

# 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

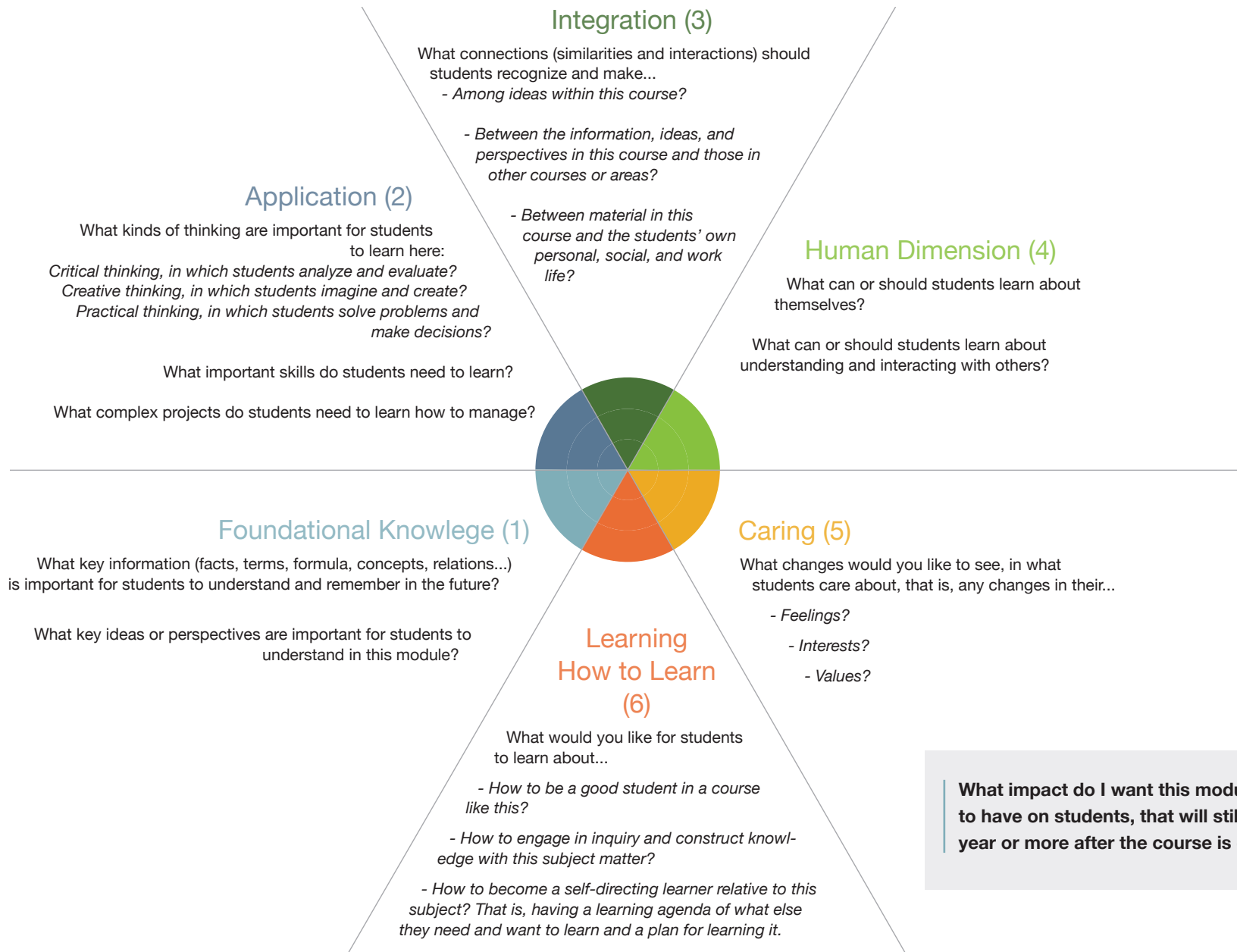
- 5.1 | Develop an interest in using one's engineering understanding to create sustainable alternatives to industrial-era products and processes.
- 5.2 | Feel empowered by understanding to innovate sustainable alternatives to industrial-era products and processes.

## 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?**

# Fink Taxonomy of Significant Learning



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