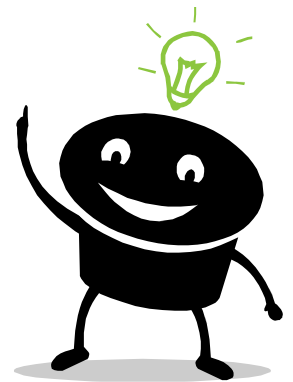
**How many can you find in
15 seconds?**

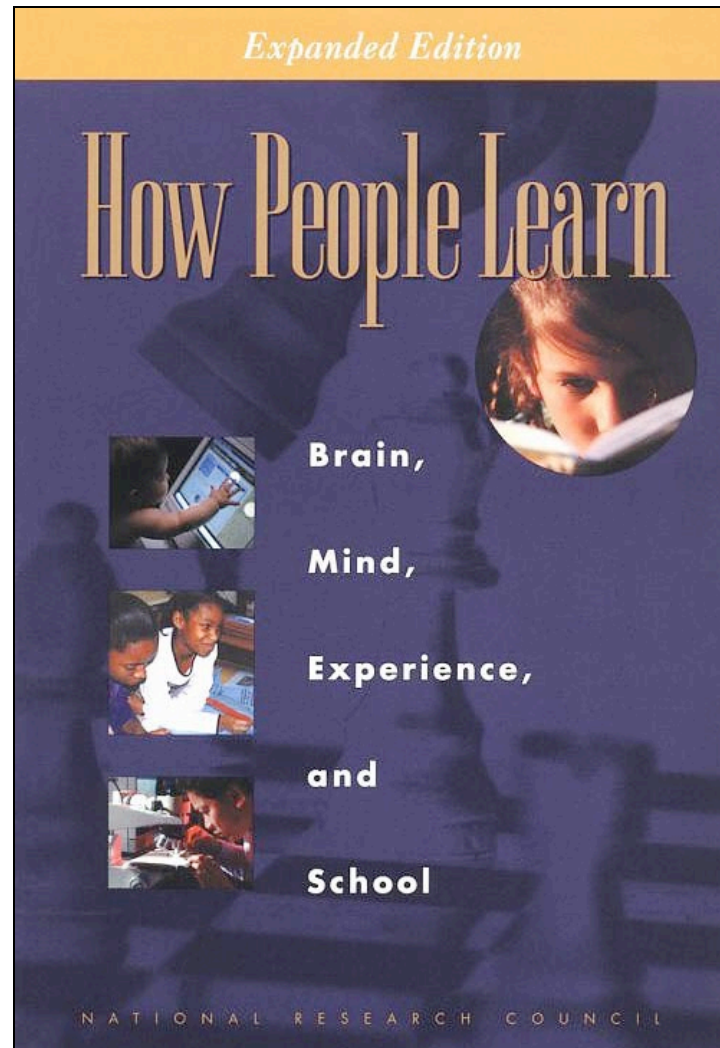
76	4	48	28	64	5	77	33	53	45
56	32	16	44	72	17	37	69	29	1
20	36	8	24	52	21	61	13	57	49
68	60	12	80	40	9	41	65	25	73
3	67	47	79	23	70	22	38	14	54
19	31	55	51	71	6	62	2	46	50
59	7	63	27	39	74	10	42	66	26
35	75	15	43	11	78	18	34	30	58

**What were two major differences
between the first attempt
and the second attempt?**

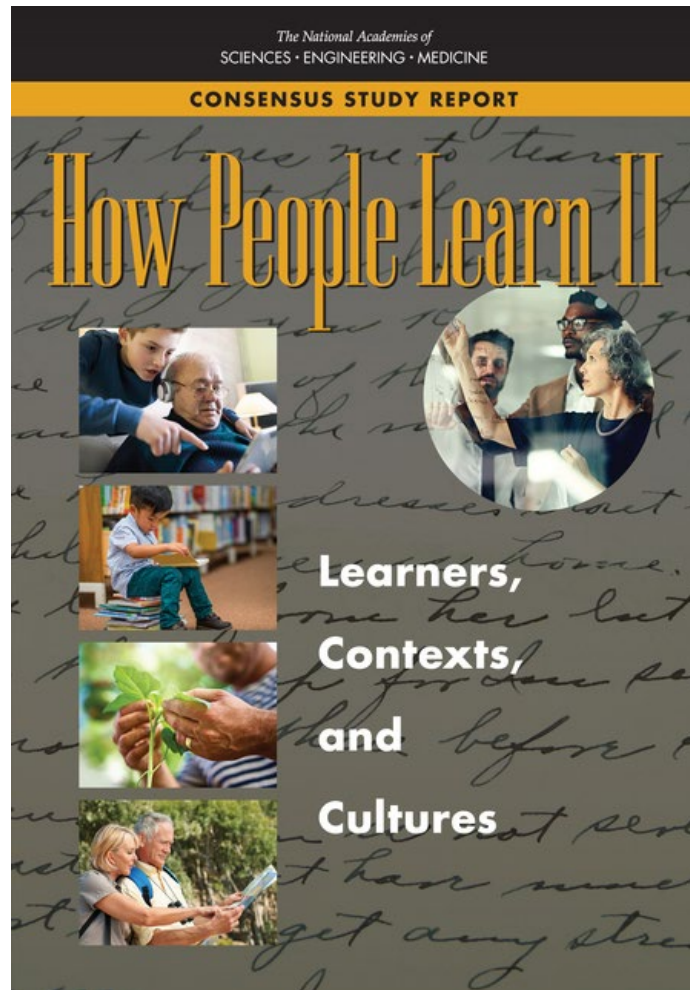
**We knew how the information
was organized**

**We could look at a smaller
section of the grid**





Bransford, J.D., Brown, A.L., Cocking, R.R. (Eds.), 2000. *How people learn: Brain, Mind, Experience, and School*. Washington, DC: National Academy Press.



**National Academies of Sciences, Engineering, and Medicine.
2018. *How People Learn II: Learners, Contexts, and Cultures*.
Washington, DC: The National Academies Press.
<https://doi.org/10.17226/24783>**

What we know about learning

- Active learning is more lasting than passive learning
 - Passive learning is an oxymoron*
- Thinking about thinking is important
 - Metacognition**
- The level at which learning occurs is important
 - Bloom's Taxonomy***

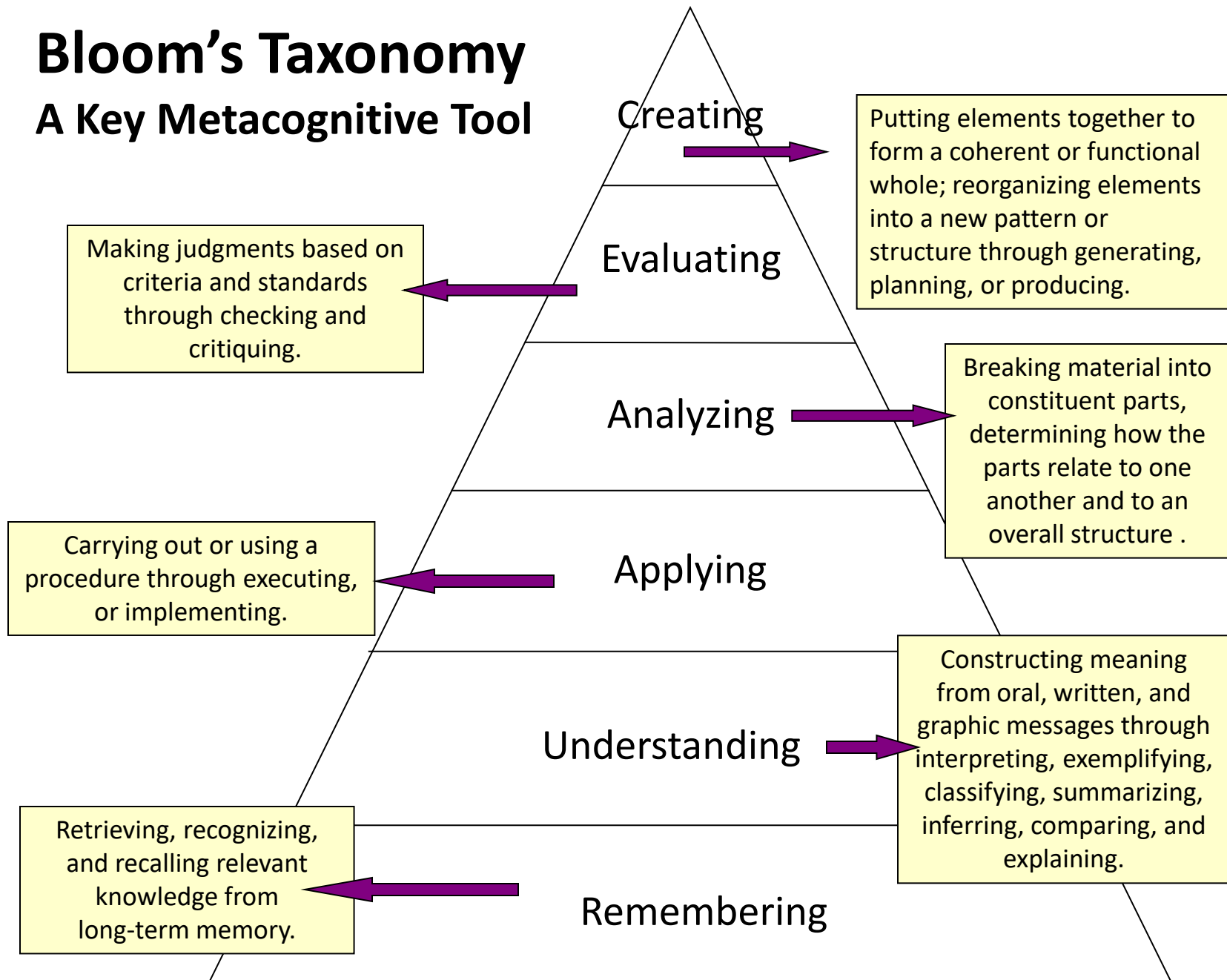
*Cross, Patricia, "Opening Windows on Learning", League for Innovation in the Community College, June 1998, p. 21.

** Flavell, John, "Metacognition and cognitive monitoring: A new area of cognitive–developmental inquiry." *American Psychologist*, Vol 34(10), Oct 1979, 906-911.

*** Bloom Benjamin. S. (1956). *Taxonomy of Educational Objectives, Handbook I: The Cognitive Domain*. New York: David McKay Co Inc.

Bloom's Taxonomy

A Key Metacognitive Tool



**When we teach students
about Bloom's Taxonomy...**

They GET it!



From: Tom Healy <healy@tois.world>  High School English Teacher, Czech Republic

Sent: Monday, September 27, 2021 3:45 AM

To: Sandra McGuire <smcgui1@lsu.edu>

Cc: Silvia Pirola <spirola@cambridge.org>; Suzanne Delassiaz
<suzannedelassiaz@gmail.com>

Subject: Re: THANKS!

Hi all,

A fellow teacher just shared with me an interesting story. They were reading a text in his class and one of the students asked, '**What's wisdom?**'... The teacher said, 'Well, there are two ways to answer that, the simple way and the much longer way.' So he showed them the basic meme of '**Knowledge is knowing a tomato is a fruit, wisdom is not putting it on a fruit salad.**' And one of the students said, '**Oh, so it's like Bloom's Taxonomy: first you know the thing, and then when you understand it and can apply it to situations, that's where wisdom is.**'

We quite liked that and thought it was pretty amazing that **the students have internalized it enough already to be thinking about it and recognizing it in various contexts.** So, definitely, some success has been had.

All the best,

--tom

How do you think students answered?

At what level of Bloom's did you have to operate to make A's or B's in high school?

1. Remembering
2. Understanding
3. Applying
4. Analyzing
5. Evaluating
6. Creating

How do you think students answered?

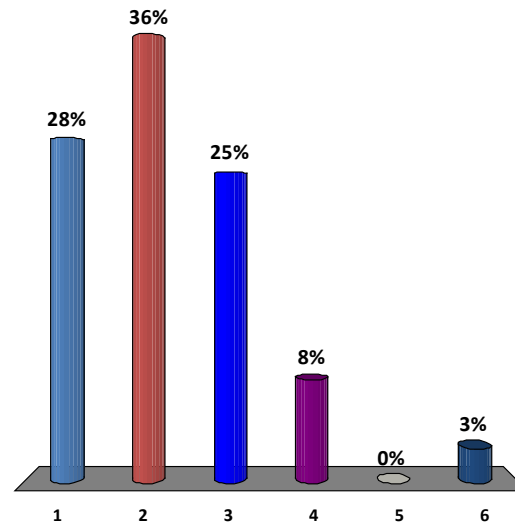
At what level of Bloom's do you think you'll need to operate to make A's in college courses?

1. Remembering
2. Understanding
3. Applying
4. Analyzing
5. Evaluating
6. Creating

How students answered (2014)

At what level of Bloom's did you have to operate to make A's and B's in high school?

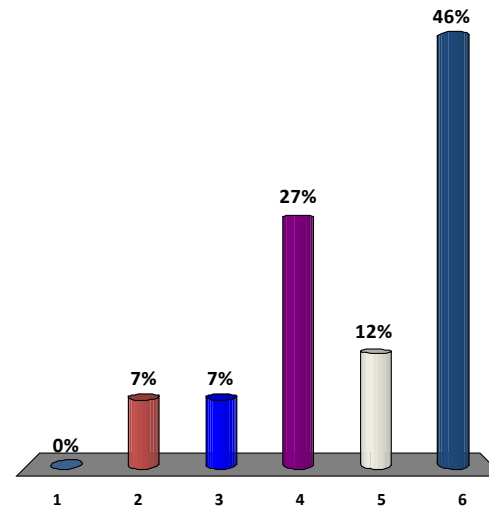
1. Remembering
2. Understanding
3. Applying
4. Analyzing
5. Evaluating
6. Creating



How students answered (in 2014)

At what level of Bloom's do you think you'll need to operate to make A's in college?

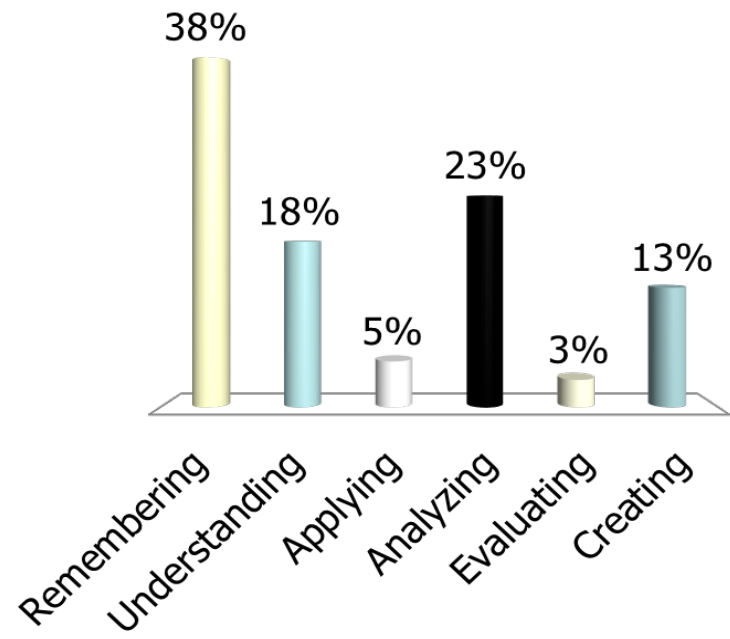
1. Remembering
2. Understanding
3. Applying
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How students answered (in 2018)

At what level of Bloom's do you think you'll need to operate to make A's and B's in high school?

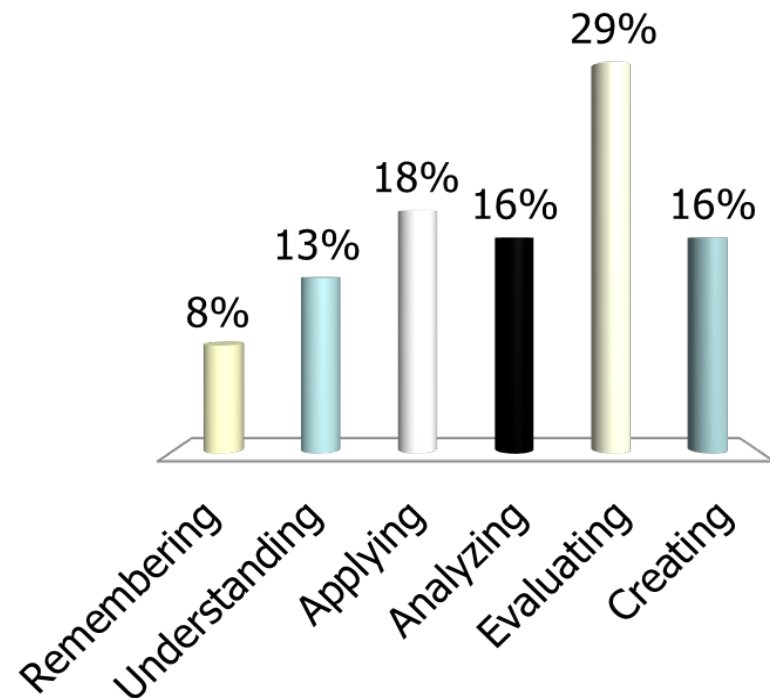
1. Remembering
2. Understanding
3. Applying
4. Analyzing
5. Evaluating
6. Creating



How students answered (in 2018)

At what level of Bloom's do you think you'll need to operate to make A's in college?

1. Remembering
2. Understanding
3. Applying
4. Analyzing
5. Evaluating
6. Creating



How do we teach students to move *higher* on Bloom's Taxonomy?



Teach them the Study Cycle*

**adapted from Frank Christ's PLRS system*

Preview

Preview before class – Skim the chapter, note headings and boldface words, review summaries and chapter objectives, and come up with questions you'd like the lecture to answer for you.

Attend

Attend class – **GO TO CLASS!** Answer and ask questions and take meaningful notes.

Review

Review after class – As soon after class as possible, read notes, fill in gaps, and note any questions.

Study

Study – Repetition is the key. Ask questions such as 'why', 'how', and 'what if'.

- Intense Study Sessions* - 3-5 short study sessions per day
- Weekend Review – Read notes and material from the week to make connections

Check

Check your Learning – Periodically perform reality checks

- Am I using study methods that are effective?
- Do I understand the material enough to teach it to others?

Focused Study Sessions

1	Set a Goal	1-2 min	Decide what you want to accomplish in your study session
2	Study with Focus	30-50 min	Interact with material- organize, concept map, summarize, process, re-read, fill-in notes, reflect, etc.
3	Reward Yourself	10-15 min	Take a break – call a friend, play a short game, get a snack
4	Review	5 min	Go over what you just studied

Brea Manuel, BS in Chemistry, 2018

Entered PhD Program at Emory University on Full Fellowship in Fall 2018

Became a PhD Candidate in Spring 2020

Successfully Defended Dissertation on October 28, 2022

Will Do Postdoc Work at University of Maryland, Baltimore County



The focused study sessions helped me most. I actually got A+ on 3 out of 4 of my finals using that method of studying. It's important to use it everyday before finals week, and I think it would **really benefit students during finals week.**

Manuel, B.A., Karloff, D.B. Recruit and retain a diverse workforce. *Nat Rev Chem* (2020). <https://doi.org/10.1038/s41570-020-0214-z>

Thermoreversible Control of Nucleic Acid Structure and Function with Glyoxal Caging
Steve D. Knutson, Aimee A. Sanford, Colin S. Swenson, Megan M. Korn, **Brea A. Manuel**,
and Jennifer M. Heemstra**J. Am. Chem. Soc.* 2020, 142, 41, 17766–17781
<https://doi.org/10.1021/jacs.0c08996>

Sharing Bloom's and The Study Cycle Improved Learning

Dr. Kelter:

After the ND-Gateway workshop this August, I shared Dr. McGuire's presentation with several of my colleagues and students in the ABEN department.

One ABEN student was struggling in his classes. I asked how he studied, and found he didn't have good study habits. I **shared the PPT with him on August 21, 2018, and also emphasized the content in slide 32 (Bloom's Taxonomy) and slide 45 (Study Cycle).** He wrote me an email today (September 7, 2018) and said:

"I actually am applying myself and changed my study and planning habits and it seems to be paying off already. I scored 114% on the first and only graded homework assignment so far and took the first exam on Wednesday and got 100%."

I also applied the suggestion in Slide 14 to my class, and **invited students to co-teach some lectures with me.** They did a fantastic job by adding much more content and real world experience to the class. This is truly a wonderful experience for me because **I saw that students poured their passion and talent into the lecture.**

Please extend my appreciation to Dr. McGuire.

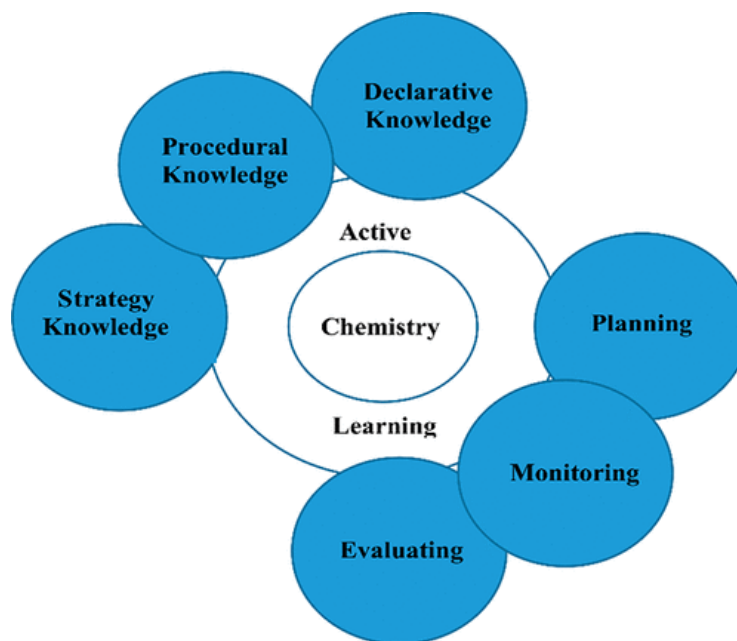
Thanks,

Xinhua Jia, Ph.D., P.E. Associate Professor, Agricultural and Biosystems Engineering
North Dakota State University

Metacognition Enhances Efficacy of Active Learning

Metacognition and Active Learning Combination Reveals Better Performance on Cognitively Demanding General Chemistry Concepts than Active Learning Alone

Jacinta M. Mutambuki*, Mwarumba Mwavita, Caroline Z. Muteti, Brooke I. Jacob, and Smita Mohanty



J. Chem. Educ. 2020, 97, 7, 1832–1840, Publication Date: June 25, 2020
<https://doi.org/10.1021/acs.jchemed.0c00254>

“Strategies to prevent cognitive overload: A team-based approach to improving student success and persistence in a gateway introductory chemistry course”*



Until Fall 2013, the student success rate of a large introductory chemistry class...was **50%**. ...We then **implemented a face-to-face class format based on The Study Cycle concepts** presented by Dr. Sandra McGuire in her book *Teach Students How to Learn*. Curriculum revisions enabled faculty to deliver well-focused lectures, with access to supporting practice problems and labs that connected clearly with each week’s learning objective... Starting in Fall 2016, some sections introduced active and cooperative learning, which led to a steady improvement in the overall success rate, ending at **75%** in Fall of 2018.

M. H. Benko, K. M. Vogelsang, K. A. Johnson, A. R. Babij, “Strategies to Prevent Cognitive Overload: A Team-based Approach to Improving Student Success and Persistence in a Gateway Introductory Chemistry Course” in *Enhancing Student Retention in Introductory Chemistry Courses: Practical Strategies*, American Chemical Society: Washington, DC: Fall 2019

Two Different Mindsets About Intelligence

- **Fixed Mindset**

 - Intelligence is static

 - You have a certain amount of it

- **Growth Mindset**

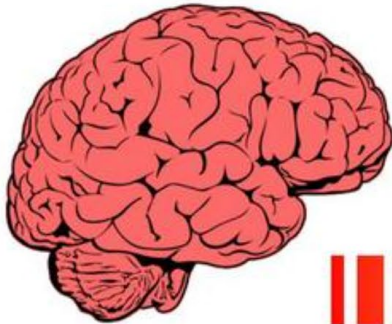
 - Intelligence can be developed

 - You can grow it with actions

Responses to *Many* Situations are Based on Mindset

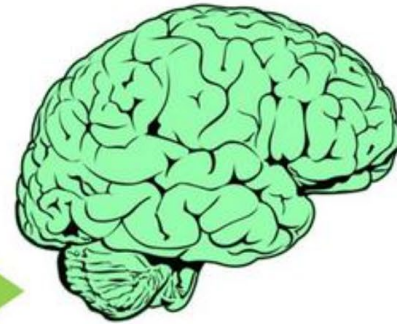
A Mindset Shift

Fixed



- Avoid challenges
- Give up easily
- See effort as pointless
- Ignore useful negative feedback
- Feel threatened by the success of others

Growth



- Embrace challenges
- Persist in the face of setbacks
- See efforts as a path to mastery
- Learn from criticism
- Feel lessons and inspiration in the successes of others.

Consider where you would place yourself currently. Now think about what you can do to release your growth mindset.

Which mindset about intelligence do you think *most students* have?

1. Fixed
2. Growth

Which mindset about student intelligence do you think *most faculty* have?

1. Fixed
2. Growth

*Email from a General Chemistry Student
with a Fixed Mindset*

“...Personally, I am not so good at chemistry and unfortunately, at this point my grade for that class is reflecting exactly that. I am emailing you inquiring about a possibility of you tutoring me.”

April 6, 2011

“I made a 68, 50, (50), **87, 87, and a 97 on my final**. I ended up earning a **90 (A)** in the course, but I started with a **60 (D)**. I think what I did different was make sidenotes in each chapter and as I progressed onto the next chapter I was able to refer to these notes. ***I would say that in chemistry everything builds from the previous topic.***

May 13, 2011

Semester GPA: 3.8

Study links faculty attitudes on intelligence to student success in STEM, with large impact on minority student success

Submitted by Scott Jaschik on February 18, 2019 - 3:00am

A new study suggests that faculty members' attitudes about intelligence can have a major impact on the success of students in science, mathematics and technology courses. Students see more achievement when their instructors believe in a "growth mind-set" about intelligence than they do learning from those who believe intelligence is fixed. The impact was found across all student groups but was most pronounced among minority students.

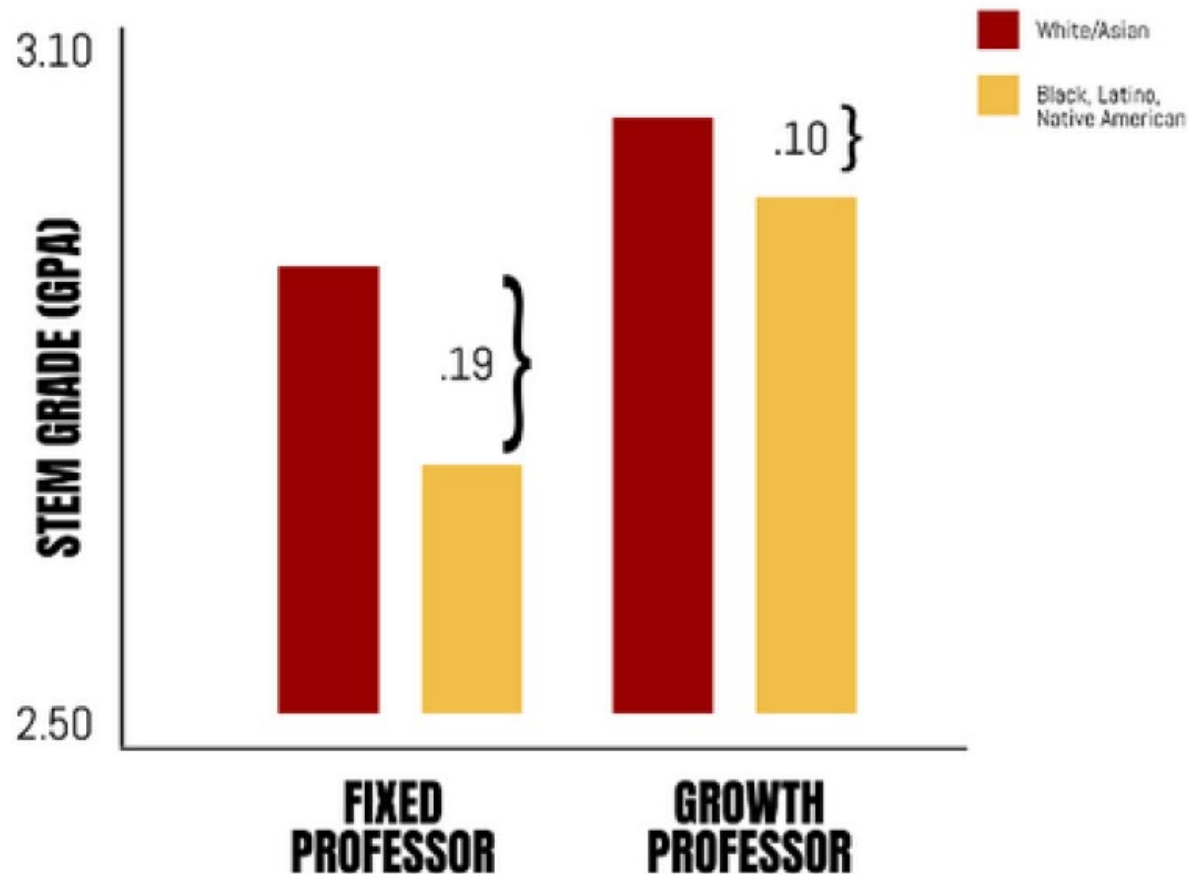
The study -- by brain science scholars at [Indiana University at Bloomington](#) [1] -- was published in the journal *Science Advances* [2] and presented last week at the annual meeting of the American Association for the Advancement of Science.

The researchers collected data on 150 faculty members in a range of STEM disciplines and 15,000 students over two years at a large public research university that is not identified. Faculty members were asked to respond to a general statement about intelligence along the lines of "To be honest, students have a certain amount of intelligence, and they really can't do much to change it."

The study then looked at student performance in courses taught by those who agreed with that perspective and those who did not.

The findings:

While all students perform better when STEM professors endorse a growth mindset belief, the racial achievement gap is almost halved when professors endorse a growth-mindset belief.



Interview with 2021 Princeton neuroscience graduate

conducted on 6/8/2021

I came from a public high school, and I **struggled a lot freshman year getting used to Princeton's culture and academics.** I and my friends used to say we're from public high schools; that's why we're like this. People from private high schools are in a better position because they had opportunities that we didn't have. The growth mindset chapter in the book was so, so important because before that I thought if you're smart, you're smart; if you came from a private high school you're set; if you're from a public high school you can't even grow. Now I know that you have challenges that you have to overcome, but you can do better.

When I got a C in my first neuro class, the professor asked "why are you even majoring in neuro, you have a C in my class" ... I got an A+ on my senior thesis... **That's one example of going from literally getting C's my freshman year and thinking I shouldn't be at Princeton and majoring in neuroscience to getting all A's while taking all neuroscience courses my senior year...** if it wasn't for the growth mindset I wouldn't be here. **I now know that just because you're from a public high school doesn't mean you can't thrive at Princeton.**

LSU Analytical Chemistry Graduate Student's Cumulative Exam Record Before and After Using Metacognitive Strategies

<u>2004 – 2005</u>			<u>2005 – 2006</u>	
9/04	Failed		10/05	Passed
10/04	Failed		11/05	Failed
11/04	Failed	Began work with CAS and the Writing Center in	12/05	Passed best in group
12/04	Failed	October 2005	1/06	Passed
1/05	Passed		2/06	Passed
2/05	Failed		3/06	Failed
3/05	Failed		4/06	Passed last one!
4/05	Failed		5/06	N/A



Dr. Algernon Kelley, December 2009

From a Xavier University student to Dr. Kelley in Fall 2011

Oct. 17, 2011

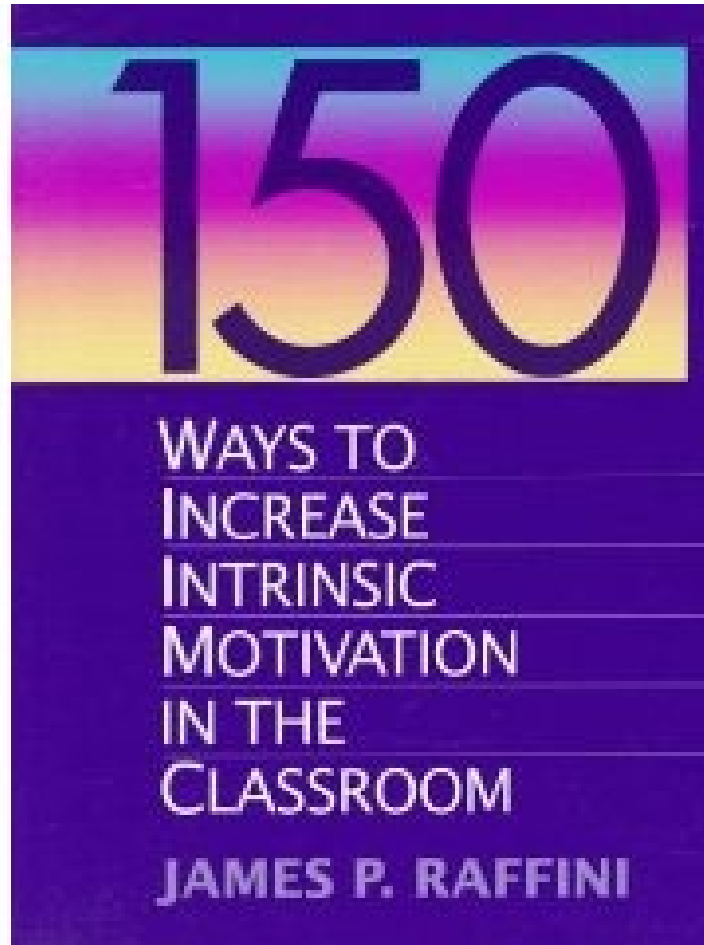
Hello Dr. Kelley. ... I am struggling at Xavier and I REALLY want to succeed, but everything I've tried seems to end with a "decent" grade. I'm not the type of person that settles for decent. What you preached during the time you were in Dr. Privett's class last week is still ringing in my head. I really want to know how you were able to do really well even despite your circumstances growing up. I was hoping you could mentor me and guide me down the path that will help me realize my true potential while here at Xavier. Honestly I want to do what you did, but I seriously can't find a way how to. Can I please set up a meeting with you as soon as you're available so I can learn how to get a handle grades and classes?

Oct. 24, 2011

Hey Dr. Kelley, I made an 84 on my chemistry exam (compared to the 56 on my first one) using your method for 2 days (without prior intense studying). Thanks for pointing me in the right direction. I'll come by your office Friday and talk to you about the test.

Nov 3, 2011

Hey Dr. Kelley! I have increased my Bio exam grade from a 76% to a 91.5% using your system. Ever since I started your study cycle program, my grades have significantly improved. I have honestly gained a sense of hope and confidence here at Xavier. My family and I are really grateful that you have taken time to get me back on track.



Raffini, James P. (1995) *150 Ways to Improve Intrinsic Motivation in the Classroom*. New York, NY: Allyn and Bacon.

Metacognition Addresses the Five Bases of Intrinsic Motivation

- **Autonomy (Control Your Own Destiny)**
- **Competence (Do Things that Help You Feel Successful)**
- **Belonging (To Feel Part of a Group Effort)**
- **Self-Esteem (To Feel Good About Who You Are)**
- **Involvement and Enjoyment (To Find Pleasure in What You Do)**

James Raffini, Allyn and Bacon, 1995

Conclusion

We *can* significantly increase student learning

- teach our students *how* to learn
- don't judge student potential on initial performance, and don't let them or anyone else do this
- encourage students to *persist in the face of initial failure* and provide examples of success stories
- motivate students to *use metacognitive strategies*



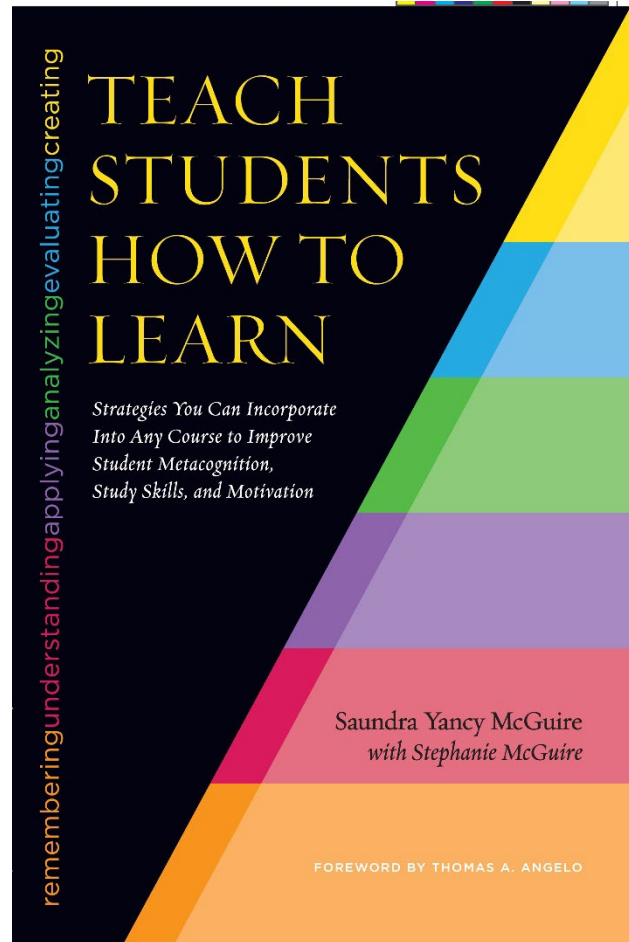
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Acknowledgments

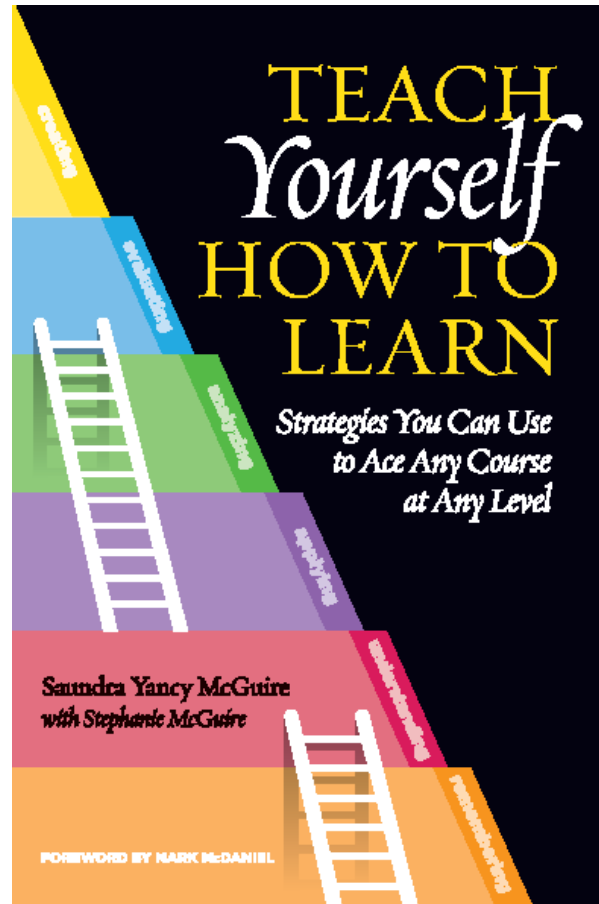
- **LSU Center for Academic Success colleagues (especially Sarah Baird)**
- **Colleagues in the International Learning Support Community**
- **The thousands of students who changed their attitudes and behaviors and taught ME that students CAN learn how to learn!**

A Resource for Instructors



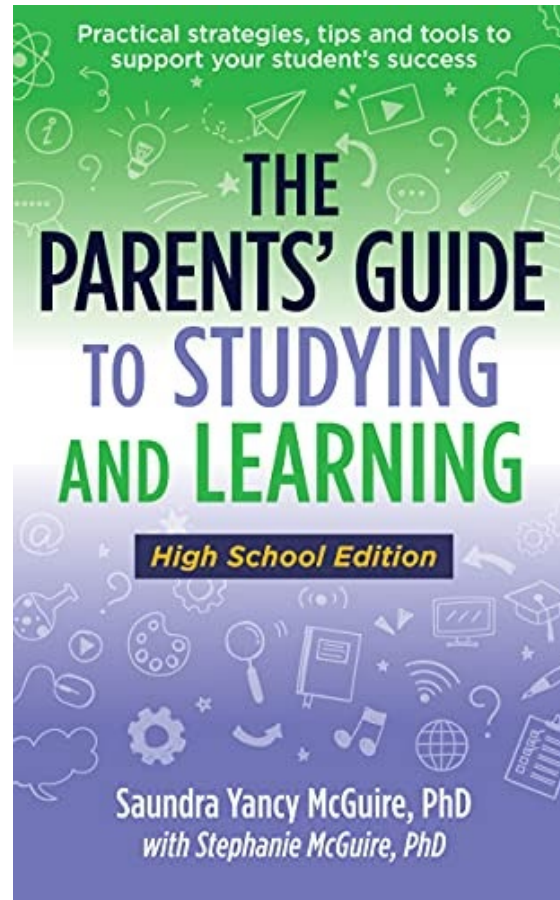
McGuire, S.Y. (2015). *Teach Students How to Learn: Strategies You Can Incorporate into Any Course to Improve Student Metacognition, Study Skills, and Motivation*. Sterling, VA: Stylus

The Book for Students



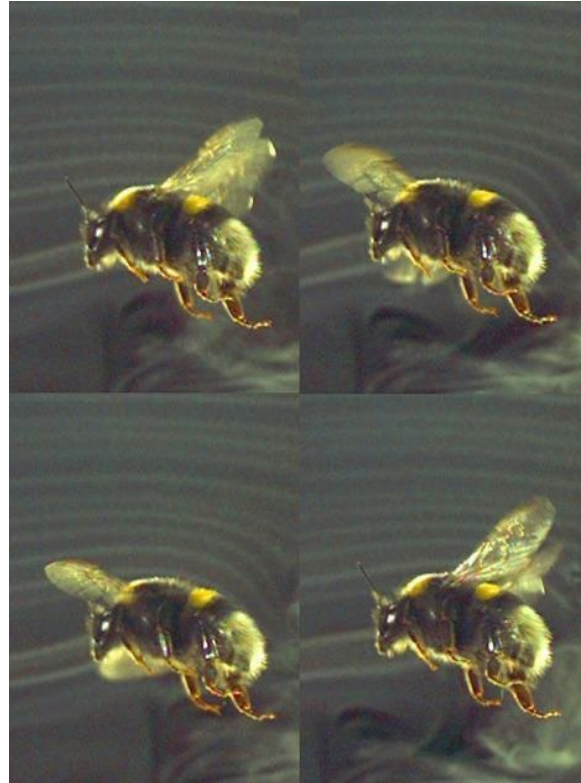
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Resource For Parents



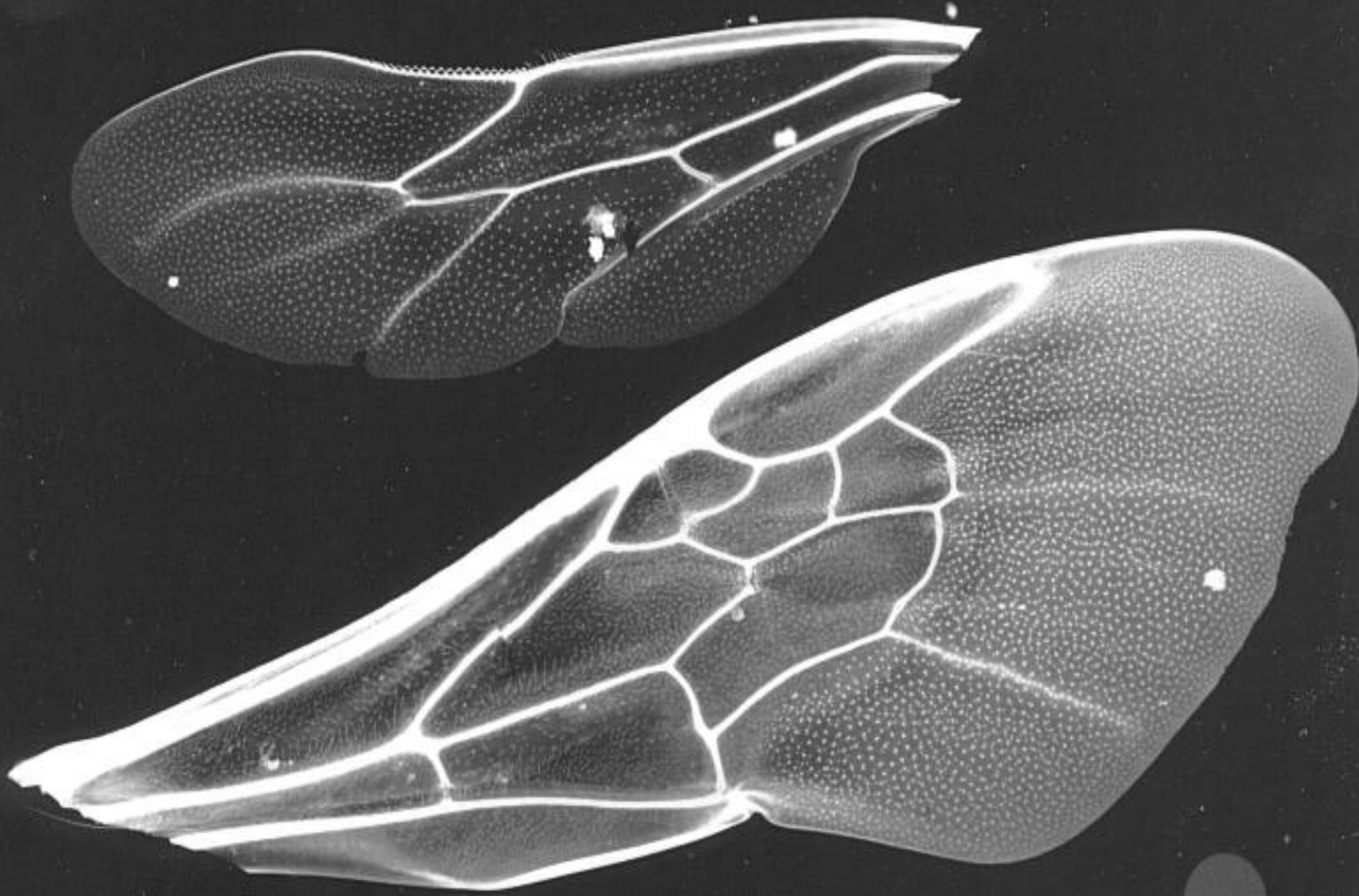
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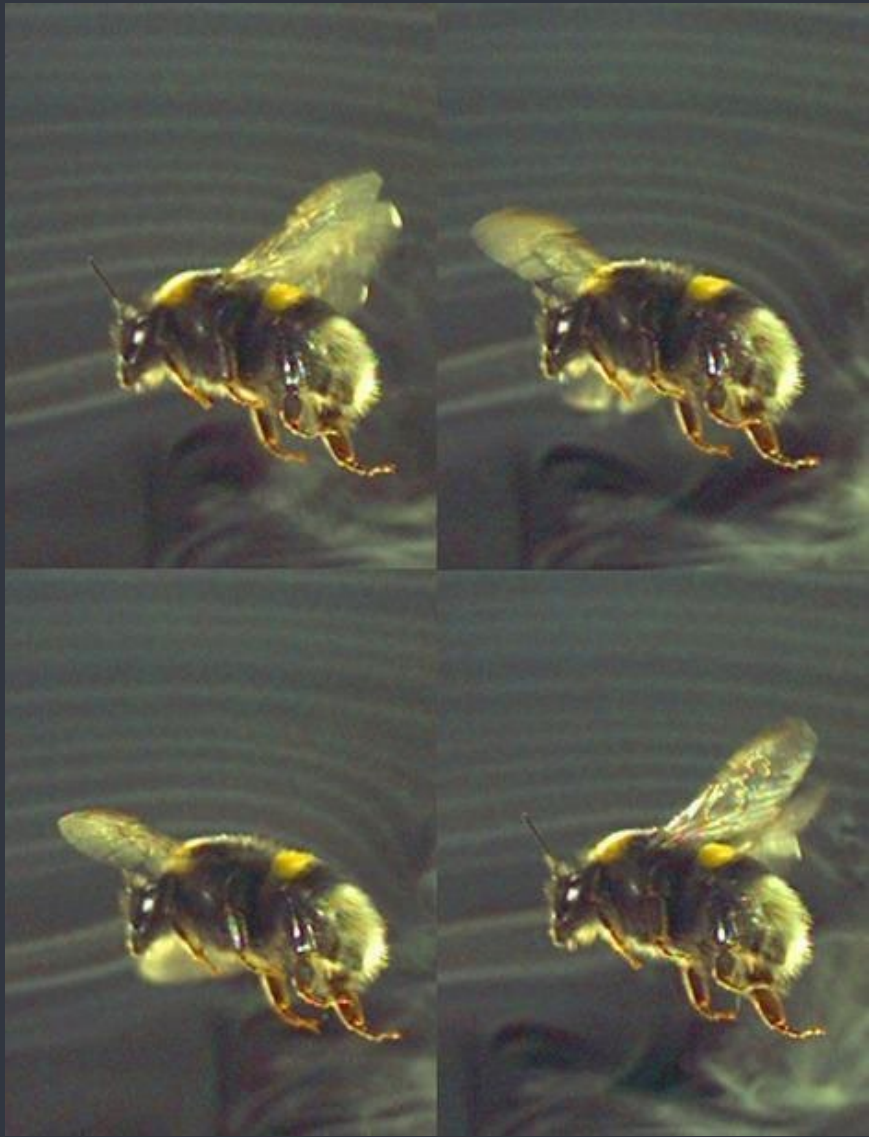
Why the Bumblebee CAN fly...















GO GOLDEN EAGLES!!!