SPIRAL PROGRESSION APPROACH TO TEACHING AND LEARNING

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Flow of Presentation

- What is the spiral progression approach?
- Why spiral progression?
- What are the criteria for placing concepts in a particular grade?
- How is spiral progression applied in Science in the K to 12?
What is the spiral progression approach?
Spiral Progression Approach

- Inspired by Bruner’s model of the spiral curriculum

  - Students continually return to basic ideas as new subjects and concepts are added over the course of a curriculum

  - Done in order to solidify understanding over periodic intervals for students to learn, rather than simply memorizing equations to pass a test.
Revolves around the understanding that human cognition evolved in a step-by-step process of learning, which relied on environmental interaction and experience to form intuition and knowledge.

In simpler terms, one learns best through the repeated experience of a concept.

Aligned with Bruner's theory of discovery learning, which posits that students learn best by building on their current knowledge.
Spiral progression means developing the same concepts from one grade level to the next in increasing complexity and sophistication.

- Revisiting concepts at each grade level with increasing depth
- Building on pupils’ prior knowledge and skills ... to allow gradual mastery from one grade level to the next
- Teaching general terms before specifics

Guide to implementation: A carefully formulated scope and sequence
The spiral progression approach is applicable not only for science and math subjects (as often misunderstood) but for all subjects.

The spiral progression approach is used from Grade 1 to Grade 10. This means that the curriculum is not divided into elementary school and high school, the way it used to be. There is now “vertical articulation,” or a seamless progression of competencies.

The seamlessness may actually be up to the university curriculum.
Why Spiral Progression?
1. High drop out rate (based on DepEd Report Card)
 Avoids the major disjunctions between stages of schooling; provides the basis for continuity and consistency; Compartmentalization inhibit transfer of learning across topics; students who exit school early do not have the basic functioning skills across requisite areas of science (University of Melbourne, Curriculum Comparison Study, 2011)

- Allows learners to learn Science topics and skills appropriate to their developmental/cognitive stages;
- Shows the interrelatedness of Science topics with each other and their connections across topics;
- Strengthens retention and mastery of topics and skills;
- Enables DepED to benchmark Filipino students with their counterparts in other countries.
- Reduce overlapping and ‘jumping’ sequence of topics in different grade levels
Science curriculum framework of high performing countries* follow a spiral progression and integrated approach at least up to G9

- No need to wait for Y2, Y3 and Y4 to learn concepts and their applications in Biology, Chemistry & Physics, respectively.

- Many topics in HS 1-4 are for college bound; Discipline based does not enable students to explore boundaries and connections across disciplines.

* Australia, Brunei, England, Finland, Japan, Taiwan, Thailand, Singapore, New Zealand, USA (3 states)
• The curriculum of high performing countries gives emphasis on connections across topics and disciplines scientific literacy)

PISA Test on Literacy
Items in international assessment studies (TIMSS 1995, 1999, 2003, 2007) have integrated questions and based on spiral progression of concepts.

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Life Sciences</td>
<td>43</td>
<td>30</td>
</tr>
<tr>
<td>Chemistry</td>
<td>45</td>
<td>30</td>
</tr>
<tr>
<td>Physics</td>
<td>40</td>
<td>24</td>
</tr>
<tr>
<td>Earth Sciences</td>
<td>46</td>
<td>32</td>
</tr>
<tr>
<td>Environmental Sciences</td>
<td>38</td>
<td>25</td>
</tr>
</tbody>
</table>
TIMSS 1999 Micro Analysis (UP NISMED, 2003)

Factual Knowledge

Conceptual Understanding

Reasoning & Analysis

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- Reduces decongestion
### Scientific Literacy Study: UP NISMED 2005*

#### STEL: G6 vs Y4

<table>
<thead>
<tr>
<th>Literacy Level</th>
<th>G6 STEL</th>
<th>Y4 STEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td>64.76</td>
<td>79.81</td>
</tr>
<tr>
<td>L2</td>
<td>34.89</td>
<td>63.58</td>
</tr>
<tr>
<td>L3</td>
<td>26.27</td>
<td>57.31</td>
</tr>
<tr>
<td>L4</td>
<td>8.39</td>
<td>25.79</td>
</tr>
<tr>
<td>L5</td>
<td>3.57</td>
<td>18.06</td>
</tr>
<tr>
<td>L6</td>
<td>0.42</td>
<td>1.48</td>
</tr>
<tr>
<td>L7</td>
<td>4.00</td>
<td>12.85</td>
</tr>
</tbody>
</table>

* Scale modified from R. Bybee, 1991

L1: Nominal;  L2-3: Functional;  L4-5-6: Conceptual;  L7: Multidimensional

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Emphasis on formative assessment (A4L)

- Promotes use of varied assessment formats used: selected-response (SR) and constructed-response (CR) types; rubrics provided for CR questions
- Assessment results are used to improve instruction
• Simplifies how science content and processes can be intertwined.
- Promotes learner-centered rather than teacher-centered instruction
Help nonmajors teach science with confidence because topics are revisited to deepen their content mastery;

Allows flexibility in sequencing of content in every quarter; encourages team teaching and other support mechanism

Address the lack of science equipment because alternative procedures are provided, student activities use micro scale chemicals and equipment easily available

Help teachers address misconceptions (TG support)
What are the bases for placing concepts in a particular grade level?

- Concrete to abstract; simple to complex
- Observable to imagery and visualization (use of models)
- Suitability to the cognitive level of learners and cognitive level demand of topic
- Prerequisite to succeeding topics/concepts
- Alignment with Math skills
- Supported by research
How is spiral progression applied in Science in the K to 12?

- Concepts and skills and revisited when using prior knowledge to discuss what students know and can do

Components of the Science Curriculum

- Scientific inquiry skills
- Content and connections
- Scientific attitudes and values
Component 1: Inquiry Skills

- Asking questions about the natural world (materials, events, phenomena, and experiences)
- Designing and conducting investigations using appropriate procedure, materials, tools, and equipment
- Employing different strategies to obtain information from different sources
- Communicating results of investigations using appropriate presentation tools
Basic Science Processes
Observing
Asking questions
Measuring
Classifying
Inferring
Finding patterns
Predicting
Communicating

Integrated Skills
Formulating hypothesis
Fair testing
- Identifying variables
- Controlling variables
Collecting and organizing data
Interpreting data
Making conclusions

Higher Order Thinking Skills
Critical thinking
Creative thinking
Problem solving
Decision making
(Real-life context)

Scientific Inquiry Skills

STE Literacy Skills
Sequence may vary from grade to grade. Ensure horizontal integration of topics across grading periods.
Component 3: Scientific Attitudes and Values

- Intellectual honesty
- Objectivity
- Perseverance
- Active listening
- Assuming responsibility
- Taking initiative
- Independent learning
- Analyzing and evaluating information, procedures, and claims.
- Making decisions based on sound judgment and logical reasoning.
### Focus on Grade 7 (for June 2012 Implementation)

<table>
<thead>
<tr>
<th>Science Areas</th>
<th>Theme</th>
<th>Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chemistry</strong></td>
<td>Diversity of materials</td>
<td>Solutions; Concentrations Acids and bases; Natural indicators Substances and mixtures Elements and compounds</td>
</tr>
<tr>
<td><strong>Life Sciences</strong></td>
<td>Diversity among and beyond Organisms: Levels of Organization</td>
<td>Levels of organizations in organisms - Cells, tissues, organs, organ systems - Plant and animal cells - Diversity of organisms - multicellular and unicellar; useful and harmful - Modes of reproduction Levels of organizations in ecosystems - Organisms, Populations, Communities, Ecosystems - Interrelationships among organisms &amp; with the physical environment</td>
</tr>
<tr>
<td>Science Areas</td>
<td>Theme</td>
<td>Coverage</td>
</tr>
<tr>
<td>---------------------</td>
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</tr>
<tr>
<td><strong>Physics</strong></td>
<td>Motion &amp; Energy</td>
<td>Uniform motion: distance and displacement; speed and velocity&lt;br&gt;Technologies that use motion detectors&lt;br&gt;Energy transfer- light, sound, heat and electricity</td>
</tr>
<tr>
<td><strong>Earth Sciences</strong></td>
<td>The Philippine Environment</td>
<td>Locating places on Earth using coordinate system-latitude and longitude; location of the Philippines with respect to the continents and oceans of the world and major landforms and bodies of water in the Philippines: effects on weather;&lt;br&gt;Resources in the Philippines: their relation to its location in the ring of fire; Conservation;&lt;br&gt;Layers of the atmosphere; how energy of the Sun enters the atmosphere; greenhouse effect; circulation in the atmosphere in relation to land &amp; sea breeze, monsoons, ITZC; Eclipses; beliefs and practices</td>
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</tbody>
</table>
### Earth and Space (Geology, Meteorology, Astronomy)

<table>
<thead>
<tr>
<th>G3</th>
<th>G4</th>
<th>G5</th>
<th>G6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate surroundings; landforms,</td>
<td>Soil &amp; water as resources: types &amp; characteristics</td>
<td>Processes that change surroundings: weathering &amp; soil</td>
<td>Other processes that change surroundings (earthquakes &amp;</td>
</tr>
<tr>
<td>bodies of water in the community &amp;</td>
<td>of soil for plant growth; sources of water, using</td>
<td>erosion</td>
<td>volcanic eruptions)</td>
</tr>
<tr>
<td>their Importance</td>
<td>water wisely, water as habitat, the water cycle</td>
<td>Weather disturbances (typhoons: effects, changes in the</td>
<td>Weather patterns (collecting, recording and interpreting</td>
</tr>
<tr>
<td>Types of weather</td>
<td>What makes up the weather (includes use of simple</td>
<td>weather, storm warning signals, preparing emergency</td>
<td>data)</td>
</tr>
<tr>
<td>(sunny, rainy, windy, &amp; combinations)</td>
<td>equipment to measure weather components)</td>
<td>plan with family)</td>
<td>Seasons in the Philippines</td>
</tr>
</tbody>
</table>

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G3
Objects in the sky; effects on human activities

G4
The Sun as main source of light and heat; effects on human activities & growth of plants
Changes in position of Sun (where it rises and sets)

G5
Moon & Stars
Pattern in the changes of the shape of the Moon in relation to length of a month; beliefs and practices
Characteristics of stars in terms of brightness and color; groups of stars

G6
Motion of the Earth (using models to show how day and night occurs, connection between Earth’s rotation and length of a day; connection of revolution of Earth and length of a year)
Solar system (comparison of eight planets)
<table>
<thead>
<tr>
<th>G7</th>
<th>G8</th>
<th>G9</th>
<th>G10</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Philippine Environment, locating places on Earth using coordinate system—latitude and longitude; location of the Philippines with respect to the continents and oceans of the world and major landforms and bodies of water in the Philippines: effects on weather; resources in Phil and its relation to its location in the ring of fire; conservation</td>
<td>Earthquakes and faults; intensity and magnitude Understanding typhoons (PAR, development, why Phil is prone to typhoons; effect of bodies of water and landforms on typhoons, disaster preparedness)</td>
<td>Volcanoes and heat inside the Earth Climate: factors that affect climate in a certain area (latitude, distance from the sea, presence of mountain range)</td>
<td>Plate tectonics (location of earthquake epicenters; location of volcanoes)</td>
</tr>
<tr>
<td>Layers of the atmosphere; how energy of the Sun enters the atmosphere; greenhouse effect; circulation in the atmosphere in relation to land and sea breeze, monsoons, ITZC) Filipino beliefs and practices</td>
<td></td>
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<tr>
<td>CEAP National Convention, 30 August 2012</td>
<td></td>
<td></td>
<td>33</td>
</tr>
</tbody>
</table>
# Matter (Properties, Structure, & Changes)

<table>
<thead>
<tr>
<th>G3</th>
<th>G4</th>
<th>G5</th>
<th>G6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Properties of SLG (e.g., weight, shape, volume)</td>
<td>Grouping materials based on properties other than as SLG</td>
<td>Characteristics and uses of mixtures</td>
<td></td>
</tr>
<tr>
<td>Materials that make up a particular solid and liquid</td>
<td>Proper handling of materials; recycling materials</td>
<td>Solvent &amp; solute; ways of dissolving solids faster</td>
<td></td>
</tr>
<tr>
<td>Materials can exist in SLG depending on the temperature</td>
<td>Changes that materials undergo when exposed to different conditions</td>
<td>Separating mixtures</td>
<td></td>
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<tr>
<td></td>
<td>Useful and harmful changes (e.g., in water); making water safe for human use.</td>
<td>Formation of colloids; colloids in real life</td>
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<tr>
<td></td>
<td>Types of changes that materials undergo</td>
<td>Storing materials based on properties</td>
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<tr>
<td></td>
<td>Storing materials based on properties</td>
<td>Importance of reading labels of products</td>
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</table>

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<table>
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<th>G8</th>
<th>G9</th>
<th>G10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diversity of Materials</td>
<td>Particulate nature of matter vis-a -vis properties of SLG</td>
<td>Chemical bonding: metallic, ionic and covalent</td>
<td>Gas laws and their applications</td>
</tr>
<tr>
<td>Solutions; Concentrations Acids and bases; natural indicators</td>
<td>Atomic structure; atoms &amp; molecules</td>
<td>Chemical formulas of ionic &amp; covalent compounds</td>
<td>Chemical reactions (types, factors affecting rates of chemical reactions)</td>
</tr>
<tr>
<td>Substances and mixtures</td>
<td>Periodic Table: (arrangement of elements; predicting chemical behaviour of an element; technological and industrial applications and impact )</td>
<td>The mole concept and its applications</td>
<td>Applications in biological and industrial processes affecting life and the environment</td>
</tr>
<tr>
<td>Elements and compounds</td>
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<tr>
<td>Metals &amp; nonmetals</td>
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Science in the K to 12 Curriculum

**shows**

- the place of science and technology in everyday activities
- the link between science and technology, including indigenous technology
- integration/connections within science and across disciplines
- how science content and processes are intertwined
- spiral progression

**is**

- learner-centered
- inquiry-based
- research-based
- decongested
Documents Reviewed

- BEC-DepEd, 2002 & 2006, BSE, 2010
- Curriculum Comparison Report (2011) SEAMEO INNOTECH
- Curriculum Comparison Report (2011) U of Melbourne
- Policy Issues in SME (2007), ICASE-UNESCO
- Science and Mathematics Curriculum Framework of Australia, Brunei, England, Japan, Singapore, Thailand New Zealand, and USA
- DESD Documents
- CVIF Manual (Bernido’s)

- Teach Less, Learn More (2010) Science Curriculum Framework for Basic Education. DOST SEI, UP NISMED, DepED, Professional Teachers Association
- Scientific, Technological, and Environmental Literacy Study (2005), UP NISMED
- And many more