# CPSC 304 Project Cover Page

Milestone #: 2

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Group Number: 9

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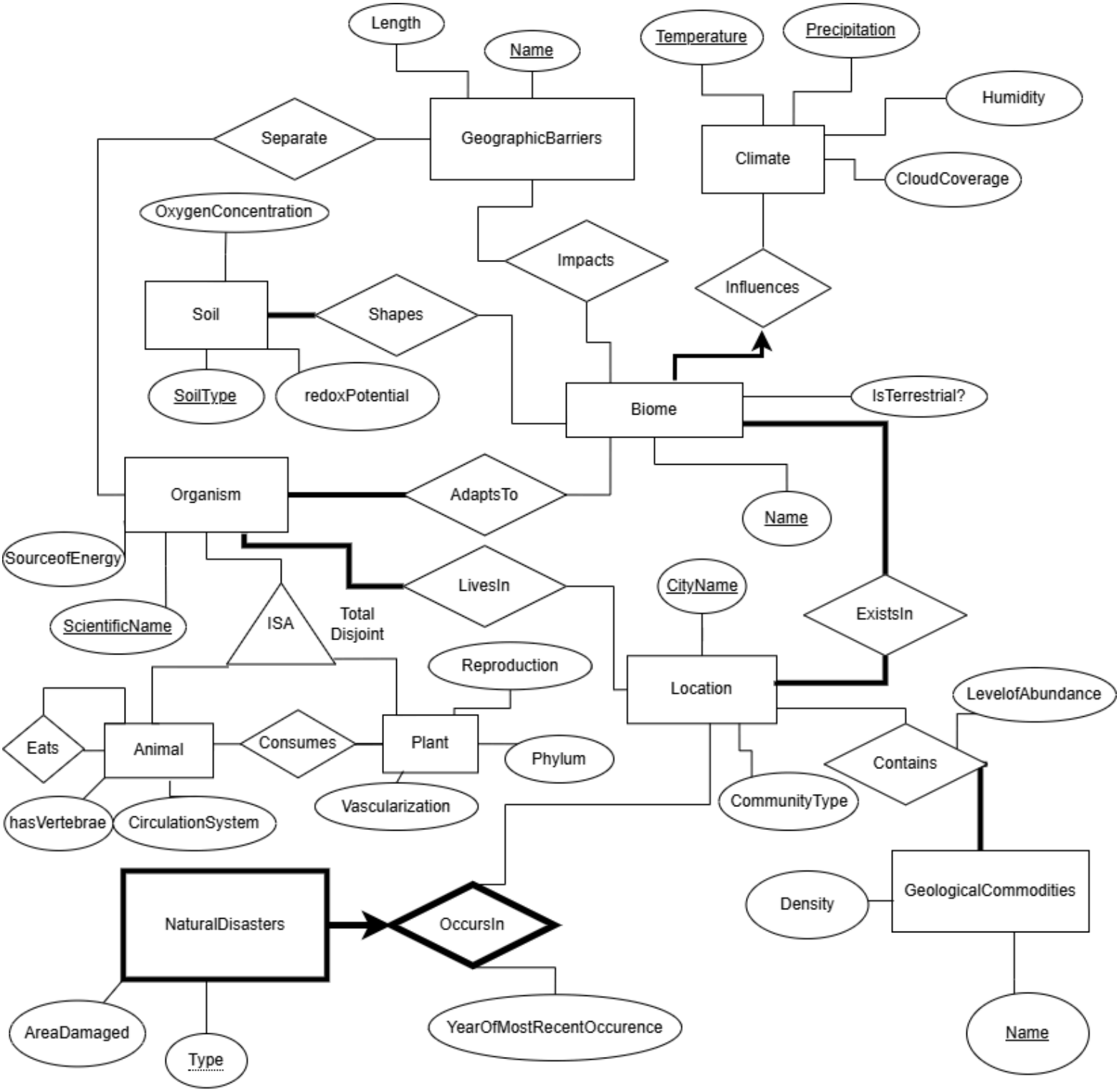
By typing our names and student numbers in the above table, we certify that the work in the attached assignment was performed solely by those whose names and student IDs are included above. (In the case of Project Milestone 0, the main purpose of this page is for you to let us know your e-mail address, and then let us assign you to a TA for your project supervisor.)

In addition, we indicate that we are fully aware of the rules and consequences of plagiarism, as set forth by the Department of Computer Science and the University of British Columbia

**2. Summary:**

The application aims to model the biotic and abiotic components of different bioregions, called biomes, in British Columbia and how they interact. Formally, a biome is a community of flora and fauna that occupies a major habitat, with examples including the biomes Tundra, Temperate Rainforest, etc. Our application includes entities under this umbrella such as organisms, climate, and soil type, and relationships such as how a spanning geographic barrier can result in speciation (separation of species) within these biomes.

### 3. ER Diagram:


Length
Name
Temperature
Precipitation
Humidity
Separate
GeographicBarriers
Climate
CloudCoverage
OxygenConcentration
Impacts
Influences
Soil
Shapes
SoilType
redoxPotential
Biome
IsTerrestrial?
Organism
AdaptsTo
Name
SourceofEnergy
LivesIn
CityName
ScientificName
ISA
Total
Disjoint
ExistsIn
Reproduction
Location
LevelofAbundance
Eats
Animal
Consumes
Plant
Phylum
Contains
Vascularization
CommunityType
hasVertebrae
CirculationSystem
NaturalDisasters
OccursIn
Density
GeologicalCommodities
AreaDamaged
Type
YearOfMostRecentOccurence
Name

## Change Log:

- Added **Density** attribute to the entity Geological Commodities as advised, as it previously only had the Name attribute.
- Removed **GrowingSeason** from Plant in exchange for more relevant attributes listed below
- Added **Soil Total Participation in Shapes:** All soil must shape at least one biome.
- Added **Biome Total Participation in Influences:** All biomes must be influenced by at least one type of climate.
- Added **Biome Total Participation in ExistsIn:** All biomes must exist in at least one location.
- Added **Location Total Participation in ExistsIn:** All locations must contain at least one biome.
- Added **Organism Total Participation in AdaptsTo**: All organisms must adapt to at least one biome.
- Added **Organism Total Participation in LivesIn:** All organisms must live in at least one location.
- Added **Geological Commodities Total Participation in Contains:** All geological commodities must have at least one location.
- Added **AreaDamaged** attribute to NaturalDisasters: The total area (in hectares) affected by a natural disaster(e.g: forest fire, flood)
- Added **hasVertebrae** to Animal: Animals can be classified as invertebrates or vertebrates (has vertebral column). TRUE if invertebrate, FALSE otherwise.
- Added **Phylum** attribute to Plant: A classification of the plant's phyla. In this project, examples would be "BRYOPHYTE", "FILICINOPHYTA", "CONIFEROPHYTA", "ANGIOSPERMS", etc.
- Added **Reproduction** attribute to Plant: The reproduction type of the plant, be one of "SPORES", "SEEDS", or "OTHER"
- Added **Vascularization** attribute to Plant: The vascular system of the plant can be one of "PRESENT" to indicate a vascular system present, or "NONE" otherwise.
- Added **CloudCoverage** attribute to Climate: The average cloud cover on a percentage level in the biome that is the result of humidity.
- Added **CirculationSystem** attribute to Animal: The circulation system of an animal, it is one of "OPEN" or "CLOSED".
- Added **redoxPotential** attribute to Plants: The soil's ability to uptake water and nutrients from the soil, it is one of "LOW", "MEDIUM", or "HIGH".
- Changed name from "Size/Length" for Geographic Barrier attribute to just "Length" for better communication.
- Changed the names of attributes and entities containing spaces into one word for consistency, for example "Year of most recent occurrence" becomes "YearOfMostRecentOccurence" and many others.

**4. Schema:**

- GeographicBarriers(Name: VARCHAR, Length: INTEGER), PK(Name)
- Soil(SoilType: CHAR(20), OxygenConcentration: FLOAT, redoxPotential: VARCHAR), PK(SoilType)
- Organism(ScientificName: VARCHAR, SourceOfEnergy: VARCHAR), PK(ScientificName)
- Animal(**ScientificName**: VARCHAR, hasVertebrae: BOOLEAN, CirculationSystem: CHAR(10))
    - PK(ScientificName)
    - FK(ScientificName)
        - Note: hasVertebrae = TRUE if vertebrae present, FALSE otherwise.
- Plant(**ScientificName**: VARCHAR, Vascularization: CHAR(10), Phylum: VARCHAR, Reproduction: CHAR(10))
    - PK(ScientificName)
    - FK(ScientificName)
- Location(CityName: VARCHAR, CommunityType: VARCHAR), PK(CityName)
- GeologicalCommodities(Name: VARCHAR, Density: DOUBLE(3)), PK(Name)
- Biome(Name: VARCHAR, IsTerrestrial: BOOLEAN), PK(Name)
- Climate(Temperature: INTEGER, Precipitation: INTEGER, Humidity: INTEGER, CloudCoverage: FLOAT)
    - PK(Temperature, Precipitation)
- NaturalDisastersOccursIn(Type: CHAR(20), **CityName**: CHAR(20), YearOfMostRecentOccurence: INTEGER, AreaDamaged: INTEGER)
    - PK(Type, CityName),
    - FK(CityName) REFERENCES Location(CityName)
    - Note: Requires ONDELETE CASCADE later on
- Separate(**o_name**: VARCHAR, **gb_name**: VARCHAR),
    - PK(o_name, gb_name)
    - FK(o_name) REFERENCES Organism(ScientificName)
    - FK(gb_name) REFERENCES GeologicalBarriers(Name)
- Shapes(**SoilType**: CHAR(20), **b_name**: VARCHAR),
    - PK(SoilType, b_name)
    - FK (SoilType) REFERENCES Soil(SoilType)
    - FK(b_name) REFERENCES Biome(Name)*
- Impacts(**gb_name**: VARCHAR, **b_name**: VARCHAR)

    - PK(gb_name, b_name)
    - FK(gb_name) REFERENCES GeographicBarriers(Name)
    - FK(b_name) REFERENCES Biome(Name)
- AdaptsTo(**o_name**: VARCHAR, **b_name**: VARCHAR)
    - PK(o_name, b_name),
    - FK(o_name) REFERENCES Organism(ScientificName),
    - FK(b_name) REFERENCES Biome(Name)*
- LivesIn(**o_name**: VARCHAR, **loc_name**: VARCHAR)
    - PK(o_name, loc_name),
    - FK(o_name) REFERENCES Organism(ScientificName),
    - FK(loc_name) REFERENCES Location(CityName)*
- ExistsIn(**loc_name**: VARCHAR, **b_name**: VARCHAR)
    - PK(loc_name, b_name)
    - FK(loc_name) REFERENCES Location(CityName)
    - FK(b_name) REFERENCES Biome(Name)*
- Contains(**gc_name**: VARCHAR, **loc_name**: VARCHAR, levelOfAbundance: INTEGER),
    - PK(gc_name, loc_name)
    - FK(gc_name) REFERENCES GeologicalCommodities(Name),
    - FK(loc_name) REFERENCES Location(CityName)*
- Consumes(**a_name**: VARCHAR, **p_name**: VARCHAR)
    - PK(a_name, p_name),
    - FK(a_name) REFERENCES Animal(ScientificName),
    - FK(p_name) REFERENCES Plant(ScientificName)
- Eats(**pred_name**: VARCHAR, **prey_name**: VARCHAR)
    - PK(pred_name, prey_name),
    - FK(pred_name) REFERENCES Animal(ScientificName),
    - FK(prey_name) REFERENCES Animal(ScientificName)
- BiomeInfluences(**b_name**: VARCHAR, **Temperature**: INTEGER, **Precipitation**: INTEGER)
    - PK(b_name)
    - FK(b_name) REFERENCES Biome(Name)
    - FK(Temperature, Precipitation) REFERENCES Climate
    - NOT NULL(Temperature, Precipitation)*
        - Note: NOT NULL assigned due to One-to-Many total participation.

**indicates a many-to-many relationship with total participation. We can not enforce this constraint in SQL without Assertions.*

5. **Functional Dependencies:**

**The FD's written in Blue are one's where the LHS is not a PK.**
Note: Organism ⟶ SourceofEnergy is decidedly not added as the ISA is total.

- GeographicBarrierName ⟶ Length
- Temperature, Precipitation ⟶ Humidity, CloudCoverage
- Humidity⟶CloudCoverage
- BiomeName ⟶ Temperature, Precipitation, IsTerrestial, CloudCoverage
- SoilType ⟶ OxygenConcentration, redoxPotential
- OxygenConcentration ⟶ redoxPotential
- CityName ⟶ CommunityType
- GeologicalCommoditiesName ⟶ Density
- GeologicalCommoditiesName, CityName ⟶ LevelofAbundance
- AnimalScientificName ⟶ SourceofEnergy
- PlantScientificName ⟶ SourceofEnergy, Phylum, Reproduction, Vascularization
- Phylum ⟶ Reproduction, Vascularization
- AnimalScientificName ⟶ hasVertebrae, circulationSystem
- hasVertebrae ⟶ circulationSystem
- NaturalDisasterType, CityName⟶ AreaDamaged, YearOfMostRecentOccurence

6. **Normalization:**

We have decided to do **3NF Synthesis**:

1. Minimal Cover (Standardize RHS, Remove Redundant LHS, Remove Redundant FD's)

| |
|---|
| GeographicBarrierName ⟶ Length<br>BiomeName ⟶ Temperature<br>BiomeName ⟶ Precipitation<br>Temperature, Precipitation ⟶ Humidity<br>Humidity⟶ CloudCoverage<br>BiomeName ⟶ IsTerrestial<br>SoilType ⟶ OxygenConcentration<br>OxygenConcentration ⟶ redoxPotential<br>CityName ⟶ CommunityType<br>GeologicalCommoditiesName ⟶ Density<br>GeologicalCommoditiesName, CityName ⟶ LevelofAbundance |

AnimalScientificName → SourceofEnergy
PlantScientificName → SourceofEnergy
PlantScientificName → Phylum
Phylum → Reproduction
Phylum → Vascularization
AnimalScientificName → hasVertebrae
hasVertebrae → circulationSystem
NaturalDisasterType, CityName→ AreaDamaged
NaturalDisasterType,CityName→ YearOfMostRecentOccurence

2. Synthesis Method: Adding all the FD's in the Minimal Cover, we get:

R1(GeographicBarrierName, Length), R2(Humidity, CloudCoverage), R3(Temperature, Precipitation, Humidity), R4(BiomeName, Temperature), R5(BiomeName, Precipitation), R6(BiomeName, isTerrestrial), R7(OxygenConcentration, redoxPotential), R8(SoilType, OxygenConcentration), R9(CityName, CommunityType), R10(GeologicalCommoditiesName, Density), R11(GeologicalCommoditiesName, CityName, LevelofAbundance), R12(AnimalScientificName, SourceofEnergy), R13(PlantScientificName, SourceofEnergy), R14(Phylum, Reproduction), R15(Phylum, Vascularization), R16(PlantScientificName, Phylum), R17(hasVertebrae, circulationSystem), R18(AnimalScientificName, hasVertebrae), R19(NaturalDisasterType, CityName, AreaDamaged), R20(NaturalDisasterType, CityName, YearOfMostRecentOccurence)

3. Add the minimal key R21(GeographicBarriersName, BiomeName, SoilType, AnimalScientificName, PlantScientificName, GeologicalCommoditiesName, CityName, NaturalDisastersType)

**Final Relations:**

R1(GeographicBarrierName, Length), R2(Humidity, CloudCoverage), R3(Temperature, Precipitation, **Humidity**), R4(**BiomeName**, Temperature),

R5(**BiomeName**, Precipitation), R6(BiomeName, isTerrestrial), R7(OxygenConcentration, redoxPotential), R8(SoilType, **OxygenConcentration**), R9(CityName, CommunityType), R10(GeologicalCommoditiesName, Density), R11(**GeologicalCommoditiesName**, **CityName**, LevelOfAbundance), R12(AnimalScientificName, SourceofEnergy), R13(PlantScientificName, SourceofEnergy), R14(Phylum, Reproduction), R15(**Phylum**, Vascularization), R16(PlantScientificName, **Phylum**), R17(hasVertebrae, circulationSystem), R18(AnimalScientificName, **hasVertebrae**), R19(NaturalDisasterType, CityName, AreaDamaged), R20(**NaturalDisasterType, CityName**, YearOfMostRecentOccurence), R21(**GeographicBarriersName**, **BiomeName**, **SoilType**, **AnimalScientificName**, **PlantScientificName**, **GeologicalCommoditiesName, CityName**, **NaturalDisastersType**)

**7. DDL Statements:**

The SQL DDL statements required to create all the tables from item #6. The statements should use the appropriate foreign keys, primary keys, UNIQUE constraints, etc.

Unless you know that you will always have exactly x characters for a given character, it is better to use the VARCHAR data type as opposed to a CHAR(Y). For example, UBC courses always use four characters to represent which department offers a course. In that case, you will want to use CHAR(4) for the department attribute in your SQL DDL statement. If you are trying to represent the name of a UBC course, you will want to use VARCHAR as the number of characters in a course name can vary greatly.

R1:

```
CREATE TABLE LengthsOfGeographicBarriers(
        GeographicBarrierName VARCHAR,
        Length INTEGER,
        PRIMARY KEY(GeographicBarrierName)
)
```

R2:

```
CREATE TABLE HumidityAndCloudCoverage(
        Humidity INTEGER,
        CloudCoverage FLOAT,
        PRIMARY KEY(Humidity),
)
```

R3:

```
CREATE TABLE TempPrecipitationHumidity(
        Temperature INTEGER,
        Precipitation INTEGER,
        Humidity INTEGER,
        PRIMARY KEY(Temperature, Precipitation),
        FOREIGN KEY(Humidity) REFERENCES HumidityAndCloudCoverage(Humidity)
)
```

R4:

```
CREATE TABLE TemperaturesOfBiomes(
        BiomeName VARCHAR,
        Temperature INTEGER,
        PRIMARY KEY(BiomeName),
        NOT NULL (Temperature),
```

```
        FOREIGN KEY (BiomeName) REFERENCES BiomeAndType
)
```

R5:

```
CREATE TABLE PrecipitationOfBiomes(
        BiomeName VARCHAR,
        Precipitation INTEGER,
        PRIMARY KEY(BiomeName),
        NOT NULL (Precipitation),
        FOREIGN KEY (BiomeName) REFERENCES BiomeAndType
)
```

R6:

```
CREATE TABLE BiomeAndType(
        BiomeName VARCHAR,
        isTerrestrial BOOLEAN,
        PRIMARY KEY(BiomeName),
)
```

R7:

```
CREATE TABLE OxygenConcentrationAndRedox(
        OxygenConcentration FLOAT,
```

redoxPotential INTEGER,

PRIMARY KEY(OxygenConcentration)

)

R8:

CREATE TABLE SoilAndOxygenConcentration(

SoilType VARCHAR,

OxygenConcentration FLOAT,

PRIMARY KEY(SoilType),

FOREIGN KEY(OxygenConcentration) REFERENCES OxygenConcentrationAndRedox

)

R9:

CREATE TABLE CitiesAndCommunityTypes(

CityName VARCHAR,

CommunityType VARCHAR,

PRIMARY KEY(CityName)

)

R10:

CREATE TABLE DensitiesOfGeologicalCommodities(

GeologicalCommoditiesName VARCHAR,

```
        Density DOUBLE(3),
        PRIMARY KEY(DENSITY)
)
```

R11:

```
CREATE TABLE DistributionOfGeologicalCommodities(
        GeologicalCommoditiesName VARCHAR,
        CityName VARCHAR,
        LevelOfAbundance INTEGER,
        PRIMARY KEY(GeologicalCommoditiesName, CityName),
        FOREIGN KEY(GeologicalCommoditiesName) REFERENCES
        DensitiesOfGeologicalCommodities,
        FOREIGN KEY CityName REFERENCES CitiesAndCommunityTypes
)
```

R12:

```
CREATE TABLE AnimalsAndSourcesOfEnergy(
        AnimalScientificName VARCHAR,
        SourceofEnergy VARCHAR,
        PRIMARY KEY(AnimalScientificName)
)
```

R13:

```
CREATE TABLE PlantsAndTheirSourcesOfEnergy(
        PlantScientificName VARCHAR,
        SourceofEnergy VARCHAR,
        PRIMARY KEY(PlantScientificName)
)
```

R14:

```
CREATE TABLE ReproductionInPlantPhylums(
        Phylum VARCHAR,
        Reproduction CHAR(10),
        PRIMARY KEY(Phylum),
)
```

R15:

```
CREATE TABLE VascularizationInPlants(
        Phylum VARCHAR,
        Vascularization CHAR(10),
        PRIMARY KEY(Phylum),
        FOREIGN KEY(Phylum) REFERENCES ReproductionInPlantPhylums
)
```

R16:

```
CREATE TABLE PlantSpeciesAndTheirPhylums(
        PlantScientificName VARCHAR,
         Phylum VARCHAR,
        PRIMARY KEY(PlantScientificName)
        FOREIGN KEY(Phylum) REFERENCES ReproductionInPlantPhylums
)
```

R17:

```
CREATE TABLE CirculationSystemsOfVertebrates(
        hasVertebrae BOOLEAN,
        circulationSystem CHAR(10),
        PRIMARY KEY(hasVertebrae)
)
```

R18:

```
CREATE TABLE VertebratesAndInvertebrates(
        AnimalScientificName VARCHAR,
        hasVertebrae BOOLEAN,
        PRIMARY KEY(AnimalScientificName)
        FOREIGN KEY(hasVertebrae) REFERENCES CirculationSystemsOfVertebrates
)
```

R19:

```
CREATE TABLE EnvironmentalDamageCausedByNaturalDisasters(
        NaturalDisasterType CHAR(20),
        CityName VARCHAR,
        AreaDamaged INTEGER,
        PRIMARY KEY(NaturalDisasterType, CityName),
        FOREIGN KEY (CityName) REFERENCES CitiesAndCommunityTypes, ON
        DELETE CASCADE
)
```

Note: ON DELETE CASCADE used due to weak entity relationship described in Q4. The foreign key CityName thus must exist in the CitiesAndCommunityTypes table due to this relationship.

R20:

```
CREATE TABLE NaturalDisastersOccurrencesInBC(
        NaturalDisasterType CHAR(20),
        CityName VARCHAR,
        YearOfMostRecentOccurence INTEGER,
        PRIMARY KEY(NaturalDisasterType, CityName),
        FOREIGN KEY(NaturalDisasterType, CityName) REFERENCES
        EnvironmentalDamageCausedByNaturalDisasters,
        FOREIGN KEY(CityName) REFERENCES CitiesAndCommunityTypes, ON
        DELETE CASCADE
)
```

Note: ON DELETE CASCADE used due to weak entity relationship described in Q4. The foreign key CityName thus must exist in the CitiesAndCommunityTypes table due to this relationship.

R21:

```
CREATE TABLE EcosystemsInBC(
        GeographicBarriersName VARCHAR,
        BiomeName VARCHAR,
        SoilType CHAR(20),
        AnimalScientificName VARCHAR,
        PlantScientificName VARCHAR,
        GeologicalCommoditiesName VARCHAR,
        CityName VARCHAR,
        NaturalDisastersType CHAR(2),
        PRIMARY KEY(GeographicBarriersName, BiomeName, SoilType,
        AnimalScientificName, PlantScientificName, GeologicalCommoditiesName,
        CityName, NaturalDisastersType))
        FOREIGN KEY(GeographicBarriersName) REFERENCES
        LengthsOfGeographicBarriers
        FOREIGN KEY (BiomeName) REFERENCES BiomeAndType,
        FOREIGN KEY (SoilType) REFERENCES SoilAndOxygenConcentration,
        FOREIGN KEY (AnimalScientificName) REFERENCES
        VertebratesAndInvertebrates,
```

FOREIGN KEY (PlantScientificName) REFERENCES

PlantsAndTheirSourcesOfEnergy,

FOREIGN KEY (CityName, GeologicalCommodities) REFERENCES

DistributionOfGeologicalCommodities,

FOREIGN KEY (CityName, NaturalDisastersType) REFERENCES

EnvironmentalDamageCausedByNaturalDisasters )

**8. INSERT Table:**

INSERT statements to populate each table with at least 5 tuples. You will likely want to have more than 5 tuples so that you can have meaningful queries later.

TABLE R1()

- INSERT INTO LengthsOfGeographicBarriers(Name, Length) VALUES(Canadian Rockies, 1460)
- INSERT INTO LengthsOfGeographicBarriers(Name, Length) VALUES(Coast Mountains, 1600)
- INSERT INTO LengthsOfGeographicBarriers(Name, Length) VALUES(Fraser River, 1375)
- INSERT INTO LengthsOfGeographicBarriers(Name, Length) VALUES(Skeena River, 570)
- INSERT INTO LengthsOfGeographicBarriers(Name, Length) VALUES(Okanagan Lake, 135)

*Note: LENGTH is in km*

TABLE R2()

- INSERT INTO HumidityAndCloudCoverage(Humidity, CloudCoverage) VALUES (90, 76.0)
- INSERT INTO HumidityAndCloudCoverage(Humidity, CloudCoverage) VALUES(30, 50.5)

- INSERT INTO HumidityAndCloudCoverage(Humidity, CloudCoverage) VALUES(95, 14.0)
- INSERT INTO HumidityAndCloudCoverage(Humidity, CloudCoverage) VALUES(30, 10.0)
- INSERT INTO HumidityAndCloudCoverage(Humidity, CloudCoverage) VALUES(65, 80.5)

*Note: Humidity and CloudCoverage is in %*

TABLE R3()

- INSERT INTO TempPrecipitationHumidity(Temperature, Precipitation, Humidity) VALUES(9, 300, 95)
- INSERT INTO TempPrecipitationHumidity(Temperature, Precipitation, Humidity) VALUES(17, 25, 85)
- INSERT INTO TempPrecipitationHumidity(Temperature, Precipitation, Humidity) VALUES(4, 50, 95)
- INSERT INTO TempPrecipitationHumidity(Temperature, Precipitation, Humidity) VALUES(-5, 30, 90)
- INSERT INTO TempPrecipitationHumidity(Temperature, Precipitation, Humidity) VALUES(8, 100, 99)

TABLE R4()

- INSERT INTO TemperaturesOfBiomes(BiomeName, Temperature) VALUES('Coastal Rainforest', 9)
- INSERT INTO TemperaturesOfBiomes(BiomeName, Temperature) VALUES('Grasslands', 17)
- INSERT INTO TemperaturesOfBiomes(BiomeName, Temperature) VALUES('Boreal Forest', 4)
- INSERT INTO TemperaturesOfBiomes(BiomeName, Temperature) VALUES('Alpine Tundra', -5)
- INSERT INTO TemperaturesOfBiomes(BiomeName, Temperature) VALUES('Interior Rainforest', 8)

*Note: Temperature is in Celsius (°C)*

TABLE R5() #precipitation of biomes

- INSERT INTO PrecipitationOfBiomes(BiomeName, Precipitation) VALUES('Coastal Rainforest', 300)
- INSERT INTO PrecipitationOfBiomes(BiomeName, Precipitation)

VALUES('Grasslands', 25)

- INSERT INTO PrecipitationOfBiomes(BiomeName, Precipitation) VALUES('Boreal Forest', 50)
- INSERT INTO PrecipitationOfBiomes(BiomeName, Precipitation)) VALUES('Alpine Tundra', 30)
- INSERT INTO PrecipitationOfBiomes(BiomeName, Precipitation) VALUES('Interior Rainforest', 100)

*Note: Precipitation is in cm.*

TABLE R6()

- INSERT INTO BiomeAndType(BiomeName, isTerrestrial) VALUES('Boreal Forest', TRUE)
- INSERT INTO BiomeAndType(BiomeName, isTerrestrial)VALUES('Alpine Tundra', TRUE)
- INSERT INTO BiomeAndType(BiomeName, isTerrestrial) VALUES('Interior Rainforest', TRUE)
- INSERT INTO BiomeAndType(BiomeName, isTerrestrial) VALUES('Lake', FALSE)
- INSERT INTO BiomeAndType(BiomeName, isTerrestrial) VALUES('River', FALSE)
- INSERT INTO BiomeAndType(BiomeName, isTerrestrial) VALUES('Semi-arid desert', TRUE)

*Note: Precipitation is in cm.*

TABLE R7()

- INSERT INTO OxygenConcentrationAndRedox(OxygenConcentration, redoxPotential) VALUES (2.0, "LOW")
- INSERT INTO OxygenConcentrationAndRedox(OxygenConcentration, redoxPotential) VALUES (10.0, "MEDIUM")
- INSERT INTO OxygenConcentrationAndRedox(OxygenConcentration, redoxPotential) VALUES (40.0, "HIGH")
- INSERT INTO OxygenConcentrationAndRedox(OxygenConcentration, redoxPotential) VALUES (50.0, "HIGH")
- INSERT INTO OxygenConcentrationAndRedox(OxygenConcentration, redoxPotential) VALUES (25.0, "HIGH")

*Note: OxygenConcentration is in %*

TABLE R8()

- INSERT INTO SoilAndOxygenConcentration(SoilType, OxygenConcentration) VALUES (‘Clay’, 5.0)
- INSERT INTO SoilAndOxygenConcentration(SoilType, OxygenConcentration) VALUES (‘Silt’, 10.0)
- INSERT INTO SoilAndOxygenConcentration(SoilType, OxygenConcentration) VALUES (‘Loam’, 30.0)
- INSERT INTO SoilAndOxygenConcentration(SoilType, OxygenConcentration) VALUES (‘Peat’, 40.0)
- INSERT INTO SoilAndOxygenConcentration(SoilType, OxygenConcentration) VALUES (‘Sandy Loam’, 40.0)

TABLE R9()

- INSERT INTO CitiesAndCommunityTypes(CityName, CommunityType) VALUES(‘Vancouver’, ‘Urban’)
- INSERT INTO CitiesAndCommunityTypes(CityName, CommunityType) VALUES(‘Burnaby’, ‘Urban’)
- INSERT INTO CitiesAndCommunityTypes(CityName, CommunityType) VALUES(‘Surrey’, ‘Urban’)
- INSERT INTO CitiesAndCommunityTypes(CityName, CommunityType) VALUES(‘Langley’, ‘Urban’)
- INSERT INTO CitiesAndCommunityTypes(CityName, CommunityType) VALUES(‘Abbotsford’, ‘Urban’)

TABLE R10()

- INSERT INTO DensitiesOfGeologicalCommodities(
- GeologicalCommoditiesName, Density) VALUES (‘Granite’, 2.58)
- INSERT INTO DensitiesOfGeologicalCommodities(
- GeologicalCommoditiesName, Density) VALUES (‘Limestone’, 2.70)
- INSERT INTO DensitiesOfGeologicalCommodities(
- GeologicalCommoditiesName, Density) VALUES (‘Marble’, 2.67)
- INSERT INTO DensitiesOfGeologicalCommodities(
- GeologicalCommoditiesName, Density) VALUES (‘Slate’, 2.79)
- INSERT INTO DensitiesOfGeologicalCommodities(
- GeologicalCommoditiesName, Density) VALUES (‘Sandstone’, 2.28)

TABLE R11()

- INSERT INTO DistributionOfGeologicalCommodities( GeologicalCommoditiesName, CityName, LevelOfAbundance) VALUES

('Copper', 'Kamloops', 4)

- INSERT INTO DistributionOfGeologicalCommodities( GeologicalCommoditiesName, CityName, LevelOfAbundance) VALUES ('Coal', 'Quesnel', 4)
- INSERT INTO DistributionOfGeologicalCommodities( GeologicalCommoditiesName, CityName, LevelOfAbundance) VALUES ('Lead', 'Kimberley', 3)
- INSERT INTO DistributionOfGeologicalCommodities( GeologicalCommoditiesName, CityName, LevelOfAbundance) VALUES ('Silver', 'Surrey', 2)
- INSERT INTO DistributionOfGeologicalCommodities( GeologicalCommoditiesName, CityName, LevelOfAbundance) VALUES ('Slate', 'Abbotsford', 1)

*Note: LevelOfAbundance is in a 1-5 scale*

TABLE R12()

- INSERT INTO AnimalsAndSourcesOfEnergy (AnimalScientificName, SourceofEnergy) VALUES ('Canis latrans', 'Omnivore')
- INSERT INTO AnimalsAndSourcesOfEnergy (AnimalScientificName, SourceofEnergy) VALUES ('Canis lupus', 'Carnivore')
- INSERT INTO AnimalsAndSourcesOfEnergy (AnimalScientificName, SourceofEnergy) VALUES ('Vulpes vulpes', 'Omnivore')
- INSERT INTO AnimalsAndSourcesOfEnergy (AnimalScientificName, SourceofEnergy) VALUES ('Odocoileus virginianus', 'Herbivore')
- INSERT INTO AnimalsAndSourcesOfEnergy (AnimalScientificName, SourceofEnergy) VALUES ('Urocitellus parryii', 'Herbivore')

TABLE R13()

- INSERT INTO PlantsAndTheirSourcesOfEnergy(PlantScientificName, SourceofEnergy) VALUES ('Adiantum pedatum', 'Phototroph')
- INSERT INTO PlantsAndTheirSourcesOfEnergy(PlantScientificName, SourceofEnergy) VALUES ('Allium cernuum', 'Phototroph')
- INSERT INTO PlantsAndTheirSourcesOfEnergy(PlantScientificName, SourceofEnergy) VALUES ('Aquilegia formosa', 'Phototroph')
- INSERT INTO PlantsAndTheirSourcesOfEnergy(PlantScientificName, SourceofEnergy) VALUES ('Calochortus lyallii', 'Phototroph')
- INSERT INTO PlantsAndTheirSourcesOfEnergy(PlantScientificName, SourceofEnergy) VALUES ('Cimicifuga elata', 'Phototroph')

TABLE R14()

- INSERT INTO ReproductionInPlantPhylums(Phylum, Reproduction) VALUES (‘Bryophyta’, ‘Spores’)
- INSERT INTO ReproductionInPlantPhylums(Phylum, Reproduction) VALUES (‘Coniferophyta’, ‘Seeds’)
- INSERT INTO ReproductionInPlantPhylums(Phylum, Reproduction) VALUES (‘Ginkgophyta’, ‘Seeds’)
- INSERT INTO ReproductionInPlantPhylums(Phylum, Reproduction) VALUES (‘Pteridophyta’, ‘Spores’)
- INSERT INTO ReproductionInPlantPhylums(Phylum, Reproduction) VALUES (‘Cycadophyta’, ‘Seeds’)

TABLE R15()

- INSERT INTO VascularizationInPlants(Phylum, Vascularization) VALUES (‘Bryophyta’, ‘Non-vascular’)
- INSERT INTO VascularizationInPlants(Phylum, Vascularization) VALUES (‘Coniferophyta’, ‘Vascular’)
- INSERT INTO VascularizationInPlants(Phylum, Vascularization) VALUES (‘Ginkgophyta’, ‘Vascular’)
- INSERT INTO VascularizationInPlants(Phylum, Vascularization) VALUES (‘Pteridophyta’, ‘Vascular’)
- INSERT INTO VascularizationInPlants(Phylum, Vascularization) VALUES (‘Cycadophyta’, ‘Vascular’)

TABLE R16()

- INSERT INTO PlantSpeciesAndTheirPhylums(PlantScientificName, Phylum) VALUES (‘Adiantum pedatum’, ‘Pteridophyta’)
- INSERT INTO PlantSpeciesAndTheirPhylums(PlantScientificName, Phylum) VALUES (‘Allium cernuum’, ‘Coniferophyta’ )
- INSERT INTO PlantSpeciesAndTheirPhylums(PlantScientificName, Phylum) VALUES (‘Aquilegia formosa’, ‘Anthophyta’ )
- INSERT INTO PlantSpeciesAndTheirPhylums(PlantScientificName, Phylum) VALUES (‘Calochortus lyallii’, ‘Anthophyta’)
- INSERT INTO PlantSpeciesAndTheirPhylums(PlantScientificName, Phylum) VALUES (‘Cimicifuga elata’, ‘Pteridophyta’)

TABLE R17()

- INSERT INTO CirculationSystemsOfVertebrates(hasVertebrae, circulationSystem) VALUES (TRUE, ‘Closed’)

- INSERT INTO CirculationSystemsOfVertebrates(hasVertebrae, circulationSystem) VALUES (FALSE, ‘Open’)
- INSERT INTO CirculationSystemsOfVertebrates(hasVertebrae, circulationSystem) VALUES (FALSE, ‘Open’)
- INSERT INTO CirculationSystemsOfVertebrates(hasVertebrae, circulationSystem) VALUES (FALSE, ‘Open’)
- INSERT INTO CirculationSystemsOfVertebrates(hasVertebrae, circulationSystem) VALUES (TRUE, ‘Closed’)

TABLE R18()

- INSERT INTO VertebratesAndInvertebrates(AnimalScientificName, hasVertebrae) VALUES (‘Canis latrans’, TRUE)
- INSERT INTO VertebratesAndInvertebrates(AnimalScientificName, hasVertebrae) VALUES (‘Canis lupus’, TRUE)
- INSERT INTO VertebratesAndInvertebrates(AnimalScientificName, hasVertebrae) VALUES (‘Vulpes vulpes’, TRUE)
- INSERT INTO VertebratesAndInvertebrates(AnimalScientificName, hasVertebrae) VALUES ('Apis mellifera', FALSE)
- INSERT INTO VertebratesAndInvertebrates(AnimalScientificName, hasVertebrae) VALUES ('Octopus vulgaris', FALSE)

TABLE R19()

- INSERT INTO EnvironmentalDamageCausedByNaturalDisasters( NaturalDisasterType, CityName, AreaDamaged) VALUES (‘WildFire’, ‘Kelowna’, 1000)
- INSERT INTO EnvironmentalDamageCausedByNaturalDisasters( NaturalDisasterType, CityName, AreaDamaged) VALUES (‘Earthquake’, ‘Vancouver’, 500)
- INSERT INTO EnvironmentalDamageCausedByNaturalDisasters( NaturalDisasterType, CityName, AreaDamaged) VALUES (‘Flood’, ‘Abbotsford’, 800)
- INSERT INTO EnvironmentalDamageCausedByNaturalDisasters( NaturalDisasterType, CityName, AreaDamaged) VALUES (‘Earthquake’, ‘Surrey’, 1000)
- INSERT INTO EnvironmentalDamageCausedByNaturalDisasters(
- NaturalDisasterType, CityName, AreaDamaged) VALUES (‘Flood’, ‘Merritt’, 600)

*Note: AreaDamaged is in hectares*

TABLE R20()

- INSERT INTO NaturalDisastersOccurrencesInBC(NaturalDisasterType, CityName, YearOfMostRecentOccurence) VALUES (‘Earthquake’, ‘Vancouver’, 2025)
- INSERT INTO NaturalDisastersOccurrencesInBC(NaturalDisasterType, CityName, YearOfMostRecentOccurence) VALUES (‘WildFire’, ‘Kelowna’, 2017)
- INSERT INTO NaturalDisastersOccurrencesInBC(NaturalDisasterType, CityName, YearOfMostRecentOccurence) VALUES (‘Flood’, ‘Abbotsford’, 1996)
- INSERT INTO NaturalDisastersOccurrencesInBC(NaturalDisasterType, CityName, YearOfMostRecentOccurence) VALUES (‘Earthquake’, ‘Surrey’, 1980)
- INSERT INTO NaturalDisastersOccurrencesInBC(NaturalDisasterType, CityName, YearOfMostRecentOccurence) VALUES (Flood’, ‘Merritt’, 2005)

TABLE R21()

- INSERT INTO EcosystemsInBC(GeographicBarriersName, BiomeName, SoilType, AnimalScientificName, PlantScientificName, GeologicalCommoditiesName, CityName, NaturalDisastersType) VALUES (‘Rocky Mountains’, ‘Alpine Tundra’, ‘Sandy Loam’, Urocitellus parryii’, Calochortus lyallii’ ‘Granite’, ‘Revelstoke’, ‘Landslide’)
- INSERT INTO EcosystemsInBC(GeographicBarriersName, BiomeName, SoilType, AnimalScientificName, PlantScientificName, GeologicalCommoditiesName, CityName, NaturalDisastersType) VALUES (‘Coastal Mountains’, ‘Coastal Rainforest’, ‘Clay’, ‘Canis lupus’, ‘Cimicifuga elata’, ‘Limestone’, ‘Vancouver’, ‘Earthquake’)
- INSERT INTO EcosystemsInBC(GeographicBarriersName, BiomeName, SoilType, AnimalScientificName, PlantScientificName, GeologicalCommoditiesName, CityName, NaturalDisastersType) VALUES (‘Fraser River’, ‘Grasslands’, ‘Silt’, ‘Vulpes vulpes’, ‘Allium cernuum’, ‘Sandstone’, ‘Merritt’, ‘Flood)
- INSERT INTO EcosystemsInBC(GeographicBarriersName, BiomeName, SoilType, AnimalScientificName, PlantScientificName, GeologicalCommoditiesName, CityName, NaturalDisastersType) VALUES (‘Okanagan Lake’, ‘Boreal Forest’, ‘Loam’, ‘Canis latrans’, ‘Adiantum pedatum’, ‘Coal’, ‘Kelowna’, ‘Flood’)
- INSERT INTO EcosystemsInBC(GeographicBarriersName, BiomeName,

```
SoilType, AnimalScientificName, PlantScientificName,
GeologicalCommoditiesName, CityName, NaturalDisastersType) VALUES
('Skeena River', 'Boreal Forest', 'Granite', 'Odocoileus virginianus', 'Aquilegia
formosa', 'Slate', 'Victoria', 'Flood')
```

**9. Explicit Acknowledgement:**

There is no use of GenAI in this project.