

STANDARDS-BASED GRADING IN MATH AND BEYOND

Christopher Hanusa

Queens College Mathematics

@mathzorro #sbg #MasteryGrading #edchat

Life Before Standards

- ▶ Material to cover
- ▶ Teach it well

Life Before Standards

- ▶ Material to cover
- ▶ Teach it well
- ▶ How do I assess their learning?
- ▶ Choose concepts to test

Life Before Standards

- ▶ Material to cover
- ▶ Teach it well
- ▶ How do I assess their learning?
- ▶ Choose concepts to test



“What should I study?”

Life Before Standards

- ▶ Material to cover
- ▶ Teach it well
- ▶ How do I assess their learning?
- ▶ Choose concepts to test



“What should I study?”



“STUDY
IT ALL”

Life Before Standards

- ▶ Material to cover
- ▶ Teach it well
- ▶ How do I assess their learning?
- ▶ Choose concepts to test



“What should I study?”



“STUDY
IT ALL”

Life Before Standards

- ▶ Material to cover
- ▶ Teach it well
- ▶ How do I assess their learning?
- ▶ Choose concepts to test
- ▶ Partial credit: Worth 5 points? 7?
- ▶ What corresponds to an A?



“What should I study?”



“STUDY
IT ALL”

Life Before Standards

- ▶ Material to cover
- ▶ Teach it well
- ▶ How do I assess their learning?
- ▶ Choose concepts to test
- ▶ Partial credit: Worth 5 points? 7?
- ▶ What corresponds to an A?
- ▶ Final grade: Average exam grades.



“What should I study?”



“STUDY
IT ALL”

My issues

- ▶ Exams are high stakes

My issues

- ▶ Exams are high stakes
- ▶ Focus on **grades**, NOT **learning**

My issues

- ▶ Exams are high stakes
- ▶ Focus on **grades**, NOT **learning**
- ▶ Grades don't align with mastery

Is a B:

Fair
understanding of
most material?

Excellent
understanding of
some material?

My issues

- ▶ Exams are high stakes
- ▶ Focus on **grades**, NOT **learning**
- ▶ Grades don't align with mastery
- ▶ We assess only what is testable

Is a B:

Fair
understanding of
most material?

Excellent
understanding of
some material?

My issues

- ▶ Exams are high stakes
- ▶ Focus on **grades**, NOT **learning**
- ▶ Grades don't align with mastery
- ▶ We assess only what is testable
- ▶ Exams gauge understanding at a fixed point in time

Is a B:

Fair
understanding of
most material?

Excellent
understanding of
some material?

My issues

- ▶ Exams are high stakes
- ▶ Focus on **grades**, NOT **learning**
- ▶ Grades don't align with mastery
- ▶ We assess only what is testable
- ▶ Exams gauge understanding at a fixed point in time
- ▶ Opaqueness of the whole system

Is a B:

Fair
understanding of
most material?

Excellent
understanding of
some material?

My Standards-Based Grading

- ▶ Transparent list of standards
- ▶ Assessments of 3-4 standards every 2-3 weeks

My Standards-Based Grading

- ▶ Transparent list of standards
- ▶ Assessments of 3-4 standards every 2-3 weeks
- ▶ Each standard scored for mastery
 - 4:** Completely correct **3:** Almost correct with most main ideas
 - 2:** Some main ideas; not complete **1:** Very partial solution **0:** Weak Start

My Standards-Based Grading

- ▶ Transparent list of standards
- ▶ Assessments of 3-4 standards every 2-3 weeks
- ▶ Each standard scored for mastery
 - 4:** Completely correct **3:** Almost correct with most main ideas
 - 2:** Some main ideas; not complete **1:** Very partial solution **0:** Weak Start
- ▶ Reassessments to improve score (2 per week)

My Standards-Based Grading

- ▶ Transparent list of standards
- ▶ Assessments of 3-4 standards every 2-3 weeks
- ▶ Each standard scored for mastery
 - 4:** Completely correct **3:** Almost correct with most main ideas
 - 2:** Some main ideas; not complete **1:** Very partial solution **0:** Weak Start
- ▶ Reassessments to improve score (2 per week)
- ▶ Grade based on mastery of standards:
 - ▶ A: 90% 3.5+, others 3+
 - ▶ B: 80% 3+, others 2.5+
 - ▶ C: 80% 2+, others 1.5+
 - ▶ F: less than 80% 2+

Examples of Standards

▶ **Basic Integrals. (core)**

Can you **evaluate** standard antiderivatives, definite integrals, and indefinite integrals involving polynomials? Involving trigonometric functions?

▶ **Area between curves.**

Can you set up and evaluate an integral with respect to x ? y ? Can you **convert** between the two? This involves determining the correct bounds of integration.

▶ **Key Theorems.**

Can you **state and apply** the Fundamental Theorem of Calculus, parts I and II? Mean Value Theorem for Integrals? Do you understand their interpretations?

▶ **Mathematical Experience.**

Can you approach problems in multiple ways? Are you **willing to make mistakes**? Can you learn from your mistakes? Are you able to **discuss mathematical concepts** with your classmates?

▶ **Project Management.**

Can you **work together** on your project as a group? Can you follow project instructions? Can you work within a given timeframe and **meet deadlines**?

What I Love About Standards

- ▶ Focus is on the learning

What I Love About Standards

- ▶ Focus is on the learning
- ▶ Growth mindset – “How do I improve?”
 - ▶ More one-on-one contact & just-in-time teaching

What I Love About Standards



- ▶ Focus is on the learning
- ▶ Growth mindset – “How do I improve?”
 - ▶ More one-on-one contact & just-in-time teaching
- ▶ Transparency in Grading

Grade Sheet Example - Gradesly

Assignment Name	Your Score
----- Current Standard Scores -----	999
Current Score for Standard 1	4
Current Score for Standard 2	2
Current Score for Standard 3	3
Current Score for Standard 4	1
Current Score for Standard 5	2
Current Score for Standard 6	4
---- For an A you need 90% of your scores ≥ 3.5 and no scores under 3 -----	999
---- For a B you need 80% of your scores ≥ 3 and no scores under 2 -----	999
---- For a C you need 80% of your scores ≥ 2 and no scores under 1 -----	999
You have this many scores less than 3.5:	4
You have this many scores less than 3:	3
You have this many scores less than 2:	1
You have this many scores less than 1:	0
----- Raw Score for Assessment 1 -----	999
A1S1: Assessment 1, Standard 1	0
A1S2: Assessment 1, Standard 2	2
----- Raw Scores for Assessment 2 -----	999
A2S3: Assessment 2, Standard 3	1
A2S4: Assessment 2, Standard 4	1
----- Raw Scores for Assessment 3 -----	999
A3S5: Assessment 3, Standard 5	2
A3S6: Assessment 3, Standard 6	4
----- Scores for Any Reassessments Taken Below -----	999
S1R1: Standard 1 Reassessment 1	4
S1R2: Standard 1 Reassessment 2	999
S2R1: Standard 2 Reassessment 1	999
S2R2: Standard 2 Reassessment 2	999
S3R1: Standard 3 Reassessment 1	3
S3R2: Standard 3 Reassessment 2	999

What I Love About Standards



- ▶ Focus is on the learning
- ▶ Growth mindset – “How do I improve?”
 - ▶ More one-on-one contact & just-in-time teaching
- ▶ Transparency in Grading
- ▶ Assessments not as stressful

What I Love About Standards



- ▶ Focus is on the learning
- ▶ Growth mindset – “How do I improve?”
 - ▶ More one-on-one contact & just-in-time teaching
- ▶ Transparency in Grading
- ▶ Assessments not as stressful
- ▶ Higher expectations for students



Challenges with SBG

- ▶ Extra start-up costs: Multiple questions per standard



Challenges with SBG

- ▶ Extra start-up costs: Multiple questions per standard
- ▶ Extra work from tabulation
- ▶ Extra work from reassessments



Challenges with SBG

- ▶ Extra start-up costs: Multiple questions per standard
- ▶ Extra work from tabulation
- ▶ Extra work from reassessments
- ▶ Doesn't scale well – Automate?



Challenges with SBG

- ▶ Extra start-up costs: Multiple questions per standard
- ▶ Extra work from tabulation
- ▶ Extra work from reassessments
- ▶ Doesn't scale well – Automate?
- ▶ Questions spanning multiple standards?



Challenges with SBG

- ▶ Extra start-up costs: Multiple questions per standard
- ▶ Extra work from tabulation
- ▶ Extra work from reassessments
- ▶ Doesn't scale well – Automate?
- ▶ Questions spanning multiple standards?
- ▶ Higher expectations for students



Challenges with SBG

- ▶ Extra start-up costs: Multiple questions per standard
- ▶ Extra work from tabulation
- ▶ Extra work from reassessments
- ▶ Doesn't scale well – Automate?
- ▶ Questions spanning multiple standards?
- ▶ Higher expectations for students
- ▶ Students are working – Scheduling constraints?

Student Feedback

- ▶ “I like **knowing what I should learn** from each topic”
- ▶ “SBG lets **the student control** their grade.”
- ▶ “It helped me to understand each topic **more thoroughly.**”
- ▶ “Grading scheme made me go back over **where I was weak.**”
- ▶ “I **wouldn’t have bothered** to study this concept.”
- ▶ “I’ve never been **so excited** to “get” a math concept.”
- ▶ “**YES! I finally got it!**”

Course Projects

- ▶ **Projects = Active Learning**

Course Projects

- ▶ **Projects = Active Learning**
- ▶ **Math Modeling:** Simulate real-world scenario using Python
 - Bikeshare
 - Population Growth
 - Infectious Diseases
- ▶ **Math Programming:** Learn Mathematica and program:
 - Tutorial
 - Mathematical Art
 - Interactive App
- ▶ **Combinatorics:** Find real world situations / objects to count
- ▶ **Integral Calculus:** The Goblet Project

Project Deliverables

- ▶ Papers (Summary / Reflection)
 - ▶ Revision Process
- ▶ Programming Notebooks

Project Deliverables

- ▶ Papers (Summary / Reflection)
 - ▶ Revision Process
- ▶ Programming Notebooks
- ▶ Presentations
- ▶ Posters

Project Deliverables

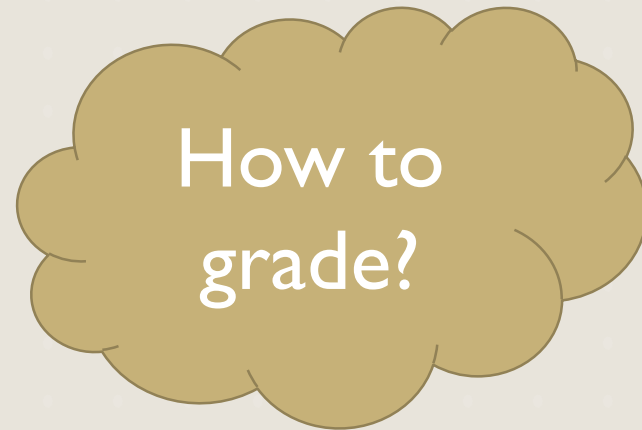
- ▶ Papers (Summary / Reflection)
 - ▶ Revision Process
- ▶ Programming Notebooks
- ▶ Presentations
- ▶ Posters
- ▶ 3D Printed Artwork / Exhibit

Project Deliverables

- ▶ Papers (Summary / Reflection)
 - ▶ Revision Process
- ▶ Programming Notebooks
- ▶ Presentations
- ▶ Posters
- ▶ 3D Printed Artwork / Exhibit
- ▶ Podcasts

Project Deliverables

- ▶ Papers (Summary / Reflection)
 - ▶ Revision Process
- ▶ Programming Notebooks
- ▶ Presentations
- ▶ Posters
- ▶ 3D Printed Artwork / Exhibit
- ▶ Podcasts



Grading, Before and After

- (5) Format Specifications
- (10) Organization
- (10) Grammar + Sent. Struct
- (5) Abstract
- (10) Background
- (15) Model
- (15) Results
- (20) Discussion
- (5) Appendices
- (5) Bib. / References

Add up the points to get a **weighted average.**

Grading, Before and After

- (5) Format Specifications
- (10) Organization
- (10) Grammar + Sent. Struct
- (5) Abstract
- (10) Background
- (15) Model
- (15) Results
- (20) Discussion
- (5) Appendices
- (5) Bib. / References

Add up the points to get a **weighted average.**

Standards List

- Timeliness
- Writing Style
- Abstract
- Introduction
- Methodology
- Results
- Analysis
- Conclusions
- Python Notebook

Score each standard:

- 4: Truly exceptional
- 3: Exceeds expectations
- 2: Meets expectations
- 1: Minimally Acceptable
- 0: Unacceptable

Grading, Before and After

- (5) Format Specifications
- (10) Organization
- (10) Grammar + Sent. Struct
- (5) Abstract
- (10) Background
- (15) Model
- (15) Results
- (20) Discussion
- (5) Appendices
- (5) Bib. / References

Add up the points to get a **weighted average.**

Standards List

- Timeliness
- Writing Style
- Abstract
- Introduction
- Methodology
- Results
- Analysis
- Conclusions
- Python Notebook

Score each standard:

- 4: Truly exceptional
- 3: Exceeds expectations
- 2: Meets expectations
- 1: Minimally Acceptable
- 0: Unacceptable

Grade based on scores:

- A+** 4 on 3 stds, others 3+
- A** 3 on 6 stds, others 2+
- B** 3 on 2 stds, 2 on 7 stds,
no 0's
- C** 2 on 4 stds, at most 1 0
- D** at most one 0
- F** at least two 0's

Thank you!

- ▶ Mastery Grading Slack:
bit.ly/join-masterygrading
- ▶ Robert Talbert
- ▶ Kate Owens
- ▶ My students

qc.edu/~chanusa

> Research > Talks
Slides Available

> Courses
Course Materials

> Math 142
Integral Calculus

> Math 636
Combinatorics