T-E-A Writing Workshop Handout 2B

Research Essay on Pharmaceutical Innovation

Note: Use this handout to write your team's expository essay with the T-E-A (thesis-evidence-analysis) structure.

Essay Prompt

"Discuss one of the latest innovations in the pharmaceutical field and find out how it contributed to or hurt the pharmaceutical industry."

Your essay must have an 800-1000-word (1000-1500 words for Master's) expository essay with at least three (five for Master's) credible journal references.

Part 1: Introduction Paragraph

The introduction should:

- ✓ Hook the reader (use a surprising fact, question, or context)
- ✓ Provide a brief background on the innovation
- ✓ End with a clear thesis statement: Thesis Statement = Topic + Controlling Idea

❖ **Thesis Development: Topic + Controlling Sentence Examples:**

"One of the most promising pharmaceutical innovations today is **lipid nanoparticle-based drug delivery**, which significantly improves the stability and bioavailability of mRNA treatments." (topic + 2 main ideas)

"**Lipid nanoparticle-based drug delivery** is a leading pharmaceutical innovation that enhances the stability and bioavailability of mRNA treatments." (topic + 2 main ideas)

❖ ***In writing***, the researcher must clearly state the paper's intention—whether it is to explain, explore, describe, or something else. Since **expository essays** aim to **explain**, **analyze**, or **explore**, strong academic verbs include:

- analyze
- examine
- explore
- discuss
- investigate
- present
- evaluate (sometimes, if your analysis draws implications

Tips: Avoid persuasive verbs like "argue," "claim," or "prove"—those are for argumentative essays.

❖ **Full Thesis Statement:**

1. **Blueprint Thesis (Forecasting the Main Body Points) -** This clearly outlines the main ideas or structure of the body paragraphs.

   e.g., *"This essay **examines** how artificial intelligence enhances drug discovery, **explores** how nanotechnology advances drug delivery, and **analyzes** the combined potential of these technologies to revolutionize personalized medicine."*

   - ✓ Verb: *examines, explores, analyzes* (clear and appropriate)
   - ✓ Each body paragraph topic is forecasted
   - ✓ Clear academic tone

2. Open (General) Thesis Statement - This introduces the topic and the writer's position or approach **without** previewing all the main points.

*e.g., "This essay **discusses** how technological innovations such as artificial intelligence and nanotechnology are transforming pharmaceutical research and healthcare practices."*

- ✓ Verb: *discusses* (neutral and informative)
- ✓ Broad but still signals the essay's subject
- ✓ Doesn't reveal the paragraph structure directly

✍ Activity: Write Your Team's Thesis Statement

Topic: _____

Controlling Idea: _____

Full Thesis Statement: _____

Part 2: Developing Body Paragraphs

Each body paragraph should follow the TEA structure:

T - Thesis (Topic Sentence)	**E** – Evidence (Cited Information)	**A** - Analysis (Your Explanation)

💡 *Address each paragraph's distinct point and develop it fully.*

Which of the following is the thesis, evidence, and analysis?

Artificial Intelligence is fundamentally reshaping drug discovery by improving the speed, accuracy, and cost-efficiency of identifying new therapeutic compounds. AI models can analyze millions of molecular combinations and biological targets much faster than traditional lab-based methods. For example, Insilico Medicine's AI-driven drug development reduced drug discovery time from years to just months (Zhavoronkov et al., 2023). Another study from ScienceDirect shows that AI algorithms successfully predicted protein-ligand interactions, reducing experimental trial costs. While AI accelerates discovery, challenges remain regarding **data quality, bias**, and **regulatory approval**. Poor data inputs may produce misleading predictions, which could be costly or dangerous. Moreover, AI-generated drug candidates still require rigorous preclinical and clinical testing (Blanco-Gonzalez et al., 2022). Thus, AI is a powerful tool but not a substitute for critical human judgment and experimental validation.

Thesis:

Artificial Intelligence is fundamentally reshaping drug discovery by improving the speed, accuracy, and cost-efficiency of identifying new therapeutic compounds.

Evidence:

(explanation/background)AI models can analyze millions of molecular combinations and biological targets much faster than traditional lab-based methods. ***(illustration/proof)*** For example, Insilico Medicine's AI-driven drug development reduced drug discovery time from years to just months (Zhavoronkov et al., 2023). Another study from ScienceDirect shows that AI algorithms successfully predicted protein-ligand interactions, reducing experimental trial costs (Wang et al., 2023).

Analysis:

(author's voice) While AI accelerates discovery, **challenges remain regarding data quality, bias**, and **regulatory approval**. Poor data inputs may produce misleading predictions, which could be costly or dangerous. Moreover, AI-generated drug candidates still require rigorous preclinical and clinical testing (Blanco-Gonzalez et al., 2022) ***(credible backing on opinion)***. Thus, AI is a powerful tool but not a substitute for critical human judgment and experimental validation.

Quick Guide to Harvard In-text Citation

Use this format: (Author Last Name, Year)

Example: (Zhang, 2022)

When paraphrasing:

According to Zhang (2022), lipid nanoparticles improve bioavailability.

In-text Citation Reference	✅ Harvard Format	📝 Examples
Single Author	Author's surname + year	(Chen, 2021)
Single Author (Quoted)	"Quote" + (Author, Year, p. Page)	"AI reduces cost in pharma R&D" (Chen, 2021, p. 45)
Two Authors	Both surnames with "&" + year	(Patel & Zhang, 2020)
Three or More Authors	First author's surname + *et al.* + year	(Wang et al., 2023)
Author Named in Sentence	Author (Year) + paraphrased or quoted text	According to Chen (2021), AI is revolutionizing pharma.
No Author	Use the organization or title + year	(World Health Organization, 2020)
No Date	Use *(n.d.)*	(Chen, n.d.)
Multiple Sources	Alphabetical by first author's surname, separated by semicolons	(Chen, 2021; Patel & Zhang, 2020; Wang et al., 2023)
Different Works by Same Author	Same author + different years	(Chen, 2020; Chen, 2023)
Same Author, Same Year	Add letter suffix to years (a, b, c…)	(Chen, 2021a; Chen, 2021b)
Multiple Mentions in a Sentence	Cite once at the end unless clearly referring to different works	AI is transforming pharma globally (Chen, 2021; Wang et al., 2023).
Block Quote (40+ words)	Indent entire quote; omit quotation marks; include citation after final punctuation	(Chen, 2021, p. 45)

Activity: Draft One (1) Body Paragraph following the T-E-A structure

- ✓ Refer to your thesis statement.
- ✓ Write a topic sentence for the first main point.
- ✓ Look for credible journal articles to back up your point.
- ✓ Follow the *paraphrasing* principles and create the *spreadsheet file* to keep your work (1st column – original text; 2nd column – paraphrased version; 3rd column – your thoughts for citing the source; 4th column – complete reference list)

Original Text	Paraphrased Version	Writers' Thoughts	Full Reference
(Your first journal entry)			

Body Paragraph 1: (Topic Sentence)

Body Paragraph 1: (Evidence)

Body Paragraph 1: (Evidence)

Body Paragraph 1: (Analysis)

Part 3: Conclusion Paragraph

The conclusion should:

- Restate the thesis in different words
- Summarize the main ideas
- Suggest broader implications or future directions

e.g. ***Thesis (introduction paragraph)*** *"This essay discusses how technological innovations such as artificial intelligence and nanotechnology are transforming pharmaceutical research and healthcare practices."*

Paraphrased: "*The convergence of Artificial Intelligence and nanotechnology is transforming pharmaceutical research and patient care."*

"(thesis restatement) The convergence of Artificial Intelligence and nanotechnology is transforming pharmaceutical research and patient care. ***(summary)*** AI accelerates drug discovery, while nanotechnology improves delivery mechanisms. Their integration supports personalized medicine, providing tailored and efficient treatments. However, successful implementation requires addressing regulatory, ethical, and scientific challenges. ***(implications/future directions)*** As research advances, these technologies promise to improve health outcomes and reshape modern pharmacology."

✍ Activity: Write a Conclusion Sentence

Restated Thesis: _____

Summary: _____

Future Direction: _____

Sample Expository Essay

What is an Expository Essay?

An **expository essay** presents facts, explanations, and evidence to inform or explain a topic clearly and logically. Unlike argumentative or persuasive essays, it does not aim to convince the reader but rather to present information supported by research. In this case, the essay uses the **T-E-A structure** (Thesis–Evidence–Analysis) to discuss how **Artificial Intelligence (AI)** and **nanotechnology** are changing pharmaceutical innovation.

The sample essay is ***labeled for your detailed guidance. However, your final version should **NOT** have any subheadings except for the References.

Title: "Harnessing Artificial Intelligence and Nanotechnology in Pharmaceutical Innovations"

Introduction

The pharmaceutical industry is undergoing digital and technological transformation driven by innovations. Among the most significant of these developments are Artificial Intelligence (AI) and nanotechnology, which are transforming the landscape of drug research and development. AI enhances the drug discovery process by predicting molecular interactions and optimizing development timelines, while nanotechnology revolutionizes drug delivery through precise targeting and controlled release mechanisms. This essay examines how the integration of AI and nanotechnology is revolutionizing the pharmaceutical development process **(thesis statement)**.

Body Paragraph 1: Artificial Intelligence in Drug Discovery

Thesis:

Artificial Intelligence is fundamentally reshaping drug discovery by improving the speed, accuracy, and cost-efficiency of identifying new therapeutic compounds.

Evidence:

AI models can analyze millions of molecular combinations and biological targets much faster than traditional lab-based methods. For example, Insilico Medicine's AI-driven drug development reduced drug discovery time from years to just months (Zhavoronkov et al., 2023). Another study from ScienceDirect shows that AI algorithms successfully predicted protein-ligand interactions, reducing experimental trial costs (Wang et al., 2023).

Analysis:

While AI accelerates discovery, challenges remain regarding **data quality, bias**, and **regulatory approval**. Poor data inputs may produce misleading predictions, which could be costly or dangerous. Moreover, AI-generated drug candidates still require rigorous preclinical and clinical testing (Blanco-Gonzalez et al., 2022). Thus, AI is a powerful tool but not a substitute for critical human judgment and experimental validation.

Body Paragraph 2: Nanotechnology in Drug Delivery

Thesis:

Nanotechnology offers advanced drug delivery systems that enhance the precision, timing, and safety of pharmaceutical treatments.

Evidence:

Nanoparticles can carry drugs across biological barriers and release them in targeted areas,

reducing side effects and increasing effectiveness. For instance, lipid-based nanoparticles have shown high efficacy in mRNA vaccine delivery, as demonstrated in COVID-19 vaccines (Chen et al., 2021). A review by Hua et al. (2018) confirms that nanocarriers improve solubility and protect active ingredients from premature degradation.

Analysis:

Despite its benefits, nanotechnology faces barriers in **scalability, reproducibility**, and **long-term toxicity studies**. The clinical translation of nanomedicines is still limited by high production costs and lack of standardized testing protocols. Regulatory bodies are also adapting slowly, which delays approval timelines (Hua et al., 2018). Therefore, interdisciplinary collaboration and robust testing frameworks are essential for nanomedicine success.

Body Paragraph 3: AI-Nano Synergy for Personalized Medicine

Thesis:

The integration of AI and nanotechnology presents new opportunities for personalized medicine through data-driven and adaptive drug delivery.

Evidence:

AI can optimize the design of nanocarriers based on patient-specific biomarkers. For example, AI models can simulate how different nanoparticle sizes and shapes behave in the bloodstream, improving targeting accuracy (Chen & Zhang, 2024). One study from *Annual Review of Pharmacology and Toxicology* described AI-guided engineering of polymeric nanoparticles for cancer therapy, enabling dosage adjustments based on real-time data (Wang & Zhao, 2024).

Analysis:

The synergy of AI and nanotech demands collaborative expertise in computer science, biomedical engineering, and pharmacology. Ethical concerns like **data privacy** and **algorithmic bias** must also be addressed. Nevertheless, this interdisciplinary approach

could revolutionize how treatments are designed and delivered, especially in oncology and chronic disease management.

Conclusion

The convergence of Artificial Intelligence and nanotechnology is transforming pharmaceutical research and patient care. AI accelerates drug discovery, while nanotechnology improves delivery mechanisms. Their integration supports personalized medicine, providing tailored and efficient treatments. However, successful implementation requires addressing regulatory, ethical, and scientific challenges. As research advances, these technologies promise to improve health outcomes and reshape modern pharmacology.

References (Harvard Style and to be written on a separate sheet)

Blanco-Gonzalez, A., Cabezon, A., Seco-Gonzalez, A., Conde-Torres, D., Antelo-Riveiro, P., Pineiro, A. and Garcia-Fandino, R., 2022. The Role of AI in Drug Discovery: Challenges, Opportunities, and Strategies. *arXiv*. Available at: https://arxiv.org/abs/2212.08104 [Accessed 2 June 2025].

Chen, H. and Zhang, X., 2024. AI-driven nanoparticle design for precision oncology: A data-integrated approach. *Annual Review of Pharmacology and Toxicology*, 64, pp.213–230. https://doi.org/10.1146/annurev-pharmtox-040323-040828

Chen, Y., Liu, L., and Zhang, Q., 2021. Lipid nanoparticles for mRNA delivery: current advances and future perspectives. *Advanced Drug Delivery Reviews*, 176, p.113889. https://doi.org/10.1016/j.addr.2021.113889

Hua, S., De Matos, M.B.C., Metselaar, J.M., and Storm, G., 2018. Current trends and challenges in the clinical translation of nanoparticulate nanomedicines: pathways for translational development and commercialization. *Frontiers in Pharmacology*, 9, p.790. https://doi.org/10.3389/fphar.2018.00790

Wang, L., He, Y., Liu, H., and Sun, Q., 2023. Artificial intelligence for structure-based drug design. *Journal of Molecular Structure*, 1289, p.135994. https://doi.org/10.1016/j.molstruc.2023.135994

Wang, Z. and Zhao, L., 2024. Polymer-based nanomedicine: AI-assisted design and clinical translation. *ScienceDirect*. Available at: https://www.sciencedirect.com/science/article/pii/S2095177925000656 [Accessed 2 June 2025].