Learning Objectives

Materials

Foundational Knowledge

Key information:

1.1 | A material's engineering performance encompasses the entire material life cycle.

1.2 | Natural and artificial materials have fundamentally different life cycle behaviors.

1.3 | Material resources are finite in our closed thermodynamic system of earth.

Key ideas or concepts:

1.4 | Realize that all sustainable materials accounting systems are based on current understanding; each has inherent limitations.

1.5 | Realize that our scientific models are in a process of becoming more accurate; all models are "wrong," yet some are useful.

1.6 | Understand that not all interventions are equal; interventions that change the design assumptions have a higher potential to change systemic outcomes.

1.7 | Understand that enlarging the boundaries of the system create more and higher impact opportunities for systemic re-design.

1.8 | Realize that there are several frameworks for developing strategies for sustainable designs; examples include: The IPAT equation; Daly sustainability principles, Green Chemistry and Engineering Principles; Biomimicry; Meadow's Hierarchy of Systemic Interventions.

Application

Critical thinking:

2.1 | From data on a material' s life cycle behavior, identify potential high-leveraged intervention opportunities.

2.2 | Evaluate and articulate potential social and environmental consequences associated with a material.

2.3 | Assess the potential appropriateness of specifying specific materials in different geographical settings by evaluating the materials life cycle behavior.

Creative thinking:

2.4 | Imagine the viable applications of "waste" materials from a material's life cycle.

2.5 | Conceive of ways that biomimicry principles can be applied in a specific material case.

2.6 | Conceive of ways that green engineering principles can be applied in a specific material case.

Practical thinking:

2.7 | Use Meadow's hierarchy of systems interventions to identify high-leveraged opportunities to lower the impact of a design.

Skills:

2.8 | State the general framework of a material life cycle.

Integration

3.1 | Realize that using materials in products implies the entire life cycle activities that includes resource use and waste outputs at each stage.

3.2 | Formulate questions about the local, regional and global implications of each step in a material's life cycle; (i.e. civil war, conflict, loss of biodiversity, etc.)

3.3 | Realize that material use can have societal implications ranging from new economies to civil war, conflict, social inequity, depending on the design choices in the life cycle.

3.4 | Realize that materials use can have environmental implications ranging from ecosystem recovery to biodiversity loss and pollution, depending on the design choices in the life cycle.

Human Dimension

4.1 | Understand that the personal and professional decisions we make regarding the materials we use have a profound impact on ourselves and the environment.

4.2 | Be able to articulate their interpretation of the meaning of the engineer's creed with respect to the implications of their personal and professional choices.

Caring

5.1 | Develop an interest in using one's engineering understanding to create sustainable alternatives to industrial-era products and processes.

5.2 | Feel empowered by understanding to innovate sustainable alternatives to industrial-era products and processes.

Learning How to Learn

6.1 | Formulate questions about broader societal implications of materials in designs.

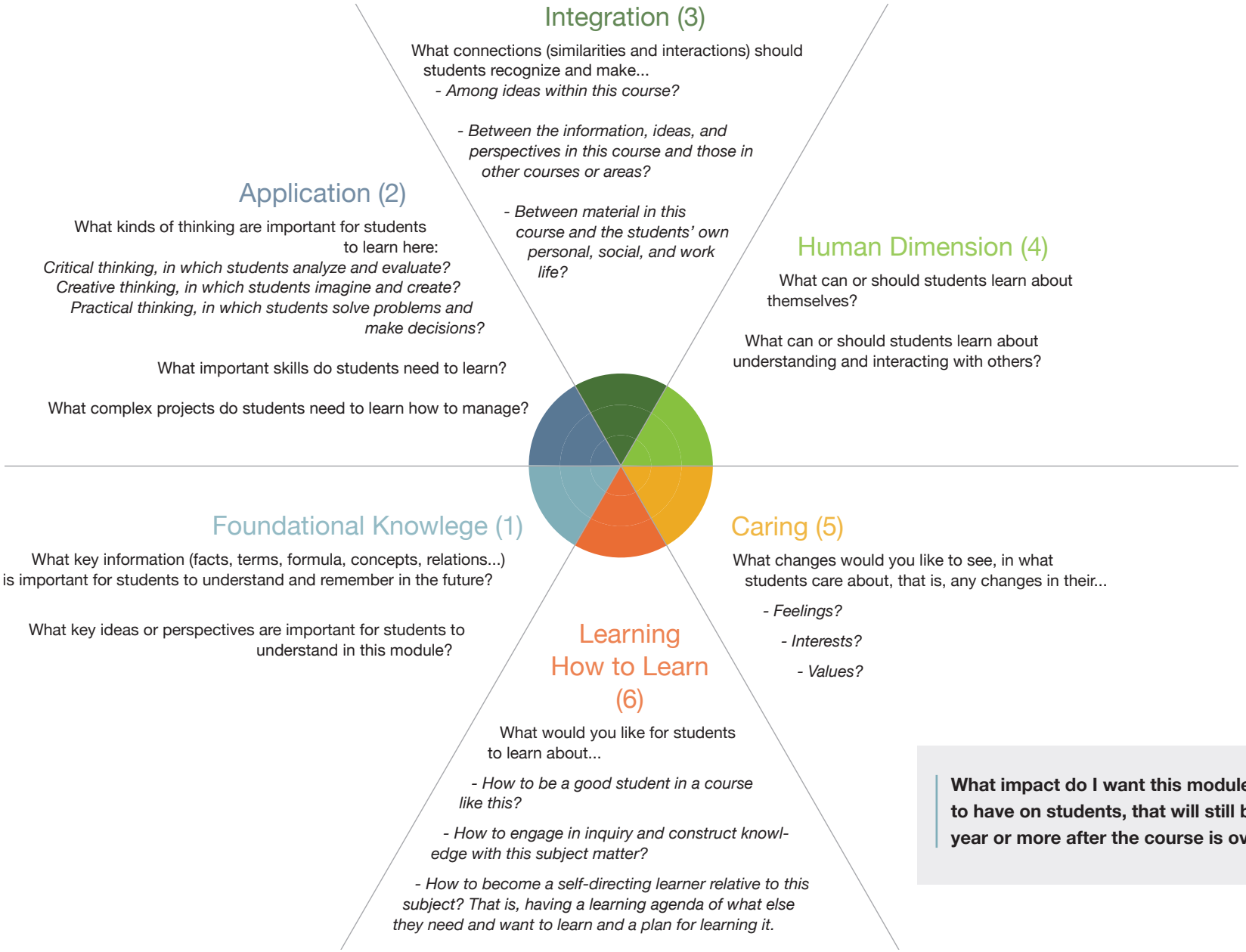
6.2 | Practice the virtues of critical thinking when evaluating new information:

1. Intellectual integrity, ***2.*** Intellectual humility, ***3.*** Confidence in Reason, ***4.*** Intellectual Perseverance, ***5.*** Fairmindedness, ***6.*** Intellectual Courage, ***7.*** Intellectual Empathy, ***8.*** Intellectual Autonomy

> **What impact do I want this module experience to have on students, which will still be there a year or more after the course is over?**

Learning Objectives

Fink Taxonomy of Significant Learning



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