GEOL 104 Dinosaurs: A Natural History
Final Review

Review Tests 1 & 2, especially:
Definition of Dinosauria (the concestor of *Iguanodon* and *Megalosaurus* and all of its descendants)
Proper taxonomic grammar!
What are the relationships between dinosaurs and other tetrapods?
What are the relationships between and important adaptations of the major groups of dinosaurs? (Pay particular attention to those groups who were referred to again during the last third of the course!); Bird origins
Evolution & Cladistics (be able to read a cladogram) Geologic time

Dinosaur Paleoecology
Ecology, Paleoecology, Autecology vs. Synecology [community ecology]
Trophic relationships & trophic levels: producers, decomposers, consumers (1st order, 2nd order, 3rd order, etc.); apex predators
Fauna, paleofauna, biogeography, paleobiogeography, cosmopolitan vs. provincial, Laurasia vs. Gondwana
Food webs, energy pyramids
How paleoecology is assessed: methods, evidence
Patterns of dinosaurian history: Late Triassic ("when dinosaurs shared the Earth"); Early Jurassic (diversification); Middle & Late Jurassic ("Golden age"); Early Cretaceous ("rise of the low browsers"); mid-Cretaceous warm peak. Many worlds of the Late Cretaceous: provincialism (distinction between Asiamerica, Europe, Gondwana, etc.)

Dinosaur Functional Anatomy & Behavior
Significance of osteological correlates
Methods of interpreting function & behavior: Analogies with living forms; Phylogenetic distribution of behaviors; Biomechanics; Geological Evidence (tracks, coprolites, bite marks, etc.)
Striding locomotion in dinosaurs
Difficulty in determining top speeds (even for living animals)
Use (and difficulties) of footprints in studying dinosaur locomotion
Cursoriality vs. Graviportality: osteological correlates of each
Scaling issues, allometry: isometry, negative allometry, positive allometry
Which groups of dinosaurs have the most cursorial adaptations? Which the most graviportal?
Changes of locomotion in eumaniraptorans: knee-driven striding
Other types of functional analysis: bite force, digestion, joint motion
Dinosaur Senses and how we reconstruct them: brains, balance (equilibrium), hearing, smelling, vision
Interspecific vs. Intraspecific Behavior
Message of display: Defensive, Territorial, Sexual (courtship), Species Recognition
Medium of display: Visual, Sound, etc.
Examples of dinosaur behavior from the fossil record
Why display?
Gregarious behavior: evidence (direct and inferred); advantages to predators, to prey; disadvantages to living in groups; Kin Selection & Reciprocal Altruism
Sexual strategies; sexual dimorphism
Difficulties in determining sex of dinosaurs

Dinosaur Eggs and Babies
Altricial vs. Precocial Growth
Dinosaur nests, clutches, and nesting patterns
Evidence for parental care; Evidence for **paternal** (fatherly) care in maniraptoans
Evidence for baby dinosaurs in groups
Changes in dinosaur growth (esp. appearance of species-level features in sub-adults)
Skeletochronology & use of Lines of Arrested Growth
How dinosaur growth compares to non-avian reptiles? To mammals?
Dinosaur lifespans
Life-history strategies: K-selected vs. r-selected

Endothermy vs. Ectothermy

	"Warm-Blooded"	"Cold-Blooded"
Energy Source:	Endothermy	Ectothermy
Metabolic Rate:	Tachymetabolism	Bradymetabolism
Temperature over Time:	Homeothermy	Poikilothermy

Resting vs. active metabolic rates; duration of sustained activity; recovery time

Why evolve endothermy? Increased aerobic capacity, greater environmental tolerance, increased metabolic efficiency, help in parental care (pre- and post-natal)

The Aerobic Equation ($C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O$ + energy; or "glucose + oxygen yields carbon dioxide, water, and energy"). How to get extra glucose & oxygen? How to distribute extra glucose & oxygen to cells? How to get rid of extra carbon dioxide?

Traditional Estimates of Dinosaur Physiology:

Posture | Latitudinal distribution | Feeding adaptations (such as dental batteries)
Relation to birds | Predator-prey ratio | Microscopic bone structure (Haversian canals, reworked bone)
Insulation

Non-traditional Physiologies:

Gigantothermy | Heterometabolism (Ontogenetic and Behavioral)

Respiration in Mammals vs. Crocs vs. Birds vs. other tetrapods. Belly-breathing in basal archosaurs (and at least some dinosaurs?); One-way lungs in Archosauria; Air sac breathing in at least Saurischia. Other variations of respiration (in Ornithischia, in Pterosauria).

Function of four-chambered hearts, and evidence for such in dinosaurs.

Nasal Turbinates, and significance of enlarged nares in bigger/more derived dinosaurs.

Evidence for enhanced metabolic rates in Crurotarsi (and reversal to ectothermy in crocodilians)

Significance of higher oxygen and carbon dioxide levels, and higher plant productivity, in Mesozoic

Other organisms of the Mesozoic

Pterosauria: basic adaptations, especially for flight and for physiology
"Rhamphorhynchoidea" vs. Pterodactyloidea. Terrestrial locomotion; feeding

Mesozoic marine reptiles: why would an amniote return to the sea? What problems would they face; what sort of adaptations would they need?
Know the basic adaptations (especially feeding, locomotion, and reproduction) and be able to identify: Mesosaurs; ichthyosaurs; placodonts; plesiosaurs (both plesiosauroid and pliosauroid); mosasaurs; marine crocodiles; sea turtles; hesperornithids

Mesozoic mammals: Origins; diversity; major adaptations; major groups: monotremes, multituberculates, therians (eutherians (placentals and our ancestors) plus metatherians (marsupials plus their ancestors))

Mesozoic plants: Photosynthesis ($6\ CO_2 + 6\ H_2O$ + sunlight $\rightarrow C_6H_{12}O_6 + 6\ O_2$). Basic adaptations. Difference between spore plant, gymnosperm, and angiosperm reproduction. Angiosperm origins in Cretaceous: what are the co-evolutionary partners and function of flowers and fruit?

The K/Pg Extinction

Be familiar with the following groups and their fate relative to the K/Pg Extinction:

Marine life: Coccolithophorids; foraminiferans; ammonoids; belemnoids; rudists; inoceramids, the various marine reptiles

Terrestrial life: Plants, insects, amphibians, turtles, tuataras, lizards (incl. snakes), crocodilians (incl. various non-aquatic types), champsosaurs, pterosaurs, the various mammals

Definitions: Extinction | Mass extinction | Maastrichtian | Campanian
"Tertiary" | Paleogene | K/Pg extinction

Hypotheses of extinction: What evidence exists for different causal agents of extinction?
How might each have caused the event?
Why some old extinction models don't work

Good evidence for: Volcanism: esp. Deccan Traps (India)
Asteroid impact: Iridium layer at Gubbio, Italy; Shocked quartz, melt glass, tsunami deposits, ejecta deposits, etc.; Crater at Chicxulub (Yucatán)
Maastrichtian Regression

What is the environmental impact of each of those agents? The effects and timing of each? What does the magnetostratigraphic record say about the timing of Deccan Traps and the Chicxulub Impact?
Phases of destruction from the Chicxulub impact: Phase I Shockwave & Tsunami; Phase II “Easy-Bake Oven”; Phase III Impact Winter; Phase IV Greenhouse Summer
Changes in dinosaur populations (especially in western North America) before and at K/Pg boundary
Pattern of fates at K/Pg in marine and continental environments
Recovery from the K/Pg extinctions