Unpacked South Dakota State Mathematics Standards

Purpose: *In order for students to have the best chance of success, standards, assessment, curriculum resources, and instruction must be aligned in focus, coherence, and rigor. Unpacked standards documents are intended to help align instruction to the focus, coherence, and rigor of the South Dakota State Mathematics Standards. The standards have been organized in clusters as they are not so much built from topics, but rather woven out of progressions. Not all content in a given grade is emphasized equally in the mathematics standards. Some clusters require greater emphasis than others based on the depth of the ideas, the time that they take to master, and/or their importance to future mathematics or the demands of college and career readiness. To say that some things have greater emphasis is not to say that anything in the standards can safely be neglected in instruction. Neglecting standards will leave gaps in student skill and understanding and may leave students unprepared for the challenges of a later grade.*

<table>
<tr><td colspan="2">Domain: Geometry</td><td>Grade Level: Geometry</td></tr>
<tr><td colspan="3">G.G.CO.D Cluster: Make geometric construction
This cluster focuses on hands-on basic constructions. Learners use geometric tools (compass and straightedge) to generate foundational pieces of geometry.</td></tr>
<tr><td colspan="3">**This is a ADDITIONAL cluster. Students should spend the large majority of their time (65-85%) on the major work of the grade. Supporting work and, where appropriate, additional work should be connected to and engage students in the major work of the grade.

G.G.CO.D.12 Perform geometric constructions with a compass and straightedge. including copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines/segments, constructing a line parallel to a given line through a point not on the line.

G.G.CO.D.13 Construct an equilateral triangle, a square, and a regular hexagon.</td></tr>
<tr><td colspan="3">Aspects of Rigor: (Conceptual, Procedural, and/or Application)</td></tr>
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<tr><td>Conceptual Understanding</td><td>Procedural Fluency</td><td>Application</td></tr>
<tr><td>Construction techniques (compass and straightedge) are used to create figures.</td><td>Perform constructions including: copy a segment, copy an angle, bisect segments and angles, construct perpendicular lines/segments, construct parallel lines.</td><td></td></tr>
<tr><td colspan="3">G.G.CO.D.13 Construct an equilateral triangle, a square, and a regular hexagon.</td></tr>
<tr><td>Conceptual Understanding</td><td>Procedural Fluency</td><td>Application</td></tr>
<tr><td>Construction techniques are used to create polygons.</td><td>Construct an equilateral triangle (using SSS, inscribed in a circle), square, and a regular hexagon using a compass and straightedge.</td><td></td></tr>
<tr><td colspan="3">Enacting the Mathematical Practices - Evidence of Students Engaging in the Practices</td></tr>
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1. **Make sense of problems and persevere in solving them.**
    - Learners must be challenged to develop deep understanding of the ideas in the clusters through exploring tasks that require problem solving.
    - As learners reason and experiment with rigid motions, determining a correct sequence of transformations will require perseverance.
2. **Reason abstractly and quantitatively.**
3. **Construct viable arguments and critique the reasoning of others.**
    - Learners should be encouraged to form arguments explaining why certain patterns hold in transformations and constructions, and to critique arguments that are presented to them.
    - In addition to creating proofs (constructing viable arguments), learners should have an opportunity to compare their proofs to those created by their classmates (critique the reasoning of others).
4. **Model with mathematics.**
    - Learners will apply ideas about transformations to model real-world contexts.
5. **Use appropriate tools strategically.**
    - Learners should use a variety of tools constructions and transformations, including compass and straightedge, graph paper, tracing paper, or geometry software.
    - The use of a variety of tools will be useful in making generalizations and proofs about when two triangles will be congruent.
6. **Attend to precision.**
    - While appearances might lead learners to certain conclusions, they need to precisely describe the transformations that they use and ensure that they work as they thought.
    - Learners need to use precise mathematical language to thoroughly explain the reasoning behind their work and when formalizing definitions.
    - Precision is of crucial importance in constructions, since even small errors in executing a construction may lead to results that don't work.
    - Use precise geometric language within proofs.
7. **Look for and make use of structure.**
    - Learners should look for patterns in their explorations, leading them to making generalizations about the transformations and constructions.
    - Looking for structure is an important aspect of conjecturing.
8. **Look for and express regularity in repeated reasoning.**
    - Looking for patterns is an important aspect of conjecturing.
    - Learners will need to look for patterns that will help them see general methods for constructions that can be used.

Vertical and Horizontal Coherence and Learning Progressions

Previous Learning Connections	***Current Learning Connections***	***Future Learning Connections***
In 8th grade, learners have worked with two-dimensional figures and verified their properties. (**8.GA**)	Construction adds to learning from previous clusters by building on triangle congruence theorems (SSS, SAS), properties of parallel and perpendicular lines, and polygons and their properties.	Construction techniques could be applied to unit circle, and conic sections in future courses. Learners will find applications if considering drafting and/or engineering careers. Electronic methods of construction (Geogebra, Desmos, Sketchpad) enable learners to extend/expand their construction methods.

Vocabulary (key terms and definitions)

- bisect
- compass
- equilateral triangles
- arc
- regular hexagons
- squares
- inscribed polygons
- congruent figures
- corresponding parts
- geometric construction

Relevance, Explanations, and Examples:

Use constructions to highlight geometric properties. For example, when copying an angle to construct parallel lines, a pair of congruent corresponding angles are constructed.

Draft plans for building, find distance using equilateral shapes.

Learners develop a deeper understanding of the properties of geometric figures through hands-on constructions.

Learners will use constructions to copy figures, verify congruence, or prove geometric properties.

Generating and critiquing arguments will be important in explaining why a given construction works.

Determining when exact measurements (construction) versus measured values (tape measure etc.) will be most beneficial.

Explore various methods of performing constructions. For example a 30 degree angle can be constructed by constructing a right triangle with one leg with a length half that of the hypotenuse, or construct an equilateral triangle and bisect an angle. Consider incorporating these constructions in different units to reinforce the geometric relationships.

Achievement Level Descriptors

Cluster: Make geometric constructions

Concepts and Procedures	***Level 1:*** Students should be able to base arguments on concrete referents such as objects, drawings, diagrams, and actions and identify obvious flawed arguments in familiar contexts.
	Level 2: Students should be able to find and identify the flaw in an argument by using examples or particular cases. Students should be able to break a familiar argument given in a highly scaffolded situation into cases to determine when the argument does or does not hold.
	Level 3: Students should be able to use stated assumptions, definitions, and previously established results and examples to test and support their reasoning or to identify, explain, and repair the flaw in an argument. Students should be able to break an argument into cases to determine when the argument does or does not hold.
	Level 4: Students should be able to use stated assumptions, definitions, and previously established results to support their reasoning or repair and explain the flaw in an argument. They should be able to construct a chain of logic to justify or refute a proposition or conjecture and to determine the conditions under which an argument does or does not apply.