

Subject Guide

Ein Beispiel aus dem Pilotprojekt Bioverfahrenstechnik

Studierende erarbeiten über ein Semester einen eigenen Subject Guide zu einem selbstgewählten Fachthema. Die folgenden Ausschnitte zeigen den Aufbau anhand eines Beispiels zum Thema rekombinanter Faktor VIII, einem Medikament für die Bluterkrankheit Hämophilie A.

Der Guide entsteht in vier Schritten: **Erschließen** mit KI, **Prüfen** in der Bibliothek, **Nachfragen** im Fachgespräch und **Vermitteln** auf Englisch. Er wird auf Englisch geführt, weil das Modul ein englischsprachiger Fachsprachenkurs ist. Rechts neben jedem Ausschnitt steht, was der Abschnitt leistet.

1

Erschließen

Mit KI-Werkzeugen ins Thema finden und eigene Fragen schärfen.

2

Prüfen

Die Aussagen gegen wissenschaftliche Quellen aus der Bibliothek halten.

3

Nachfragen

Im Fachgespräch die Denkweise des Fachs kennenlernen.

4

Vermitteln

Den Rechercheweg dokumentieren und auf Englisch darstellen.

1. Das eigene Thema

Research Topic & Question

INTRODUCED

UNicert: writing

Choose something from bioprocess engineering that genuinely interests you. It can connect to a class topic (e.g., vanillin, bioreactors, fermentation) or to any area of bioprocessing. Think about your own background, home country, or curiosity. You don't need to decide right away — use the first weeks to explore before committing.

My system / product

Recombinant Factor VIII: a protein that helps blood to clot, that is, to become solid so that bleeding stops.
"Recombinant" means it is made by putting the human gene into cells, which then produce the protein in cell culture.

Version

3

My topic area

Making a medicine (therapeutic) protein using mammal (animal) cells, then purifying it, that is, making it pure.

Why this interests me

It is the medicine for hemophilia A, a disease in which the blood cannot clot properly. Because Factor VIII is difficult to make, the process design really matters.

My first research question (rough — you will refine this)

How can recombinant Factor VIII be produced more sustainably, with less material taken from animals and a better yield?

A good research question is specific enough to investigate but open enough to explore. You will refine it over the coming weeks.

Die Studierenden wählen ein eigenes Thema aus ihrem Fach und formulieren dazu eine Forschungsfrage. Sie wird über das Semester mehrfach überarbeitet, daher das Feld **Version**.

Worauf es ankommt

Das Thema kommt von den Studierenden, nicht von der Lehrkraft.
Daraus entsteht die Bereitschaft, ein Semester lang daran zu bleiben.

2. Der Prozess

Process Overview

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Based on this week's class content, begin mapping the bioprocess relevant to your topic. You only need to fill in what you can — gaps are expected.

Upstream

What organism or cell is involved? What does it need to grow?

Special animal cells (called CHO or BHK cells) are changed so that they carry the human Factor VIII gene, and they are grown in large bioreactors. Modern processes use a growth liquid (called a medium) that contains no material taken from humans or animals.

Downstream

How is the product separated, purified, or finished?

The protein is captured (bound onto a resin) from the liquid where the cells grew, and purified through about four or five chromatography steps. There are also virus-safety steps, for example nanofiltration (filtering through very small pores). Finally the product is formulated (mixed into its final form) and freeze-dried.

Key Challenge

What makes this process difficult or interesting to optimise?

Factor VIII is large, fragile (easily damaged), and made in only small amounts, so the yield is low and the purification must be gentle.

Sustainability

What is the environmental, social, or economic impact?

Newer processes are "albumin-free": they do not use albumin, a protein taken from blood. Removing materials that come from humans or animals lowers the risk of passing on pathogens (germs that can cause disease). Using fewer chromatography steps also raises the yield.

Engineering approach (initial thinking)

If I had to improve this process, I would look at two things: the growth liquid (choosing one with no material from animals) and the number of purification steps, because each step also loses some product. Fewer, gentler steps could raise the yield.

Die Studierenden bilden den bioverfahrenstechnischen Prozess ab: Upstream, Downstream, die technische Schwierigkeit und die Nachhaltigkeitsfrage. Dazu kommt ein erster eigener Lösungsansatz.

Worauf es ankommt

Der Hinweis am Ende des Abschnitts ist bewusst gesetzt: Es geht um erstes Denken unter Unsicherheit, nicht um eine fertige Lösung.

3. Bibliothek und Validierung

Source & Validation

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You will develop this section more fully during the library session. For now, note any source you encountered this week.

Source title / URL (if you found one)

Frontiers in Medicine (2019), Status of Recombinant Factor VIII Concentrate Treatment for Hemophilia A

What it covers & why it's relevant to your question

It reviews how recombinant Factor VIII is made, and how newer products removed materials that come from animals.

How you found it

I first asked an AI tool for an overview. It named albumin-free processes but gave no source, so I searched in the library for a review and found the Frontiers in Medicine article, which confirmed the point and explained the virus safety steps.

Validation Note (Library Session)

Claim I want to check

Albumin-free processes, which use no protein taken from blood, lower the risk of passing on pathogens (disease germs).

Source I used to check it

Frontiers in Medicine (2019), review on recombinant Factor VIII.

What changed in my thinking

I understood that sustainable here can mean safety and fewer animal materials, not only lower energy. The Fachgespräch then showed me that yield and safety are linked, so removing a step is never only a gain.

In der Bibliothekssitzung suchen die Studierenden eine wissenschaftliche Quelle und prüfen damit eine konkrete Aussage. Festgehalten wird auch, wie sie die Quelle gefunden haben.

Worauf es ankommt

Hier wird der Kern des Projekts sichtbar: Eine KI-Aussage wird nicht übernommen, sondern gegen eine geprüfte Quelle gehalten.

4. Das Fachgespräch

🔴 Faculty Dialogue Note (group meeting)

Professor / course

Prof. Dr. Weber, Cell Culture Technology

Group members

Lena, Jonas, and me

My prepared question (refined in class before the meeting)

When a product is fragile, how do you decide which purification steps to remove and which to keep?

What the professor suggested I think about further

Prof. Weber said the question is not only about the protein but about what the patient is exposed to, so I should look at risk and not just at yield. She also pointed out that yield and purity are not two separate problems: every extra step raises purity and loses product, so the process is always a trade-off. She suggested I look at how the virus safety steps are justified.

How this changed or sharpened my thinking

Before the meeting I thought sustainability meant energy and water. Now I think the more important question for this product is which materials come from humans or animals, and whether a step can be removed without lowering safety. I also stopped looking for the one best process and started looking at where the trade-off sits.

Die Studierenden bereiten eine Frage vor und besprechen sie in kleinen Gruppen mit einer Lehrperson des Studiengangs. Notiert wird, was die Lehrperson angeregt hat und was sich dadurch verändert hat.

Worauf es ankommt

Weitergegeben wird nicht Wissen über das Thema, sondern die Denkweise des Fachs. Im Beispiel verschiebt sich der Blick von der Ausbeute zum Zielkonflikt zwischen Ausbeute und Sicherheit.

5. Reflexion zum KI-Einsatz

AI Tool Reflection

INTRODUCED

Critical AI Use

Document how you used AI (Fran.ki, Copilot) to explore your topic. AI is a thinking companion, not an answer machine.

AI as Thinking Companion

What you asked the AI

I asked Fran.ki to explain how recombinant Factor VIII is produced and what makes the process difficult. Then I asked a second, narrower question: why the yield is so low compared with other therapeutic proteins.

What the AI suggested

It gave a clear overview of upstream and downstream and said the protein is large and unstable. It also claimed that modern processes are albumin-free and safer, and it mentioned a figure for the number of chromatography steps. No sources were given for any of it.

What you kept, changed, or rejected — and why

I kept the overall structure, because the library sources described the same sequence. I kept the albumin-free point but only after I found it in the Frontiers in Medicine review, which also explained why it matters: fewer materials from humans or animals means less risk of passing on pathogens. I rejected the number of chromatography steps, because the AI gave a single figure and the review says it varies between products. The AI was useful for getting into the topic and for finding out what to ask, but every statement I wanted to use had to be checked first.

Dokumentiert wird, was gefragt wurde, was die KI geantwortet hat und was davon behalten, geändert oder verworfen wurde, jeweils mit Begründung.

Worauf es ankommt

Entscheidend ist das dritte Feld. Im Beispiel wird eine Zahl verworfen, weil die Quelle sie nicht stützt. Das ist der Unterschied zwischen KI-Nutzung und kritischer KI-Kompetenz.