

PART I: General Environmental Science (GES) Exams

All approved EPI and QEP applicants are required to take this section. Up to three hours is given to complete the exam, which consists of 100 multiple-choice questions.

Sub-Part A, Basic Sciences	Percent on Exam
1. Chemistry	6%
a. Atoms, molecules, elements, & compounds	
b. Reactions & equilibria	
c. Gas laws	
d. Dissolution/precipitation	
e. Degradation/breakdown (hydrolysis, substitution, biological/chemical)	
f. Organic pollutant categories - VOCs, SVOCs, pesticides, PCBs, dioxins	
g. Inorganic pollutant categories - metals, CN, anions, cations	
h. Properties of materials - solubility, boiling point, melting point, vapor pressure	
i. pH, acidity/alkalinity, oxidation-reduction (redox) potential (Eh)	
2. Physics	4%
a. Fluid flow - viscosity & turbulence	
b. Material characteristics - density, viscosity, flash point, volatility, partition coefficient, particle size distribution	
c. Thermodynamics - 3 laws & their meaning	
d. Diffusion - in air & solutions	
e. Particle size distribution/separation	
i. Radioactivity - natural & man-made	
3. Earth Science/Geology	5%
a. Permeability of materials	
b. Aquifers & aquitards	
c. Ground water flow pathways & rates	
d. Migration of contaminants in soils, sediments, & ground water	
4. Ecology	5%
a. Ecosystem sensitivities - flora, fauna, & people	
b. Bioaccumulation & biomagnification	
c. Major ecosystem characteristics - estuaries, wetlands, streams, forests, mountains, prairies, open oceans, & lakes	
d. Species diversity	
e. Endangered species	
5. Toxicology and Risk Assessment	5%
a. Dose - response relations	
b. Physiologic endpoints - neurotoxicity, cancer (carcinogens), mutation (mutagen), etc.	
d. Acute vs. chronic effects	
e. Extrapolation issues for toxicity	
e. Exposure/pathway concepts	
f. Methods of evaluating site risk characteristics	

Sub-Part B, Mathematics	Percent on Exam
6. Mathematics/Statistics	6%
<ul style="list-style-type: none"> a. Use of "powers of 10" b. Means & measures of variation (mean, medium, mode, variance, & standard deviation) c. Probability/statistical distributions d. Unit of measurements - metric (S.I.) versus English (lb., ft., etc.,) e. Statistical confidence limits/decision making f. Representative sampling requirements & methods 	
7. Data Management	6%
<ul style="list-style-type: none"> a. Omission & error identification b. Graphical representation of data c. Trend analysis d. Modeling e. Quality assurance & quality control - outlier identification 	
8. Environmental Economics (Risk & Cost Benefit Analysis)	5%
<ul style="list-style-type: none"> a. Management system capital cost, interest rate, discount rate b. Operations, maintenance, & monitoring costs c. Beneficial reuse of waste materials d. Environmental liability implications 	
Sub-Part C, Environmental Science, Management, & Policy	Percent on Exam
9. Environmental Quality Standards	5%
<ul style="list-style-type: none"> a. Ambient air quality standards - ozone, particulates, CO, NO_x, SO_x b. Surface water quality - DO, BOD, TOC, pH, TDS, TSS, TPH, VOCs, metals c. Drinking water standards - bacteria, metals, pH, turbidity, VOCs, THA d. Ground water quality - pH, VOCs, metals, bacteria, pesticides, persistent organic pollutants (POPs) e. Soil standards - VOCs, metals, pesticides, POPs, others 	
10. Basic Principles of Environmental Systems	5%
<ul style="list-style-type: none"> a. C, N, O, H₂O, S cycles (nutrient cycles) b. Ecosystem development & climax c. Population dynamics d. Primary productivity e. Sustainable development 	
11. Cross-Media Impacts of Pollution	4%
<ul style="list-style-type: none"> a. Migration across boundaries - non-point source run-off, permeation of solvent gases through synthetics liners, liner permeability b. Liquid phase/gas phase transport - VOC emissions from ground water air stripping or in-situ soil air sparging c. Solid/gas phase transport - products of incomplete combustion, byproduct emissions, biological decomposition gas generation, and fugitive emissions from area and mobile sources d. Solid/liquid phase transport - dredged contaminated sediments resuspension, leaching of solids from landfills 	
12 Health & Safety Requirements	4%
<ul style="list-style-type: none"> a. Properties of toxics, acute vs. chronic b. Confined space entry, toxic, anoxic c. System tagging/lockout d. Safety, Health, & Emergency Response Plans (SHERP) e. Risk communication f. Training & hazard identification g. Medical surveillance h. Personal protective equipment (PPE) 	

- 13. Public Information/Community & Regulatory Relations/Ethics** **5%**
- a. Not in my back yard (NIMBY) syndrome
 - b. Environmental justice
 - c. Community hazard right-to-know
 - d. Emergency preparedness & contingency planning
 - e. Environmental Ethics (QEP/BGC Ethics Code)

Sub-Part D, Waste/Pollution Management, Treatment, & Disposal	Percent on Exam
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| 14. Waste Minimization, Recycling, Reuse | 6% |
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- a. Materials substitution
 - b. Source reduction
 - c. Process modification
 - d. Separation & hazard reduction
 - e. Waste reduction

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| 15. Hazardous Materials/Waste Management and Transport | 3% |
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- a. Hazardous material categories - flammable, poison, explosive, shock, or friction sensitive
 - b. Hazardous waste categories - toxic, corrosive, reactive, flammable, radioactive
 - c. Handling, packaging, manifesting

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| 16. Fate and Transport of Environmental Contaminants in Air/Water/Soil | 5% |
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- a. Mass transfer
 - b. Biodegradation
 - c. Vaporization
 - d. Kinetic factors
 - e. Henry's Law and partition coefficients, K_{ow}
 - f. Natural attenuation

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| 17. Principles of Water, Soil, & Solid Waste Treatment & Residuals Disposal | 7% |
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- a. Physical treatment - air/thermal stripping, sedimentation, clarification, filtration centrifugation, barriers, liners, soil washing.
 - b. Physical/chemical treatment - coagulation/clarification, absorption & adsorption, wet air oxidation, reduction, solvent extraction, solidification/stabilization
 - c. Thermal treatment - incineration, catalytic oxidation, desorption, vitrification
 - d. Biochemical treatment - aerobic/anaerobic degradation, in-situ, and ex-situ
 - e. Biosolids, treated soils, debris, and residuals management alternatives
 - f. Land disposal and leachate management practices, Hazardous vs. Non-Hazardous

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| 18. Air Pollution Control | 5% |
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- a. Pollutant elimination/minimization
 - b. Physical separation - cyclone, bag house, electrostatic precipitator
 - c. Physical/chemical treatment - wet scrubber, carbon adsorption, thermal destruction (after burner), chemical oxidation, biofilter
 - d. Mobile sources - motor vehicles, aircraft, watercraft, agricultural and construction equipment.
 - e. Mobile source controls - clean burning fuels, combustion modifications, catalytic converters, diesel particulate traps, etc.
 - f. Stationary Sources - manufacturing processes, power generation, combustion, waste management facilities, fuel terminals, pipeline transfer stations, etc.
 - g. Stationary source controls - clean burning fuels, combustion modifications, flue gas cleaning, selective catalytic reduction, etc.

19. Air Emissions Monitoring & Inventories**5%**

- a. Greenhouse gases - sources, control strategies
- b. Toxic air emissions - point sources, non-point sources, fugitive dusts and vapors
- c. Stationary Source Priority pollutants
- d. Mobile source emissions
- e. Meteorological monitoring & Modeling
- f. Atmospheric chemistry, greenhouse gases, ozone depletion
- g. Emissions inventories

20. Surface & Ground Water Monitoring**4%**

- a. Monitoring methods, frequency, & reporting
- b. Toxic substances - metals, chlorinated hydrocarbons, PAH, PCBs, pesticides, POPs
- c. Conventional pollutants - BOD, pH, TSS, oil/grease, THP, VOC, turbidity, pathogens
- d. Non-conventional pollutants - NO₃, fluoride, sulfides, phosphorous, cyanide, radioactive materials