Systems Teaching Opportunities in the NGSS

<u>Big Idea</u>: When parts are put together, they can do things collectively that they couldn't do independently.
<u>Supporting concepts</u>: System components produce the activity (process) with a force, energy, or information input. The output is the system product or result.

Grades	Learning Focus	Discipline	Disciplinary Content Examples
K-2	**What parts make up the whole?**	Life Science	Animal & plant characteristics/life needs
		LS	Life cycles
		Earth Space Science	Weather (temp, wind, snow, rain)
		ESS	Sun, stars, & planets
		ESS	Natural resources: water, air, land
		Physical Science	Objects can be built
	System Inputs	Life Science	Behaviors
		Physical Science	Simple forces (pushes & pulls)
		PS	Heating & Cooling
		PS	Sound & Light
	System Processes	Life Science	5 basic senses (sight, touch, taste, hearing, smell)
		Earth Space Science	Personal choices can affect the environment
		Physical Science & Life Science	Sending & receiving information/Communication

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3-5	**What happens if we remove a part?**	Life Science	Interactions b/w organisms & b/w organisms & the environment
		LS	Structure & function in organisms
		LS	Life cycles/ Food webs
		Earth Space Science	Rock cycle
		ESS	Human impacts
		ESS	Natural resources: renewable & nonrenewable
		Physical Science	Simple & compound machines
	System Inputs	Life Science	Food
		Physical Science	Direction & size of forces
		PS	Forms of energy
	System Processes	Life Science	Organism & population adaptations
		LS	Photosynthesis
		LS	Energy flow
		Earth Space Science	Change over time
		ESS	Matter/nutrient cycles
		ESS	Planetary orbits & rotations
		ESS	Earthquakes & volcanoes
		ESS	Human impacts on earth's resources & environments
		Physical Science	Chemical reactions to create substances
		PS	Energy conversions & transfer

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6-8	**Subsystems**	Life Science	Cells & cellular organization
		LS	Ecosystems/Biodiversity
		Earth Space Science	Solar system-Milky Way-Galaxies
		ESS	Water cycle/Watersheds
		ESS	Plate tectonics
		ESS	Earth's energy budget
		Physical Science	Atomic structure & the Periodic Table
	System inputs & outputs	Life Science	Matter & energy transfers in organisms & ecosystems
		LS	Genes & traits
		Earth Space Science	Human alteration of the environment & impacts
		Physical Science	Wave models
	System Processes	Life Science	Nerve cell signaling
		LS	Natural & artificial selection
		Earth Space Science	Climate & climate change
		Physical Science	Conservation of matter
		PS	Temperature & energy connections
		PS	Digital transmission of information

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Grades	Learning Focus	Discipline	Disciplinary Content Examples
9-12	**Complex systems**	Life Science LS LS Earth Space Science ESS Physical Science PS	Body systems Biochemical processes Genetic variation/Evolution Earth system interconnections Global climate science Electromagnetic radiation Transfer & storage of energy among systems
	System Inputs & Outputs: *Feedback mechanisms (+/-)*	Life Science Earth Space Science Physical Science	Ecosystem carrying capacities Earth system interactions F = ma
	System Processes: *Balance/Homeostasis*	Life Science Life Science & Earth Space Science Physical Science PS	Internal system regulation Sustainability & management practices Conservation of energy Conservation of momentum

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