

How does fatty acid structure affect its melting point?

Target audience: Introductory biochemistry students who have learned the basic structures of fatty acids and the distinction between saturated, cis-unsaturated, and trans-unsaturated fatty acids.

Estimated Time 10-20 minutes

Why do saturated, cis-unsaturated, and trans-unsaturated fatty acids have different melting points?

Learner Activity

1. Read/Observe

Three fatty acids have similar hydrocarbon chains, but they have very different melting points. Examine the molecular structures and the data below.

2. Examine the Evidence

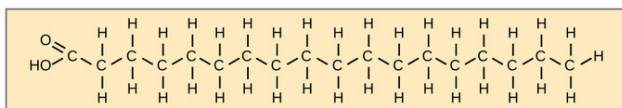
Compare the shapes of the three fatty acids. What structural difference do you notice? Why do saturated, cis-unsaturated, and trans-unsaturated fatty acids have different melting points? Which molecules appear able to pack together more orderly? Which structure appears more bent?

3. Prediction

Based **only** on the molecular structures, predict which fatty acid will have the highest melting point and which will have the lowest. Explain your prediction.

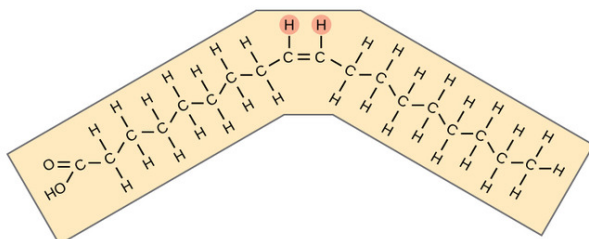
Saturated fatty acid

Stearic acid

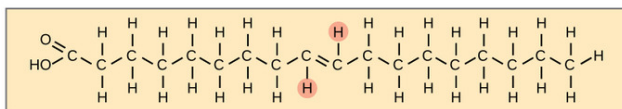


Unsaturated fatty acids

Cis oleic acid



Trans oleic acid



4. Explain

Based on the data, what relationship do you see between molecular packing and melting point? Use the structures and melting-point data as evidence to explain why saturated, cis-unsaturated, and trans-unsaturated fatty acids have different melting points.

Fatty acid	Type	Melting point
Stearic acid	Saturated	69.6°C
Oleic acid	Cis-unsaturated	13.4°C
Elaidic acid	Trans-unsaturated	45°C

5. Reflect/Extend

What additional evidence would strengthen your explanation about the relationship among fatty-acid structure, molecular packing, and melting point?

Instructor/Teacher Guide

1. Purpose

The activity teaches the relationship:

fatty-acid structure <-> molecular packing <-> melting point

Learners construct this explanation from molecular structures and data rather than simply memorizing that saturated fats have higher melting points.

2. Materials

- Learner activity sheet
- Pen/pencil or digital document

No laboratory equipment or chemicals are required.

3. Facilitation Notes

- Ask learners to examine the structures carefully before discussing the expected explanation.
- Have learners make a prediction before interpreting the melting-point data.
- During discussion, prompt learners to connect structure to packing and melting point.

4. Expected Responses

Saturated: relatively straight -> more regular packing -> stronger / more extensive interactions -> higher melting point.

Cis-unsaturated: bent -> less regular packing -> less extensive interactions -> lower melting point.

Trans-unsaturated: more extended than cis -> more regular packing -> higher melting point than the corresponding cis form.

More data are needed to strengthen the explanation about the relationship.

5. Safety Notes

No special safety precautions are required. The activity uses existing molecular diagrams and data and does not require chemicals, biological materials, or laboratory equipment.

6. Accessibility Notes

- Provide clearly print, high contrast versions of diagrams and tables.
- Describe molecular structures verbally as well as visually.

Connection to SDG 4:

This toolkit supports SDG 4 by promoting scientific literacy and active learning through evidence-based inquiry. Rather than memorizing a rule about saturated and unsaturated fats, learners analyze molecular structures and data, make predictions, and make an explanation from evidence. The activity is also relatively accessible because it requires no chemical or biological materials, or laboratory equipment.

Reference

1. Larsen, D. (n.d.). *3.3: Lipid molecules - Introduction*. Biology LibreTexts.
[https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/General_Biology_\(Boundless\)/03:_Biological_Macromolecules/3.03:_Lipid_Molecules_-_Introduction](https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/General_Biology_(Boundless)/03:_Biological_Macromolecules/3.03:_Lipid_Molecules_-_Introduction)
2. OpenStax. (2018). *Biology 2e*. OpenStax, Rice University.
<https://openstax.org/books/biology-2e/pages/3-3-lipids>

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