University of **Sheffield**

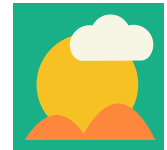Sheffield Botanical Gardens Trust

Non-Exam Assessment

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Choosing an Idea

The Non-Exam Assessment (NEA), or Independent Investigation of A-level studies, is an exciting opportunity to develop a deeper understanding of an important subject. It allows you to form your own research question and collect primary and secondary data to form a conclusion. But where do you begin? Throughout your studies you have encountered so much information, how do we choose just one idea area to focus on?

There are millions of ideas to choose from, of course, but this document uses recent information from plant biology and environmental science to give a flavour of the sorts of focussed projects that could be explored. We use the theme of **plants in the urban environment** to investigate how plants can be used to tackle important societal issues. This theme is an example of an 'ecosystem service' or 'nature based solution'. Terms you might want to remember, if you have not come across them before! This document aims to show how discrete project questions can be generated when using a single strong theme to help give focus to an area of interest.

General Principles

How to choose a topic?

Before we start diving into a topic, we need to ask ourselves a few questions.

What area of the curriculum have I enjoyed?

It is really important that your idea relates to an area of the curriculum that you have enjoyed. This usually means you know more about the area and your research will be more relevant and detailed. It is also important to choose something you find interesting as it is a big piece of work, and enjoying the topic will make it feel easier!

Where am I going to conduct my investigation?

Where you conduct your research is really important. We need to think about which locations are accessible to us. Local open spaces like parks and public streets are good as you have free access to them. Private spaces like gardens might be more tricky as you need to get permission from the owners!

What kinds of data am I going to collect?

There are two main types of data we can collect, qualitative and quantitative. Qualitative data relates to the thoughts and feelings of people, whilst quantitative data is measurable numbers. It is a good idea to have a mix of the two in your study so you can analyse a physical phenomenon, and then understand how it affects people.

What equipment do I need?

If you are going to need equipment for your research, make sure you have access to it before starting. Your school or college may have thermometers, barometers, quadrats, etc, but fully equipped weather stations might not be readily available. Have a talk with your school's technicians about which pieces of equipment can be made available to you.

Who could I interview?

If you are going to include an interview, think about who will be most relevant. If your idea is about the impact of plant cover on young people's perceptions of a place, it might not be the best idea to interview your parents / guardians / grandparents! Ensure you also have a mix of questions for your interview, where some are close-ended and others allow for a wide variety of answers.

What is my timeframe for data collection and write-up?

It is really important to think about how much data you are collecting, and how much time you have to collect it. We need to ensure that our ideas are manageable and realistic. There is nothing wrong with lots of data (see Useful Links) , we just need to make sure that it is relevant to your question and easily collectable.

How are you going to make it unique?

The aim of research is to discover something new, which can seem very daunting. But don't worry, it is actually much easier than you might think. The most important thing is first deciding upon an idea that you are excited about.

Why is the research question of interest?

It can be really important to understand why you want to ask the questions you are asking. It might be because you have enjoyed studying it, you know a lot about the topic, or you can easily collect data for it (e.g. you're investigating coastal erosion and live in a seaside town).

Putting it onto paper

The above questions are a lot to think about. To help you organise your ideas, why not try using some of the example tables below. The Field Studies Council and Royal Geographical Society also have lots of tips to help you organise your ideas (see More Useful Links).

Topics I find interesting	Locations available to me relevant to this topic	Order of preference

Topics I find interesting	Which specific part interest me	How could I link this to my local area / where my field trip is going	Order of preference

Specific questions I could investigate	Are there any ethical issues with this question?	Order of preference

Example Research Questions

Inspired by researchers at the University of Sheffield

Universities across the world are investigating how we can use plants in the urban environment in order to solve some of the most important issues facing the built environment. Here we will look at research conducted by the Department of Landscape Architecture at the University of Sheffield into how plants in the urban environment can be used to improve the liveability of cities.

Below are some example topics covered by this research, along with example research questions which relate to the subjects of Geography and Biology. These questions alone might not be enough for a full NEA investigation so make sure you take your time to think about exactly what you want to research, but they may offer some useful things to think about as you develop your own idea. The questions mostly fit under the umbrella of changing places, tackling the issues of urban climate, urban drainage, environmentally sustainable development, and health and well-being.

When you write your NEA you will start with an introduction. This is where you will demonstrate your understanding of the topic and the current state of knowledge before stating what you will be investigating. Within the introduction you should draw from a range of sources to demonstrate that you have done the research and understand the topic. Below each topic is a list of academic papers which may be useful to you if your project looks at plants within the urban environment. Remember to only reference relevant information sources! Some of these papers may not be fully accessible depending upon where you are, but usually the abstracts have lots of useful information that you can reference.

Research Areas

Temperature impacts of plants in urban areas	Due to climate change, the average temperature is rising. This rise is felt worst in urban areas where the large amount of concrete contributes to the urban heat island effect. Plants are being studied to understand how they can be used to reduce the temperature in urban areas.

The presence of plants in the urban environment can be important for people's perspectives of place. Not only can plants offer visual aesthetic to break up the monotony of a concrete landscape, but they offer thermal benefits which can improve people's relationship with an area. For example, benches placed in the middle of a courtyard may get the full sun of the day, and therefore would be too hot to sit at around lunchtime. If plants are introduced, such as trees, these can offer shade to the area and make the temperature, and therefore the place, more comfortable. Different tree species provide different levels of shade!

This is echoed in green walls and facades. These structures are walls or fences which have plants growing on or up them. UK homes are typically designed to retain heat as our climate has long been mild. However, under climate change we are experiencing higher temperatures and as a result buildings without air conditioning are become unfavourably hot. Green walls can reduce the air temperature around a building by up to 3°C, and the wall's temperature by up to 9°C. These same green walls, in the winter, can then act as an 'insulating coat' to help keep heat within the building, reducing energy losses by up to 30%!

Example research questions

> To what extent do trees / plants impact the temperature in urban areas?

> Do residents of an area perceive areas with plant cover differently than those without?

> Do people prefer parks / gardens which have more plants?

> How do plants affect temperature throughout the day and how does this impact the way people use a space?

> What are the cultural associations with plants in your area and how are these reflected in local policy?

Academic papers

- *A Hedera green façade. Energy performance and saving under different maritime-temperate, winter weather conditions*
- *To green or not to green! That is the question. Does green infrastructure provide significant thermo-regulation in a maritime temperate climate?*
- *What's 'cool' in the world of green façades? How plant choice influences the cooling properties of green walls*

The use of plants of urban areas to alleviate stresses on human health and well-being is another area of interest. Studies have shown that the presence of flowers and other plants, as well as their associated animal life, can improve the quality of life of residents.

Health & well-being benefits of urban plants

Health and mental well-being are important considerations when landscape architects create urban environments. Researchers are discovering the many ways in which plants can be used in these areas to improve people's mental and physical health, and improve the experience of places.

Gardening is a direct and rewarding way in which people can enrich both their physical and mental health. People reported higher levels of well-being when they were regular gardeners compared to non-gardeners, and the satisfaction people felt with their gardens increased when there were more plants present within them. Being close to plants and working with them translated into people feeling they had better health and lower levels of stress. The scientists also showed that regular viewing / contact with plants resulted in healthier human hormone levels. Additionally, being close to places where there were spaces to grow food, such as home gardens or allotments, actually correlated with improved mental health in people during the pandemic.

Maybe unsurprisingly, it is the colours of a garden which people respond to. Researchers have found that white and blue flowers help to relax people, whilst yellow, orange, and red flowers provide an uplifting feeling, especially so if it is the person's favourite colour!

But it is not just the plants themselves which can improve our health. The microbial communities associated with urban plants can have positive health benefits and strengthen our immune systems. Both the animals and microbial communities that call these plants home - can improve our mood and well-being.

Example research questions

What are the thoughts of different age groups in response to new tree plantings / greenspace?

Do people think the introduction of new trees to their street or local area has impacted their well-being?

To what extent does the removal of greenspace impact the character of a place and people's relationship with it?

To what extent do people hold the importance of urban plants to the identity of a town?

Does plant cover change between low and high income areas?

Do people perceive a difference in plant quality across different areas?

How is social food growing impacting people's perspective of place in an area?

"Say it with flowers" - How does flower colour affect peoples emotional response to them?

Academic papers

- _Why garden?–Attitudes and the perceived health benefits of home gardening_
- _The domestic garden – Its contribution to urban green infrastructure_

The impact of urban plants on air quality

In recent years, the role of plants in improving air quality has been highlighted. The research from the University of Sheffield goes beyond the surface to understand the mechanisms by which this happens, and how we can maximise a plant's potential to clean our air.

Plants have the potential to help mitigate some, but not all, of the pollution produced from human activities. Within UK cities, the most notable pollution that impacts human health is nitrogen dioxide gas (NO_2) and small particles of pollution, often referred to as particulate matter. This latter pollution can cause irritated eyes and lungs, and lead to severe health complications if the levels are high. It is estimated that 93% of all UK children are exposed to polluted air.

The introduction of a green barrier within a primary school in Sheffield led to the levels of the gas nitrogen dioxide (NO_2) to decrease by up to 23%, and for particulate matter to decrease by 2%, in the first year of use. The reduction in pollution is expected to increase to 30% as the plants grow and the barrier becomes thicker and more-dense. The leaves of the plants play an incredibly important role, and those with wax or hairs on the leaf surface can increase particulate matter capture by up to 20 times! In fact, the more surface area the leaves of a plant covers, the higher its ability to capture pollution. Some species of plant have tiny bumps and ridges on the surface of their leaves. These vary in size between species, with some being much smaller, and others much larger. If we plant a mix of species with complimentary ridge sizes, the range of particulate matter sizes that can be captured is increased.

If the tree cover is increased we can sequester additional carbon dioxide from the atmosphere. 'Woodland' gardens, those with trees, can sequester between 15kg and 70kg of carbon per square metre.

Example research questions

To what extent do people hold the importance of urban plants to the identity of a town?

Do residents notice a difference in air quality between areas of high and low plant cover, near and far from roads?

Analyse the impact of air quality on public health, and whether there are discernible differences in areas with high and low plant cover.

Analyse the impact of climate change on local environmental policy, and the extent to which this differs between areas of high and low income.

Identify areas of your local area which contribute greatest to air quality, and how these can be mirrored in lower performing areas / what are the barriers in the lower performing areas?

Assess the carbon storage of local woodland areas and calculate the potential storage if trees are introduced into unused urban space.

Academic papers

- *A Practical Green Infrastructure Intervention to Mitigate Air Pollution in a UK School Playground*
- *Green infrastructure for air quality plus (GI4AQ+): Defining critical dimensions for implementation in schools and the meaning of 'plus' in a UK context*
- *Urban hedges: A review of plant species and cultivars for ecosystem service delivery in north-west Europe*
- *'Green barriers' for air pollutant capture: Leaf micromorphology as a mechanism to explain plants capacity to capture particulate matter*

Increased storm events are a reality of climate change, and the increased volume of rainfall is a problem for urban drainage systems which can become overwhelmed, leading to floods. Researchers are working to understand the best possible methods of using plants in the urban environment to intercept and slow rainwater.

Urban plants impact on rainwater and flooding

The urban environment is typically characterised by high levels of impermeable surfaces. From asphalt roads to concrete buildings and courtyards, we rely on drains to direct water out of built up areas and into sewers. There have been engineering advances to help with increased water volumes, such as permeable road surfaces and retention ponds, but these may not be feasible to implement within highly built up areas due to limited space.

Residential gardens are areas where the potential to intercept and store water has not been fully realised. Front gardens have slowly been re-purposed for car parking, leading to to 25% of all UK front gardens being paved over and impermeable to water, with 33% containing no plants at all. There has been a reduction of up to 75% of vegetated area loss as a result of increased desire for low maintenance gardens.

Areas with plentiful vegetation can reduce the water run-off from rainfall by up to 50% by detaining the water in the plant's canopy, and the permeable soil allows for water to infiltrate into the ground. Even low growing plants have high potential to capture water, especially if their leaves grow vertically. These plants, like grasses (e.g. *Fescue* species), direct water down their leaves their base and into the soil. Due to these findings, it has been recommended that a minimum of 50% of garden space should be vegetated and there should be financial incentives for maintaining a plant-covered garden. In addition, 66% of a garden should be permeable to water to allow for sufficient rainwater drainage.

Example research questions

How does vegetation affect the flow rate of a local stream or river?

What are the perspectives on sustainable drainage systems in Sheffield, UK?

What are the impacts of sustainable drainage systems on flooding frequency?

Does flooding unequally affect areas depending on affluence, and is this related to plant cover?

What are the reasons for not having plants in front and back gardens, and how do people view high plant gardens vs no plant gardens?

How do plants impact water infiltration rates in urban and rural areas?

How do urban plants contribute to water security?

Academic papers

- *"Do we need to see gardens in a new light?" Recommendations for policy and practice to improve the ecosystem services derived from domestic gardens*
- *Urban hedges: A review of plant species and cultivars for ecosystem service delivery in north-west Europe*
- *Functional urban ground-cover plants: Identifying traits that promote rainwater retention and dissipation*

How plants are being impacted by climate change

Climate change is having real impacts on plant populations all over the world. Rising average temperatures, as well as increasing frequency of extreme weather events, is placing unprecedented stress on plants.

Human-led climate change has been slowly increasing the average temperature of the world since the boom of the industrial revolution. As a result, the climate envelopes of plants is shifting, and the frequency of which plants are being exposed to extreme weather events is increasing, such as droughts, high winds, and floods. Scientists have identified that those garden and landscape plant cultivars that most resemble wild species seem to have more resilience to the effects of climate change, for example, compared to those more highly-bred for larger flower sizes and greater flower numbers. So a shrub or rambling rose may cope better with future climate than say a repeat-flowering hybrid-tea rose.

By 2050, we expect plant species currently growing about 1000 miles to the south will be actually better suited to future climate conditions in the UK, than native species. Essentially the flora of Barcelona needs to 'move' to London to match the conditions predicted in future. Artificially, moving plants and essentially entire ecosystems north is controversial However, even these plants may have to adopt to more unusual rain, wind and drought patterns. In light of this we need to think of imaginative ways to ensure our city plants remain well-irrigated and withstand the additional extreme weather conditions climate change will impose.

Example research questions

To what extent do people hold the importance of urban plants to the identity of a town?

How has climate change impacted local plant strategies and what are the perspectives on these strategies?

What are the social implications of increasing plant cover in relation to safety and crime?

Compare forestry strategy in your area with that of other regions.

To what extent do plants in your area mitigate the urban heat island effect?

What are the health implications of local greenspace strategy under climate change?

Academic papers

- _Can trait-based schemes be used to select species in urban forestry?_
- _Rewilding in the Garden: Are garden hybrid plants (cultivars) less resilient to the effects of hydrological extremes than their parent species? A case study with Primula_

- *How fast can conifers climb mountains? Investigating the effects of a changing climate on the viability of Juniperus seravschanica within the mountains of Oman, and developing a conservation strategy for this tree species*
- *Tropical urban parks in Kuala Lumpur, Malaysia: Challenging the attitudes of park management teams towards a more environmentally sustainable approach*

Additional Research Ideas

Below are some more general research ideas which you could fit into the above topics. Remember, these questions are to inspire you, your research questions should be your own.

Do students / teachers prefer the areas of the schoolgrounds where there are plants?

Do students think there need to be more plants in their schools, and what reasons are given?

The extent to which Sheffield City Council and its residents contribute to the cities identity as a tree city

To what extent could plants mitigate coastal erosion?

How do plants impact water quality in your local area?

Investigate green space and biodiversity and the community's perspectives (both positive and negative) of urban plants.

Infographics

We have created a number of infographics that demonstrate research conducted in the Department of Landscape Architecture at the University of Sheffield. These are available to download from wherever you accessed this document. They contain bursts of information about various aspects of urban plants, from how they improve mental well-being to providing habitat for animals.

More useful links

Below are some more useful links to websites and documents with more direct information on how to conduct your NEA.

Royal Geographical Society

The Royal Geographical Society has produced an extensive document covering every step of the NEA investigation. It covers over 100 pages and is the most in-depth NEA guide out there.

Read the document [here](#).

Field Studies Council

The Field Studies Council have multiple resources to help you through your NEA. The documents cover glaciation, place, water & carbon, coasts, and GIS, and provide tips on how to analyse data., present data, and evaluate your work.

Read more on the FSC website [here](#).

UK Government

The UK Government provides large datasets free of charge covering a wide range of information, from tree planting and harvesting numbers to social depravation scores for each postcode, to flooding data. The datasets can be very large and complicated, so make sure you take your time to understand them. Remember to properly reference where you get any secondary data from!

Browse the available datasets [here](#).

AQA

The examining board AQA has a full example NEA which provides a useful layout for your project. Of course you cannot copy this project, that's plagiarism, but it serves as a useful guide if you do not understand a step.

Read the example NEA here.

Geography Southwest

A Q&A session with a professional examiner on how to come up with a good NEA investigation idea and write it up.

Read the Q&A here.

Your local council

The Freedom of Information (FOI) Act means that you can put in a request from your local council for information they hold. This could be for a number of different things, and as long as they have a record of the information (and it is not private), they will send it to you. However, it can take up to 20 days to get a response so make sure you ask for data as soon as possible!

To submit an FOI request, try searching for your local council followed by FOI.

About

This document has been made available through a Knowledge Exchange Partnership between the Department of Landscape Architecture at the University of Sheffield and the Sheffield Botanical Gardens. Our aim is to bring research into the public view, and create real world positive change.

We hope that you have been inspired and use the information within this document to help inform your non-examined assessment. If designing urban areas for the benefit of people is something that you are interested in, why not consider studying Landscape Architecture at the University of Sheffield.