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# Initial Science Teacher Education On Nature Of Science: A Family Resemblance Approach

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- Ireland recently introduced Junior Cycle (middle school) educational reform.

The Nature of Science refers to how science functions & key principles and ideas which provide a picture of science as a way of knowing, as well as characteristics of scientific knowledge.

(McComas et al 1998)

# Need for to upskill Pre-service teachers

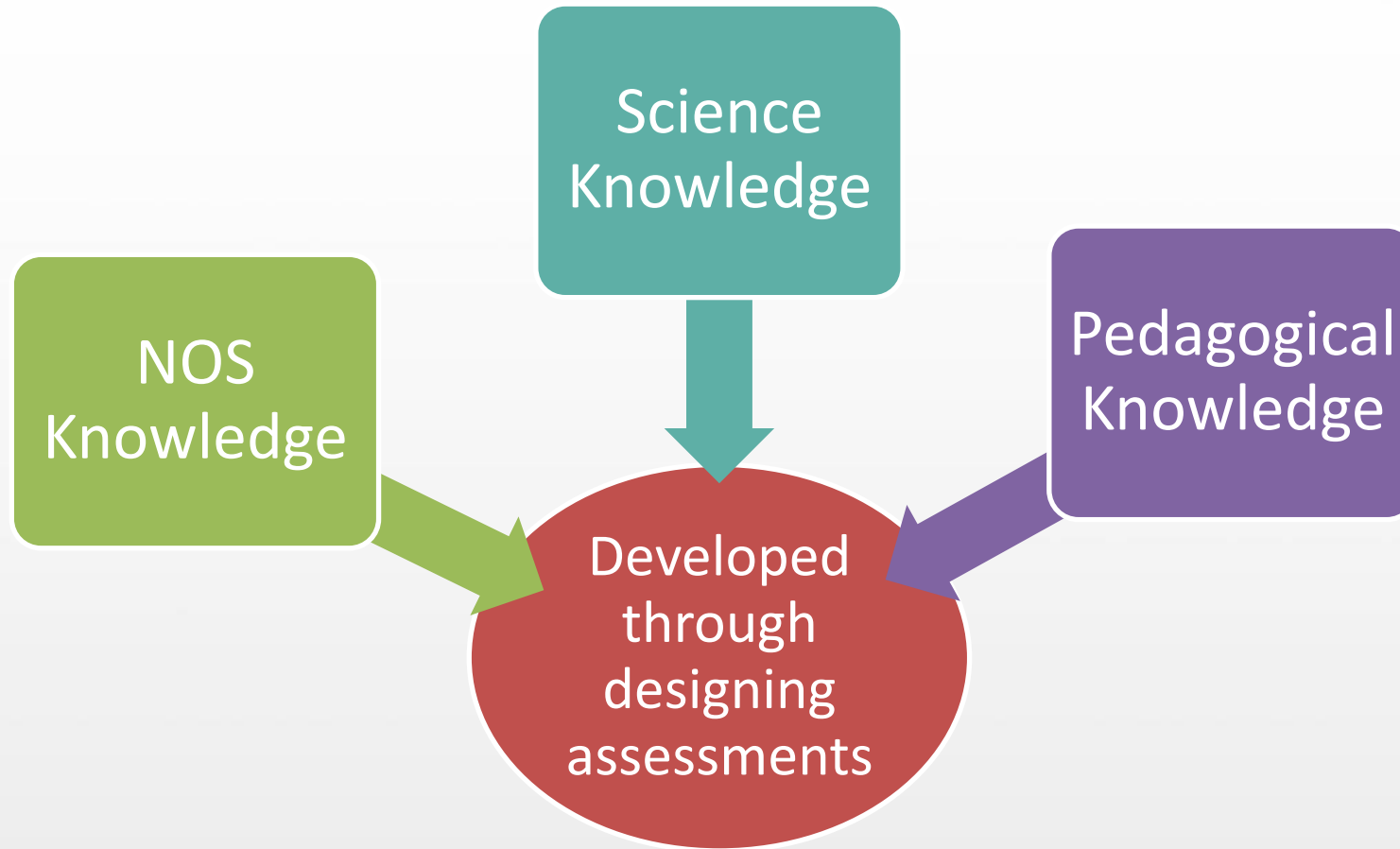
The logo for EPI-STEM is located in the top right corner. It consists of the text "EPI-STEM" in a white, sans-serif font, set against a yellow and green geometric background that resembles a stylized speech bubble or a folded piece of paper.

- Purpose-Built Workshops for Pre-service Science Teacher (PSTs) on NOS.
  - in 3<sup>rd</sup> year of a 4 year BSc.Ed programme.
  - Voluntary
- Mirrors current pedagogical provisions.
  - 6 weeks of workshops
    - Minimum of 12 contact hours (2hrs per week).
    - On-line learning platform



# Effective Science Teaching Knowledge Bases

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(Abd-El-Khalick & Lederman 2000, Shulman 1987)



# Outline for Study and Data collection

Phase 1	Phase 1.1	Phase 1.2	Phase 1.3
3rd year Pre-service students	<ul style="list-style-type: none"> <li><u>Written Pre-test on NOS conceptions</u></li> </ul> <b>(n= 26)</b>	<i>6 weeks of the purpose built workshop,</i> <ul style="list-style-type: none"> <li><u>Audio-recorded</u></li> <li><u>Classroom activities</u></li> <li><u>Assessments developed</u></li> </ul> <b>(n=range: 15 - 4)</b>	<ul style="list-style-type: none"> <li><u>Written Post-test on NOS conceptions</u></li> <li><u>Audio-recorded interview</u></li> </ul> <b>(n=4)</b>
Phase 2	Phase 2.1	Phase 2.2	Phase 2.3
Pre-service students Now in 4th year <b>(n=4)</b>	<i>Pre teaching practice prep</i> <ul style="list-style-type: none"> <li><u>Lesson plans</u></li> <li><u>Pre-planning of classroom artefact</u></li> </ul>	<i>10 Weeks of Teaching Practice</i> <ul style="list-style-type: none"> <li><u>Observe lesson</u></li> <li><u>Use of artefacts in the classroom</u></li> <li><u>Lesson plans</u></li> <li><u>Reflective diaries</u></li> </ul>	<i>Post teaching practice brief</i> <ul style="list-style-type: none"> <li><u>Delayed- post test</u></li> <li><u>Audio-recorded interview</u></li> </ul>

# Theoretical Lens

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- Underpinned by the Family Resemblance Approach
  - Conceptualize science: cognitive-epistemic and social institutional systems
- Offers an alternative to the “consensus view” of NOS.
  - A comprehensive and systematic approach:
    - Unity of science
    - Justice to diversity of science.

(Irzik and Nola 2014, Erduran and Dagher 2014)



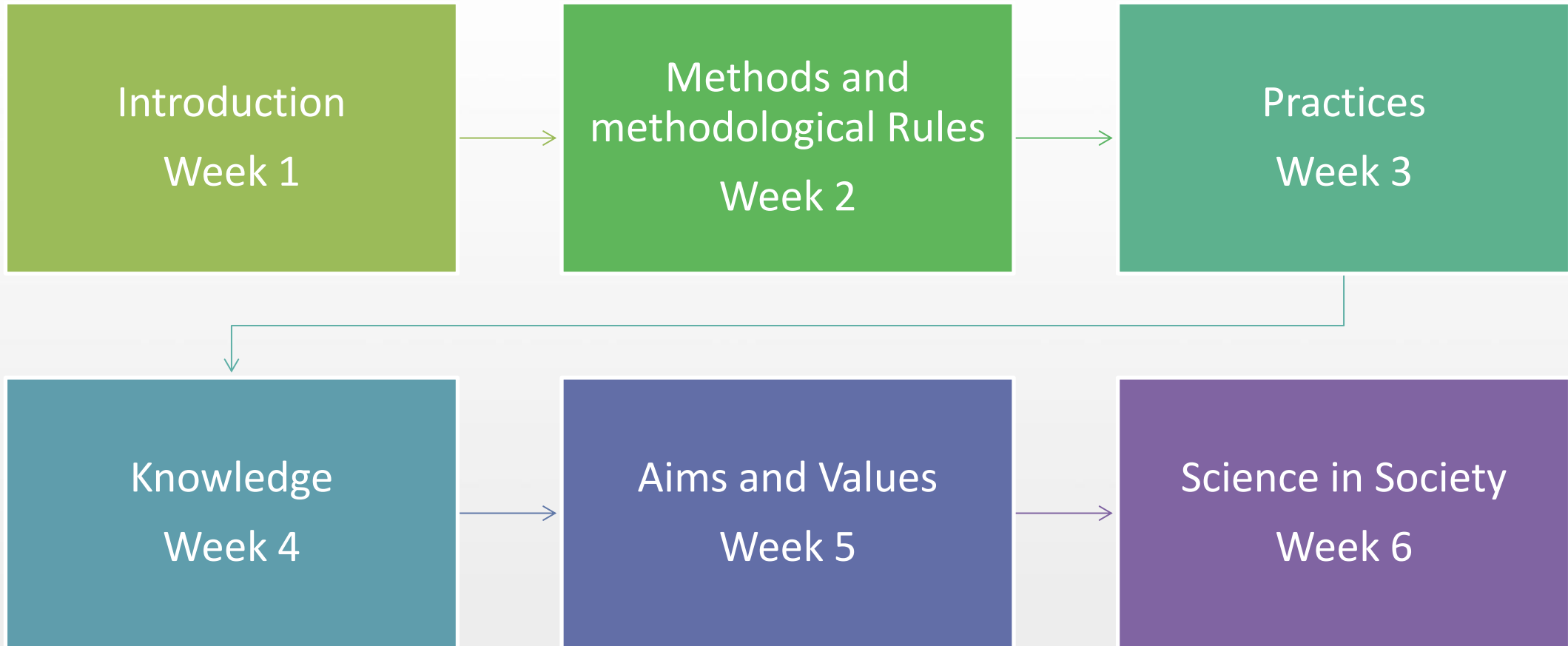
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# Sequence of Nature of Science Workshops

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# Workshop Aims

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1. To *engage* an *explore* the ideas in each area of FRA.
2. To develop knowledge of new strands and learning outcomes on the Junior Cycle science specification.
3. To develop NOS activities for their classroom around the new strands and learning outcomes.



# Mapping FRA to JC Curriculum

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Introduction

Week 1

Methods and  
methodological Rules

Week 2

Practices

Week 3

Knowledge

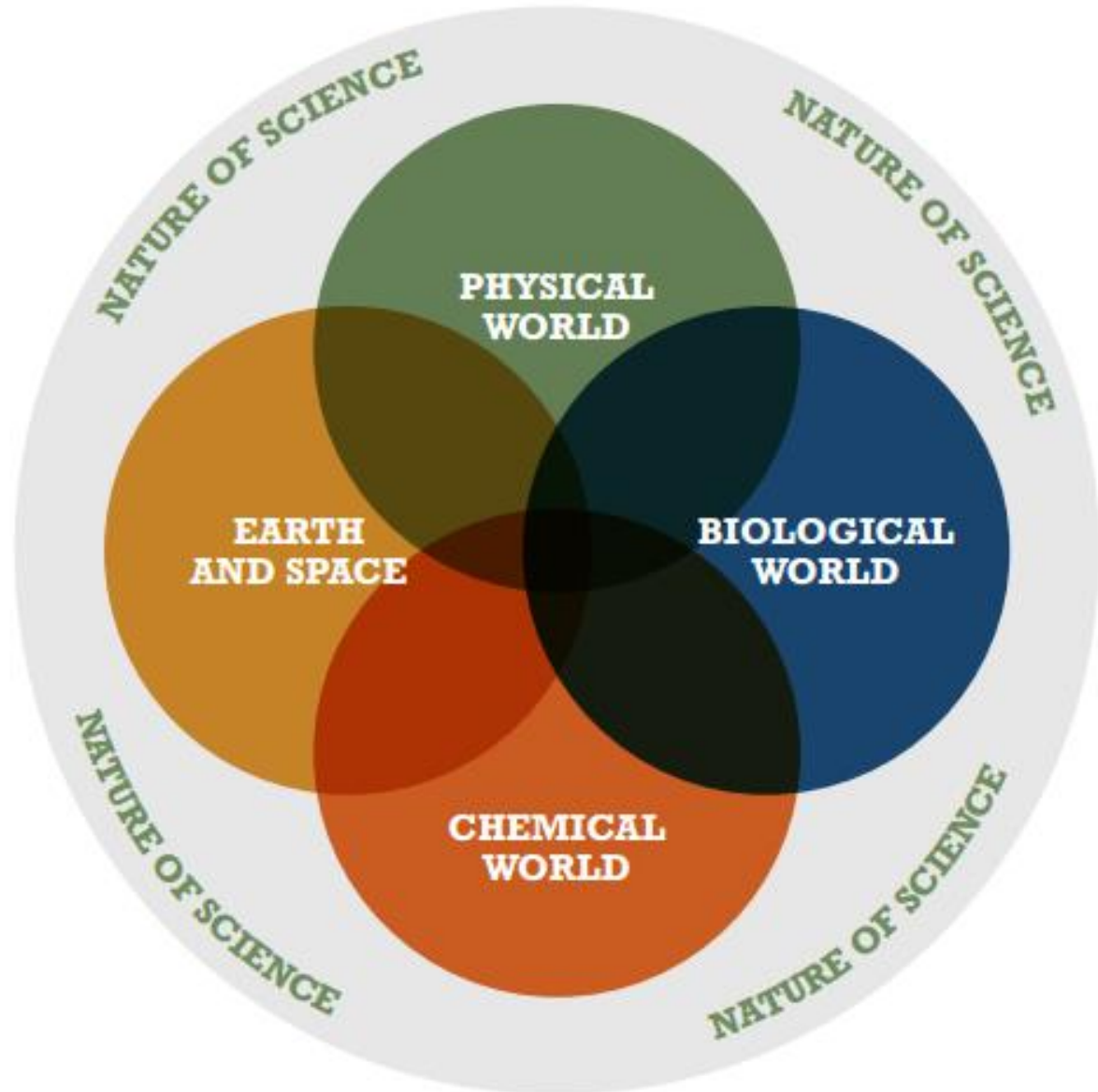
Week 4

Aims and Values

Week 5

Science in Society

Week 6



The focus of this presentation:

1. How effective is the Family Resemblance Approach (FRA) model for developing pre-service teachers' knowledge of Nature of Science (NOS)?

# Preliminary findings: Knowledge of NOS

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- Analysis of the pre/post tests and interview with PSTs indicate:
  - The model is effective at developing PSTs Knowledge of NOS.
  - Display degrees of conceptual change around a range of NOS ideas they had previously held.

*“I thought the first week was particularly good because we got to see what level we were on and then my views just totally changed”*



# Preliminary findings continued....

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- Their perspective of science changed from a concrete image in “neat pretty little boxes” to a more worldly view, open to uncertainty.



*“I thought science was very black and white, I thought it was very...you learn it off, you spit it back out. There is no ifs or buts about it! But now I realise you can take all aspects into science”...*

“In school we were taught (science) straight down, we have to do it this way, but science isn’t black and white”



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## Preliminary findings continued...

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- They are now seeing links in their own science lectures, they would not have noticed before.



***“I just never  
joined the  
dots before”***



# Preliminary findings continued...

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- Displaying signs of discontent at only having this image of science presented to them now.

***“Everyone has got a great injustice to them coming to college. You don’t have an understanding of science. You have a rote learning view of science... like we don’t even learn how science even works in the world”.***

**“You feel like you have been lied to”**



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# Preliminary findings: Their own teaching

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- The PSTs feel....
  - This view of science gives a broader perspective than what is presented in the science text books.

***“I think your teaching is broadened, rather than just your own knowledge”***



***“The wider you cast your net the more (students) you will capture”***

- This approach will capture more students not interested in science.



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# Conclusion

The logo for EPI-STEM is a green speech bubble with the text "EPI-STEM" in white, sans-serif capital letters.

- FRA has the potential to:
  - impact not only on NOS knowledge and conceptions, by imparting a more holistic image of science
  - Impact on their practice as teachers....

**“So I think we learn pedagogy, and we learn science but very often **we don't learn the two together** , which I think this brought the two together. Because I learned new science knowledge and I learned **new ways to integrate ways of teaching that science knowledge in these workshops.**”**



# Limitations of study

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- Voluntary nature of the course
  - Attracts interested PSTs
  - Small resulting sample size
  - No obligation to design assessment tasks
  - Time



Thank you for your time.

Questions?

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***Supervisors: Prof Sibel Erduran and Prof Paul Conway***





**Aims and values  
discussed in the  
workshop**

**NOS strand  
learning  
out comes**

**Assessment  
task**



Conservation at work

Bengal Tiger

Conservation aims to protect something that needs protecting, for example an endangered species or the bogland habitat.

The Corbett Reserve in North India is home to more than 100 tigers. The Chilkiya-Kota corridor divides the Corbett Reserve from the Ramnagar forest. The corridor is an ancient strip of land which is used by wildlife to move between forests in the area. The Corbett Reserve is one of the few places in the world where numbers of the big cat have increased in recent years. However in modern times people are living very close to this corridor (as you can see on the map), which is increasing the chances of human and animal encounters. Due to this, in the span of 4 years, 7 human deaths have resulted from tiger attacks.



Jim Corbett was a legendary British hunter and tracker, originally famous for hunting large numbers of tigers and leopards in India, until he turned to conserving the big cats. He played a key role in setting up India's first national park, eventually named the Corbett Reserve, which now protects the tigers in their natural habitat.

**Jim Corbett (1875-1955)**



David is a broadcaster and a conservationist. He is most famous for his whispery voice in his many nature documentaries. He has a degree in Zoology from the University of Cambridge and he has been active in conserving



**David Attenborough (1917-2021)**

**Tino**  
Kill all the tigers because I don't like them

**Brad**  
Build a fort around the village so no one can get in or out

**Jane**  
Move the families out of the area so they can have access to schools and sanitation. And the tiger can remain in their natural habitat

**Aarav**  
Why should I leave? Move the tigers to a less populated area somewhere else in India

**TASK: Arguer**  
Broadcaster and a conservationist. He is most famous for his whispery voice in his many nature documentaries. He has a degree in Zoology from the University of Cambridge and he has been active in conserving

Q: Whose idea do you like?  
Give a reason why you like it.

Q: Whose idea did you dislike?  
Give a reason why you dislike it.

Q: This problem is a big one. What does it mean in this situation?

Q: What would happen if we did nothing?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

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**Equ**  
It is v  
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**Addressing Human Needs**  
It is very important that scientists consider and address human needs.

**TASK: Financing Science**  
(Complete this exercise in your copy book)

Using the ideas suggested by Tino, Brad, Jane and Aarav, pick one and submit a proposal to get the funding for the project. Justify why you think your plan is the best and use the following heading to guide you.

- Summary of your plan
- What do you need for your plan and how much money will you need to complete it? (Examples include: Resources and materials, salaries, expert advice, advertising campaign, and other things you may need)
- How will this plan help the tigers?
- How will this plan help the people living in the area?
- Why is your plan the best?

Quietly Buzzing The decline of the Native Bee in Ireland

Ireland has 101 native bee species. In addition to the honeybee, Ireland has 20 bumblebee species and 80 solitary bee species (bees that do not live in colonies). The numbers of some bees in Ireland are declining, including the Great yellow bumblebee. This particular bumblebee is on the verge of extinction from Ireland and its numbers have declined by 68% since 1980. The maps below show the distribution of the bumblebee in Ireland before 1980 (a) and since 1980 (b)



[Special thanks to Dr Úna FitzPatrick at the National Biodiversity Data Centre for supplying the images of the distribution of the Bumblebees]



(a) Distribution of Great Yellow Bumblebee before 1980



(b) Distribution of Great Yellow Bumblebee since 1980

State two things you notice about the pictures  
1. \_\_\_\_\_ 2. \_\_\_\_\_

What do these maps tell us about how the bee population is scattered (distributed) around Ireland now compared with before 1980? \_\_\_\_\_

Why do you think the bees are distributed this way now?  
\_\_\_\_\_  
\_\_\_\_\_

[More information can be found at <http://www.biodiversityireland.ie/>]

Discussion Time – Why are the Bumblebees Declining?

In pairs, discuss the following two statements and decide which one best explains the reason for the decline of the bumblebee in Ireland. Write down reasons for your answer.

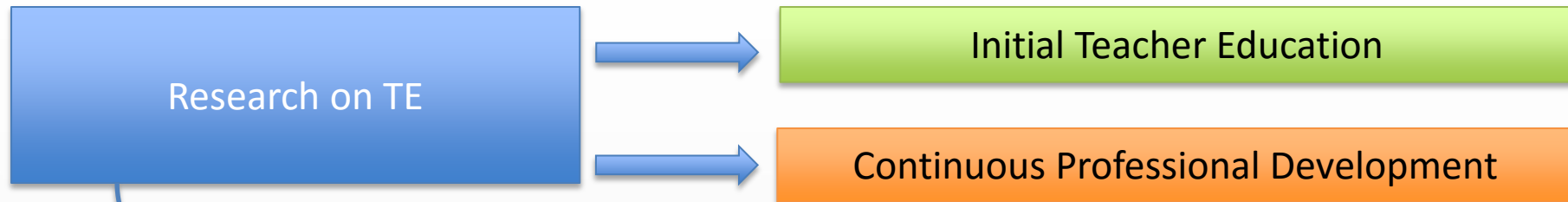
The number of bees have declined because there is a decline in the number of wildflowers in our fields and meadows. Farmers are trying to ensure their crops are very productive and are making more silage than hay. Roadsides no longer have wild flowers growing on them because we want to keep the roads tidy

**Supporting Claims**  
All scientists must aim to give reasons for their claims

Bees have declined in Ireland because they are killing each other when competing for food.

# Research on Teacher Education (TE)

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- Teacher Knowledge and Learning
  - Pedagogical content knowledge (PCK) & Content Knowledge (CK).
- Teaching of Higher Order Thinking Skills (HOTS)
- Synthesis of TE and NOS

