

Overview of Science Ethics

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Key concepts, principles, and practical applications for responsible research

1. What Is Science Ethics?

- **Definition** – The set of moral principles and standards that guide the conduct of scientific research and its application.
- **Purpose** – Protect the integrity of the scientific process, safeguard participants and the public, and ensure that knowledge benefits society responsibly.

2. Core Ethical Principles

Principle	Description	Typical Applications
Honesty	Report data, methods, and results truthfully.	Accurate publication, avoiding fabrication or falsification.
Objectivity	Minimize bias in experimental design, analysis, and interpretation.	Blind studies, conflict of interest disclosures.
Integrity	Maintain consistent ethical behavior throughout the research lifecycle.	Adhering to protocols, proper record keeping.
Transparency	Make methods, data, and assumptions openly accessible.	Open access publishing, data repositories.
Responsibility	Consider the broader impact of research on society and the environment.	Risk assessments, sustainable practices.
Respect for Persons	Protect autonomy, privacy, and welfare of individuals involved.	Informed consent, confidentiality safeguards.
Justice	Ensure fair distribution of benefits and burdens.	Inclusive participant recruitment, equitable access to interventions.
Beneficence & Non-maleficence	Maximize benefits while minimizing harm.	Safety monitoring, ethical review of animal work.

3. Institutional Frameworks

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1. Codes of Conduct

- *American Association for the Advancement of Science (AAAS) Code*
- *International Council for Science (ICSU) Statement*

2. Regulatory Bodies

- **IRBs / RECs** – Institutional Review Boards / Research Ethics Committees for human subjects.
- **IACUC** – Institutional Animal Care and Use Committee for animal research.
- **Funding Agencies** – Require compliance with ethical guidelines (e.g., NIH, EU Horizon Europe).

3. Professional Societies

- Provide discipline-specific guidance (e.g., American Chemical Society, IEEE Code of Ethics).

4. Ethical Issues in Different Research Areas

Area	Common Ethical Concerns	Mitigation Strategies
Human Subjects	Informed consent, privacy, vulnerable populations	Robust consent forms, data anonymization, ethics board approval
Animal Research	Welfare, humane endpoints, species-appropriate care	3Rs: Replace, Reduce, Refine; regular welfare audits
Genetics & Biotechnology	Gene editing, privacy of genetic data, dual-use	Oversight committees, public engagement, strict data governance
Environmental Science	Field impact, indigenous rights, climate justice	Community consultation, sustainable sampling methods
Artificial Intelligence & Data Science	Algorithmic bias, data security, misuse	Bias audits, transparent model documentation, responsible AI frameworks
Publication & Authorship	Guest/ghost authorship, plagiarism, salami slicing	Clear authorship criteria, plagiarism detection tools, open peer review

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5. The Research Lifecycle & Ethical Checkpoints

1. Idea Generation

- Conduct literature review to avoid redundant work.
- Assess societal implications early.

2. Study Design

- Choose appropriate methods to reduce bias.
- Submit protocol to IRB/IACUC.

3. Data Collection

- Follow standard operating procedures.
- Record data contemporaneously