

# Evaluation of the NGSS' Support of Large-Scale Assessment

Transparent

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# My Perspective

- ❖ Assessment Developer—primarily large-scale state assessments
  - ❖ AAAS Project 2061
  - ❖ American Institutes for Research
  - ❖ The College Board
- ❖ Disclosure: Participated in AAPT review of NGSS 2<sup>nd</sup> Draft, January 2013
- ❖ The views expressed here are my own.

# The Importance of Standards

- ❖ The standards document must describe:
  - The content to be assessed
  - The acceptable contexts in which to situate the content
  - Appropriate tasks for the student to perform.
- ❖ Transparency depends on the standards document
  - Speaks to everyone, equally
  - Single recognized authority
- ❖ This presentation examines NGSS\* DCI Grouping HS-PS2  
Motion and Stability: Forces and Interactions

\*NGSS Lead States. 2013. *Next Generation Science Standards: For States, By States*. Washington, DC: The National Academies Press.

# NGSS Performance Expectations

- ❖ “**Performance expectations** are the assessable statements of what students should know and be able to do.” (PE)

PE is accompanied by

- ❖ “**Clarification statements**, which supply examples or additional clarification.” (Clarification)
- ❖ “**Assessment boundary** statements, which specify the limits to large scale assessment.” (Boundary)

# Content: HS-PS2-1

## Insufficient Detail

PE: Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

- ❖ Different versions of Newton's 2<sup>nd</sup> Law
- ❖ Which are assessable?
- ❖ Decisions must be made—transparency is the only question.

As the net force on an object increases, its acceleration increases.

As the mass of an object increases, its acceleration decreases.

As the net force on an object doubles, its acceleration doubles.

$$\vec{F}_{\text{net}} = m\vec{a}$$

# Content: HS-PS2-2

## Incomplete Description/Limited Task

PE: Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.

❖ Does the assessable content include...

➤  $\vec{p} = m\vec{v}$  ? (Included in the “Disciplinary Core Ideas” section, but the PE describes the assessment)

➤  $\vec{p}_{\text{net}} = \vec{p}_1 + \vec{p}_2 + \dots$  ?

❖ The answer to every item will be  $\vec{p}_{\text{net, initial}} = \vec{p}_{\text{net, final}}$

# Content: HS-PS2-2, 5, 6

## Questionable Content

HS-PS2-2: ...the total momentum of a system of objects is **conserved** when there is no net force on the system.

- “constant” would be better here
- Then can say “momentum is always conserved.”

HS-PS2-5: ...an electric current **can** produce a magnetic field and that a changing magnetic field **can** produce an electric current.

- “can” is not appropriate

HS-PS2-6 PE: ...why the **molecular**-level structure is important in the functioning of designed materials.


HS-PS2-6 Clarification: Examples could include why electrically conductive materials are often made of **metal**.

- Metals are not molecular

# Contexts: HS-PS2-1

## Ineffective Communication (1 of 2)

Clarification: Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object rolling down a ramp, or a moving object being pulled by a constant force.

- ❖ Given this information, the assessment developer must predict additional acceptable contexts 
- ❖ The teacher must decide how much time to spend on Newton's 2<sup>nd</sup> Law problems



# Contexts: HS-PS2-1

## Ineffective Communication (2 of 2)

Context	Number of forces	Force orientation	Particular Force(s)
Falling object	1 or 2	Collinear	Gravity Air resistance?
Object rolling down ramp	At least 3	Noncollinear	Gravity Normal force Static friction
Moving object pulled by constant force	1+	Possibly noncollinear	Pulling force Others?
<i>Proposed context</i>	?	?	?

- ❖ The three examples do not “tell a story.”
- ❖ Not useful for predicting other acceptable contexts.

# Contexts: HS-PS2-1

## Not Appropriate for Content

- ❖ Object rolling down ramp is rotational dynamics
- ❖ Probably outside the scope of NGSS
  - NGSS “rotation” only as Earth’s rotation
  - An NGSS core idea—“focus on a smaller set of Disciplinary Core Ideas”
- ❖ I prefer sliding to rolling

Quote from NGSS Frontmatter

# Contexts: HS-PS2-3

## Not Appropriate for Audience

Clarification: Examples of evaluation and refinement could include determining the success of the device at protecting an object from damage and modifying the device to improve it. Examples of a device could include a **football helmet** or a **parachute.**

- ❖ These contexts would probably not be acceptable in a state assessment system.
  - Football helmet: Gender bias & possible Safety issues
  - Parachute: Safety issues

# Task: HS-PS2-2

## Incorrect Application of Practice

PE: Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.

- ❖ **data/evidence** supports claims
  - “Analyze data using tools, technologies, and/or models (e.g...mathematical) to make valid and reliable scientific claims...”
- ❖ Representations are a **means of expression**
  - “Use mathematical representations of phenomena to describe explanations.”

# Task: HS-PS2-6

## Unclear Writing

PE: Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

- ❖ “Why” does not work here.
- ❖ Possible intent: For a particular designed material, describe the relationship of its molecular-level structure to its function.
- ❖ Unclear

# Recommendations

- ❖ Assessable Content
  - Add much more detail
  - Review for correctness
- ❖ Acceptable Contexts
  - List all or list none (instead describe)
  - Review for content suitability
  - Review for, and remove, bias/fairness/safety issues
- ❖ Student Tasks
  - Review for correct use of science practices
- ❖ Throughout: Review for, and remove
  - Wordiness
  - Unclear language

# Takeaways

- ❖ NGSS DCI Grouping HS-PS2 does not support transparent large-scale assessment.
- ❖ How an assessment developer looks at standards.
  - Close attention to text
  - Must use exactly as written